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Evaluation Study of Port Authority of New York and New Jersey's Time of Day Pricing Initiative

FINAL REPORT

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16. Abstract

On January 25, 2001, the PANYNJ approved a new pricing structure with tolls that varied according to time of day and payment technology. It went into effect on March 25, 2001. The PANYNJ saw the plan as a means for reducing congestion, increasing the use of transit and E-ZPass, and facilitating commercial traffic control management. The main objective of this project is to monitor the impacts of the time of day pricing initiative, both at the system wide level and at the user level.

The project had three main focus areas: *Disaggregate Behavioral Impacts*, *Aggregate Impacts on Traffic and Transit Use*, and *Public Reaction to the time of day pricing initiative*. In the first area, focus group studies and surveys were conducted with both passenger car users and truck dispatchers to gain insights on the behavioral changes produced by the time of day pricing initiative. In the second area, a comprehensive data set with traffic counts at the various PANYNJ toll facilities, classified by type of vehicle and hour of the day, were used to quantify the impact of time of day pricing on overall traffic patterns, E-ZPass usage and time of day traffic changes. The third group focuses on the process followed, reactions and public opinions to, the implementation of the time of day pricing initiative.

The results indicate that 7.4 percent of passenger trips and 20.2 percent of truck trips (including those that increased shipping charges or switched to E-ZPass) changed behavior because of time of day pricing. The time of day pricing resulted in an increase on the percent share of peak shoulder traffic for both trucks and cars during weekdays, and short term pre-peak elasticities are higher than post-peak elasticities during both AM and PM periods on weekdays for almost all of crossings.

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EXECUTIVE SUMMARY

On January 25, 2001, the Board of Commissioners of The Port Authority of New York and New Jersey (PANYNJ) advanced a major intermodal and regional capital program, representing $14 billion in investments in the 2001-2006 period. A package of PATH fares and toll rate adjustments were advanced at that time to help fund this level of investment. The new toll pricing plan adopted consisted of tolls that varied according to time of day and payment type (cash, Electronic Toll Collection using E-ZPass^{sm}) used. It went into effect on March 25, 2001. The PANYNJ advanced the plan as a means for reducing congestion, increasing the use of mass transit and E-ZPass and facilitating commercial traffic management. Following this initiative, the Federal Highway Administration's time of day Pricing Program funded this research project to be conducted by a university-based team independent of the PANYNJ. The research was aimed at assessing the behavioral impacts produced by time of day pricing. The project was a joint effort of the Rensselaer Polytechnic Institute, Rutgers University and New York University. The findings in this report are solely those of the research team.

The focus of this report is on the six interstate bridges and tunnels operated by the PANYNJ to link New Jersey with New York City. These crossings carry average daily eastbound traffic of 352,000 vehicles, or more than 126 million eastbound vehicles in 2004. Tolls are collected in the eastbound (New York bound) direction only. The PANYNJ's Time of Day Pricing Program established a high cash toll at all times of day, with discounted E-ZPass toll rates set at higher levels during peak travel hours, and at lower levels during the off-peak periods. The peak hour toll rates are in effect on weekdays from 6-9 AM and 4-7 PM, as well as on weekends and holidays from 12 noon – 8 PM.

Probably, the most important finding is related to the impact of the time of day pricing initiative on traffic levels. The research has confirmed a statistically significant shift in weekday peak period traffic to the hours just before or after the peak toll rates are in effect, for both autos and trucks. There are no statistically significant findings to indicate that the weekend toll rates have had an impact on shifting travel times and Saturdays and Sundays. The research indicates that a statistically significant shift towards pre-peak hours both in the mornings (5-6 AM) and afternoons (3-4 PM) in auto traffic percentage shares has occurred at the PANYNJ crossing since time of day pricing went into effect. Also, the weekday truck traffic percent share showed a statistically significant shift to morning pre- peak hours (5-6 AM) and to afternoon post peak hours (7-8 PM). However, the weekend car and truck traffic percent share did not have a statistically significant change in peak shoulder hours (11 AM – 12 PM and 8-9 PM).

In order to assess the impacts on users, a multi-pronged strategy involving the use of aggregate and disaggregate data, and qualitative and quantitative modeling techniques, was implemented. The overall impacts of the time of day pricing initiative on traffic patterns and transit ridership were quantified with aggregate data provided by the PANYNJ and New Jersey Transit.

A second line of inquiry focused on quantification of behavioral changes at the user (disaggregate) level using three major study techniques: focus groups, behavioral surveys and behavioral modeling. It was decided that the main focus should be on regular users because doing so enables a one to one comparison of behavioral patterns before and after the time of day pricing initiative. The project studied the two user populations that were the target of the time of day pricing initiative: passenger cars and commercial trucks. In the passenger car case, the definition of who makes travel decisions is usually straightforward. However, in the case of commercial truck traffic, the situation is considerably more complex because truck traffic patterns are the result of complex and dynamic interactions between shippers, carriers and receivers. Among them, carriers and receivers are the most important to the purposes of this project because they tend to jointly decide the time of travel. Unfortunately, budget constraints prevented collecting data about impacts on receivers. As a result, unanswered questions still remain about how the time of day pricing initiative impacted the receivers of goods and services. These questions must be the target of future research.

Six focus groups gathered qualitative information about the impacts of the time of day pricing initiative on user behavior, and the underlying dynamics of decision making. The findings from the focus groups (four with auto drivers, and two with truck dispatchers) enabled the project team to refine the survey instruments, and to gain a general understanding of the impacts of the time of day pricing initiative on user behavior.

The qualitative information gathered through the focus groups was complemented with behavioral surveys targeting regular and former users (car drivers and truckers) of the facilities. The surveys collected data about socio-economic (company) characteristics, the most recent trip, E-ZPass usage patterns, opinions about time of day pricing, and a set of stated preference experiments. A total of 505 passenger car users and 200 carriers were interviewed. The interviews were conducted by the Rutgers University's Eagleton Institute using computer aided telephone interviews (CATI).

The behavioral analyses, in the case of E-ZPass adoption, were complemented with behavioral modeling which provided solid econometric evidence about the significance and the role played by the various independent variables. These analyses were conducted using a data set collected for the PANYNJ as part of another project.

Using aggregate traffic data, the project team computed rough estimates of elasticities. These are approximate numbers because of the use of aggregate data, and the resulting inability to consider cross elasticity effects, which may be important because the decision to travel in the off-peak hours, depend on both off peak and peak tolls.

The project also analyzed media and decision makers' reactions to the time of day pricing initiative, as well as user opinions (passenger and carriers) after the fact. The key findings from each chapter are summarized next.

Limitations of Data and Study Findings

The reader must be aware that the use of such a wide range of techniques is bound to lead to inconsistencies in the findings reached by the different study techniques used. Some of the factors at play that may lead to such inconsistencies are:

- Aggregate data (i.e., daily traffic and ridership), are subject to random variations that tend to mask the underlying dynamics of individual decision-making. Furthermore, such aggregate measures take into account both regular and sporadic users of the facilities from both the local region and beyond.
- Focus groups represent a very small sample of a very large and heterogeneous population. In this context, findings from focus groups do not always provide solid estimates of market behavior.
- Behavioral surveys generally represent a small sample of travelers, and do not necessarily represent the geographic distribution of PANYNJ bridge and tunnel users. Data expansion methodologies have been employed to grow the sample size to reflect trip frequency of respondents, but have not attempted to address the issue of response bias.
- Behavioral surveys in which the respondents had to remember how they reacted after the time of day pricing initiative are prone to gather imperfect data because they rely on the individuals' ability to remember past behavior. Furthermore, since only regular users were interviewed, the findings from the analyses of behavioral (disaggregate) data are not likely to match the analyses of the aggregate data that include all types of users.

The readers must interpret the sporadic inconsistencies among the findings from these three different approaches as something expected when approaching the study of a complex problem from very different perspectives. In all, these different views provide a comprehensive assessment of the impacts of the PANYNJ time of day pricing initiative.

Traffic Impacts

In order to quantify the traffic impacts, the project team obtained traffic data from PANYNJ that included hourly, daily, weekly and monthly traffic distribution during weekdays and weekends for a two-year period from 2000 to 2001. The database contained a breakdown by facility, vehicle type (bus, truck, and car) and type of payment (E-ZPass, Cash). The weekday data were analyzed for Mondays, Wednesdays and Fridays, while the weekend data focused on both Saturdays and Sundays. To avoid using traffic data affected by either the impacts of 9/11/2001 and/or the various operational restrictions placed at PANYNJ facilities after 9/11, the analyses focused on the time period from April-August 2001 (i.e., after the new toll rates went in to effect, but before the impacts of 9/11). Using this database, various statistical techniques were used to assess the changes in traffic before and after the implementation of time of day pricing to find out if there have been significant changes in overall traffic volumes, and/or in the hourly distribution of traffic volumes during the peak periods. The analyses yielded the following conclusions:

- Weekday car traffic percent share showed a statistically significant shift towards pre-peak hours both in the mornings (5-6 AM) and afternoons (3-4PM).
- Weekday truck traffic percent share showed statistically significant shift to morning pre- peak hours (5-6 AM) and to afternoon post peak hours (7-8 PM).
- Weekend car and truck traffic percent share did not have a statistically significant change on peak shoulders (11AM-12PM and 8-9PM).
- Weekday and weekend peak period car percent share experienced a statistically significant decrease only for GWB lower level and GWB upper level.
- Weekday afternoon peak period car percent share experienced statistically significant increases at the Bayonne Bridge and Holland Tunnel. A closer look at the travel patterns in peak and peak shoulder periods for these crossings show that the rate of increase of percent share of peak shoulder car traffic is higher than the rate of increase of percent share of peak period car traffic.
- Unlike car traffic, the truck traffic decreased for all peak time periods for both weekdays and weekends at all crossings after the time of day pricing initiative, though the decrease in weekend peak traffic was not statistically significant.

Impacts on Transit Ridership

Transit ridership data for travel between New York City and New Jersey, before and after the PANYNJ's time of day pricing initiative was analyzed to evaluate the impact of the time of day pricing initiative on transit. The analyses used New Jersey Transit ridership data (monthly and quarterly ridership volumes from 1986 to 2004) for bus travel and commuter rail services; as well as PANYNJ data about ferry ridership. Yearly and weekday PATH ridership data were also used to get a more complete picture of the transit demand in the study area. The following conclusions were drawn:

- NJ Transit rail and bus ridership consistently increased from 1992 to 2001, when ridership started to decrease, beginning to rebound in 2004.
- Although there is no way conclusively attribute the ridership drop to any of the potential factors (i.e., economic recession, 9/11 impacts and the time of day pricing

initiative), the data seem to indicate that the ridership decline had to do more with the economic slowdown than anything else.

- The statistical tests concluded that time of the day pricing had minimal or no impact on transit. During the period April-August 2001 (i.e., the only period before 9/11 with time of day pricing in place), transit ridership kept increasing.

Focus Group Findings

A number of focus groups were conducted to assist in gathering views and perceptions that would be useful in developing the behavioral surveys for this research. However the results of these focus groups, in and of themselves, provide from useful insights into the user perceptions and behavior.

- Most passenger car drivers had only a partial understanding of the time of day pricing initiative. In their opinion: (a) the time of day pricing initiative has not been very successful; and (b) E-ZPass users are more disconnected from their bills, especially if they pay by credit card.
- The truck dispatchers indicated that: (a) they were unaware, and still are unclear about, the time of day pricing program; (b) time of day pricing did not alter their travel behavior; (c) since toll increases are passed along to the clients they do not have any motivation to go after toll discounts by shifting to off peak times. Truckers said that time of day pricing had no value to them.
- E-ZPass was viewed as a really beneficial technology because it enables truckers to travel more quickly to and from deliveries. Overall, participants expressed a strong desire to travel when they wanted to, and to maintain their privacy.

Impacts on Passenger Travel Behavior

- The analyses conducted are based on 505 complete passenger surveys collected during the period mid June - mid July, 2004. (Percentages shown are weighted based on the number of trips made by the users.)

- Users of the PANYNJ facilities tend to exhibit an inelastic behavior with respect to tolls. The data indicates that 35 out of 505 individuals (7.4 percent of passenger trips) changed behavior after the time of day pricing initiative.
- The main reasons for not changing travel behavior include *they have no choice*, *no flexibility to change* (45.5 percent), and *they feel that they should travel whenever they want to* (32.4 percent).
- Compared with respondents who did not change behavior, the individuals who changed are younger with relatively lower education levels and household income. More females changed their behavior than males. Their households tend to have smaller families with fewer adults, but similar number of children.
- The individuals who changed behavior responded in a combination of ways to the new toll schedule.
- The data indicate that the majority (about 60 percent) of passengers have some flexibility, averaging 19.6 minutes (early arrival) and 12.2 minutes (late arrival).
- Although the majority are E-ZPass users (78.3 percent), their awareness of the toll discount programs is relatively low. 62.7 percent of all users are aware that there are toll discounts provided exclusively to E-ZPass users, though only 17.0 percent were aware of the time of day discount program. Even among E-ZPass users, the percentage is only around 21 percent.

Attitudinal Factors Determining E-ZPass Usage by Trucking Companies

- This section is based on data collected for the PANYNJ as part of a different project (see Reference 1).
- The data indicate that 6.1 percent of the carriers shifted to the off peak hours as a response to the combined effect of time savings using E-ZPass, and off peak discounts. Carriers that did not change behavior cited the *inflexibility of receivers to accept off peak deliveries* (67 percent) as the key reason suggesting that, in order to move truck traffic to the off-peak hours in significant numbers, comprehensive policies targeting receivers and carriers must be implemented.
- Private sector’s decision of using E-ZPass depends on the frequency of using the PANYNJ facilities, the awareness of E-ZPass features, the origins of deliveries, and

the cargo types they deliver. It was also identified that independent owner operators were more reluctant to use E-ZPass than other types of companies.

Impacts on Carrier Behavior

- The carrier data collected in the project included 200 complete dispatcher surveys collected from mid November to mid December, 2004. (Percentages shown are weighted based on number of trips made by the users.)
- The data indicates that 36 carriers (20.2 percent) changed behavior because of the time of day pricing initiative. This number includes 17 carriers (9.0 percent) that reacted by increasing shipping charges to receivers, which illustrates the need to find out more about how receivers reacted to the time of day pricing initiative.
- The data show that trucks travel at the time they do because: *customer requirements dictate schedule (*61.6 percent), *to avoid congestion (*26.0 percent), and *to deliver during a normal business / daytime hours (*20.8 percent). Only 3.5 percent mentioned *toll is cheaper* as a reason.
- The time of travel flexibility data indicate that 25.6 percent have flexibility, averaging 37.3 minutes (early arrival) and 48.8 minutes (late arrival).
- Though 85.5 percent use E-ZPass, they are not fully aware of toll discounts: 35.9 percent did not know of any discounts, 31.5 percent heard of discount / do not know specifics; only 27.4 percent could identify a specific discount program.
- When specifically asked about if and how the time of day pricing initiative impacted their E-ZPass usage, 88.3 percent reported no change, 8.2 percent reported switched to E-ZPass, and 2.2 percent reported increased use of E-ZPass.

Estimation of Traffic Elasticities from Observed Traffic Data

Estimates of short and long-term price elasticities were computed using aggregate traffic data for both cars and trucks. The analysis produced several interesting findings:

- The car short-term elasticities range between –0.31 and –1.97 for weekday and –0.55 and –1.68 for weekends depending on the time of the day.

- Commercial trucks seem to have lower elasticity values compared to cars. The truck short term elasticity values range between –0.25 and –0.56 for weekdays and –0.12 and –0.49 for weekends depending on the time of the day.
- In general, weekend auto and truck traffic are less responsive to time of day pricing. Even when the short-term elasticity values are higher on weekends, the rate of increase in the daily E-ZPass percentage is higher for weekends than weekdays for all crossings. The higher values include both the shift to peak shoulder periods due to time of day pricing and the increase in natural growth of E-ZPass usage.
- Auto travelers tend to shift their time of travel to take advantage of the off-peak discounts during weekdays towards the AM pre-peak hours (5-6AM) and PM pre-peak hours (3-4PM), as evidenced by the relatively higher elasticity values for these two time ranges for most of the crossings.
- Elasticities tend to increase over time. However, these results have to be used with caution because 9/11 occurred in the middle of the analysis period.

Media and Decision Makers' Reactions

This chapter describes and assesses the decision-making processes leading up to the implementation of the new pricing structure on the PANYNJ's facilities.

- The initial assessment reveals that those who were supportive of the time of day pricing initiative have remained so and those who opposed time of day pricing in this region have not changed their stance.
- The perspective of the PANYNJ is that they truly listened at the public hearings and smaller meetings that were held with the various stakeholders and that they changed the proposal based on what they heard. On the other hand, some stakeholders expressed feeling frustrated for not being heard.
- In terms of the implementation process, several conclusions are highlighted:
- Obtaining the political support of key leaders within the PANYNJ and at the State level was critical.
- Education of the media and the public was important.
- Integration of stakeholders at the beginning and during the process is key.
- Consistency in language and goals is important.

- Ongoing discussion and follow up is important.
- Finding value for users is important for future changes to the toll structure.

Public Opinion (Passengers and Commercial Sector)

Passengers' opinions:

- Only a small proportion (8.7 percent) indicated that time of day pricing has an impact on traffic congestion: 44.0 percent of them think the congestion is now a lot worse; while 33 percent think the traffic is a lot or somewhat better.
- The majority strongly or somewhat agreed that:
- *It is fair to give discounts to E-ZPass users* (84.6 percent).
- *It is a good idea to vary toll rates during different times of day to help improve traffic congestion* (58.7 percent), though when asked *is it fair to charge higher tolls during peak travel periods,* the approval drops to 26.4 percent.
- *It is fair to provide discounts to frequent users traveling during the peak hours* (82.4 percent).
- *Toll revenues should be used to support public transit* (64.7 percent)
- 42.2 percent are willing to pay more for a faster trip; while 36.8 percent said they would pay more for a more reliable trip.

Carriers' opinions:

- 12.8 percent think that time of day pricing had an effect on traffic congestion: 42.3 percent of them think that traffic congestion is *a lot worse,* while 43.6 percent think the traffic congestion is *somewhat better* or *lot better*.
- Most carriers agree that:
- *It is fair to give discounts to E-ZPass users* (91.6 percent)
- *It is fair to charge lower tolls for trucks with fewer axles* (84.9 percent)
- *it is fair to use toll revenues to support public transit* (58.4 percent)
- Carriers like to pay less during the overnight hours (88.4 percent agreed), though they do not like to pay more during the peak hours (80.1 percent disagreed).

CHAPTER I

INTRODUCTION

Introduction

The Port of New York Authority (PNYA) was created in 1921, with broad responsibility to solve regional transportation problems, as a bi-state agency in charge of "Port District" a bi-state area of approximately 1,500 square miles centered on the Statue of Liberty. [1, 2] A schematic of the Port District is shown in Figure 1. In 1972, its name was changed to the Port Authority of New York and New Jersey (PANYNJ), to make it reflects its bi-state nature.

Although originally in charge of port related activities, the PNYA filled a vacuum in the transportation sector. In 1923, after it negotiations with the railroads on improving rail access to the region foundered, the PNYA turned its attention to vehicular traffic. The same year, both states agreed that future bridges and tunnels should be "constructed and financed by the Port Authority," though the formal agreement was signed in 1930. [3] With the transfer of the Holland tunnel to PNYA in 1930 an era of involvement with vehicular traffic began. In the following years the PNYA would play a primary role in building the George Washington Bridge (1931), the Lincoln Tunnel (1937); and later on, the second deck at the George Washington Bridge, the first container port at Newark, the Port Authority Bus Terminal, and the World Trade Center. [3] The economic development impact of these investments has been significant. The cumulative investment in all facilities amounts to $35 billion in 2003. [4]

Since its modest beginnings, the PANYNJ has transformed itself into an agency of considerable size and influence with 7,000 employees, and a total budget of $4.5 billion in 2005. [4, 5] Of similar importance is the amount of users of its facilities: the six vehicular crossings handled a record 126.5 million eastbound vehicles in 2004; 5,288 ships arrived at its facilities in 2004; 93.80 million passengers used PANYNJ airports; and the PATH rapid transit system carried 57.7 milion riders in 2005. [4, 6, 7]

The PANYNJ is a self supporting public agency that relies almost entirely on revenues generated by facility users, tolls, fees and rents. It does not receive tax revenues from any local or state jurisdictions, and has no power to tax. [3] In terms of governance, the Governors of the States of New York and New Jersey each appoints six members to the Board of Commissioners who subject to state approval. The commissioners serve for overlapping six year terms, and the Governors retain the right to veto the actions of the commissioners of his or her own state. The Board of Commissioners appoints an Executive Director to carry out day to day operations.

As shown in Figure 1, the PANYNJ controls some of the most important transportation facilities in New York City, including the city's airports, port facilities and the Hudson River Crossings. The PANYNJ operates the following river crossings: George Washington Bridge, the Lincoln and Holland Tunnels, the Goethals Bridge, the Bayonne Bridge and the Outerbridge Crossing. In essence, all the vehicular traffic crossing between New Jersey and New York City uses PANYNJ facilities. [8]

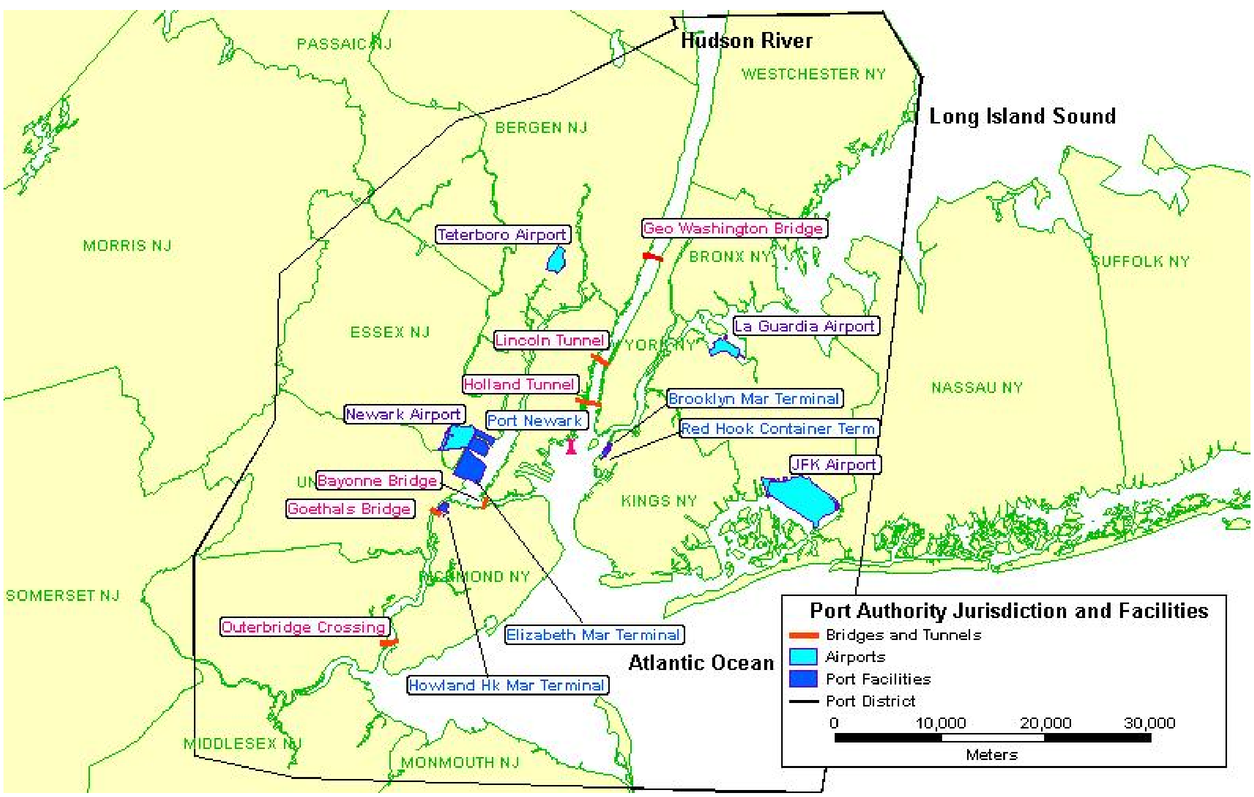

Figure 1. PANYNJ's port district and key facilities

Equally relevant to the purposes of toll policies in the New York City metropolitan area (which includes Northern New Jersey) is the complexity and size of the corresponding institutional environment. From a functional standpoint, a number of different agencies control and operate key components of the region's transportation network. Bridges and tunnels are operated and maintained by six different agencies (Port Authority of New York and New Jersey, New York City Department of Transportation, New York State Department of Transportation, New Jersey Department of Transportation, the Metropolitan Transportation Authority, and the New York State Thruway Authority). A number of special purpose authorities operate toll facilities: PANYNJ, Metropolitan Transportation Authority (MTA), New Jersey Turnpike Authority, and the New York State Thruway Authority. (In New York and New Jersey, State DOTs do not operate toll roads, and do not issue debt.) [(1)] The first two (PANYNJ and MTA) operate toll facilities in the New York City area, while the other three operate toll facilities that serve New York City, New Jersey and upstate New York and either complement or connect to the PANYNJ facilities. Needless to say, this complex institutional structure poses a significant coordination challenge to the implementation of joint (multi-agency) toll policies.

The PANYNJ's laid the foundation to explore time of day pricing with the implementation of an electronic toll collection system (E-ZPass) in 1997, which provided customers with nonstop passage through toll lanes. Users need to apply for an E-ZPass prepaid account, maintain a prepaid amount (according to the monthly level of use) in the account to cover applicable charges. After subscribing to E-ZPass, users receive a transponder that attaches to the windshield of the vehicle. The tag enables unique account identity to be electronically transferred by radio frequency to computers that that contain information about the account. Each time the vehicle passes through a toll facility where E-ZPass is offered, an antenna at the toll plaza reads the vehicle's tag identity and communicates that information to remote computers that process account information. The appropriate toll is then electronically debited from the prepaid account. A record of the transactions made is included in the periodic statements sent to the users. Beginning in May 2005, the PANYNJ started charging $1.00 monthly account service fee to help maintain the many services offered PANYNJ customers at the E-ZPass New York Customer Service Center. [9]

When the PANYNJ instituted its new toll schedule, not only was time of day pricing of roads still a relatively new application of the concept, but most of the U.S. examples that could be drawn upon were very different in nature. The PANYNJ was facing a situation in which the bridges and tunnels were already at or above capacity and tolls were already existent; there would be no free alternatives and no new capacity. In fact, the only example similar in this respect was the New Jersey Turnpike initiative which was implemented just before the PANYNJ's plan (in 1998 for commercial vehicles and in 2000 for passenger vehicles). Further, the PANYNJ's initial public plans for its time of day pricing initiative also sought to differentiate toll prices among its facilities, to charge higher tolls at the most congested facilities with the most mass transit alternatives.

Trying to implement a time of day pricing toll structure at PANYNJ facilities was no easy task. Instituting time of day pricing meant changing a culture that had historically run contrary to time of day pricing. During the 1970's, 1980's, and 1990's, tolling on PANYNJ facilities offered deep discounts for commuters who frequently utilized the facilities during peak periods – the exact opposite of what one tries to achieve with time of day pricing. The PANYNJ had already begun to eliminate frequency discounts on those facilities which were the most congested and which offered the most alternatives – in particular, the tunnels. Nevertheless, those discounts remained in effect through the 1990's on the PANYNJ's bridges. [10]

On January 25, 2001, the PANYNJ approved a time of day pricing initiative at its tunnels and bridges that varied the pricing on its facilities according to value and the corresponding demand. It entered into effect three months later, on March 25, 2001. As part of a larger initiative to finance its overall capital budget, the PANYNJ also saw the plan as a means for reducing congestion, increasing the use of mass transit, increasing the use of E-ZPass, and facilitating commercial traffic control management. The toll schedule before and after implementation of time of pricing is shown in Table 1 for autos and trucks.

Table 1. Tolls for autos and trucks

Type of Vehicle	Before Time of Day Pricing	After Time of Day Pricing
Autos		
Cash Peak	$4.00	$6.00
Cash Off-Peak	$4.00	$6.00
E-ZPass Peak	$3.60	$5.00
E-ZPass Off-Peak	$3.60	$4.00
Trucks (per axle)		
Cash Peak	$4.00	$6.00
Cash Off-Peak	$4.00	$6.00
E-ZPass Peak	$3.60	$6.00
E-ZPass Off-Peak	$3.60	$5.00
E-ZPass Overnight	$3.60	$3.50

Notes for the After Time of Day Pricing:

(1) Source: Port Authority of NY & NJ Toll Rates, http://www.panynj.gov/tbt/TOLL_RATES.pdf (12)

(2) Tolls are collected in the eastbound (New York bound) direction only).

(3) For autos, peak toll hours are weekdays 6-9 AM and 4-7 PM, weekends and holidays 12 Noon-8 PM;

Off-peak hours are weekdays 9 AM-4 PM and 7 PM-6 AM, weekends / holidays from Midnight to Noon and after 8 PM;

(3) For trucks, peak hours are weekdays 6-9 AM and 4-7 PM, weekends 12 Noon-8 PM;

Overnight hours are weekdays Midnight-6 AM;

Off-peak hours are weekdays 9 AM-4 PM and 7 PM-Midnight, weekends before 12 Noon and 8 PM-Midnight.

(4) For trucks, peak toll hours are weekdays 6-9 AM and 4-7 PM, weekends / holidays 12 Noon-8 PM;

Overnight toll rate discount hours are weekdays Midnight-6 AM;

Off-peak hours are weekdays 9 AM-4 PM and 7 PM-Midnight, weekends / holidays from Midnight to Noon and after 8 PM.

(5) Port Authority Staten Island Bridges Plan - This commuter discount plan provides customers with a significant discount on the Bayonne Bridge, Goethals Bridge, and Outerbridge Crossing. Under this plan, 20 trips are purchased in advance, and must be used within 35 days. Unused

trips are billed to the account. The discounted toll rate is as low as $2.50 per trip at the Staten Island crossings if all trips are used.

(6) Port Authority Carpool Commuter Plan - This plan is for commuters with three or more occupants in a passenger vehicle, traveling on the PANYNJ facilities through a staffed lane with a pre-registered E-ZPass account. The discounted rate per trip is $1.00.

Organizational Structure

This project was a joint collaboration between the Rensselaer Polytechnic Institute (lead contractor), Rutgers University and New York University. The Principal Investigator (PI) was Professor José Holguín-Veras (Rensselaer), and the co-Principal Investigators (co-PI) were Professor Kaan Ozbay and Dr. Allison de Cerreño (New York University). In general terms, the team from Rensselaer Polytechnic Institute was in charged of the behavioral analyses and overall managing of the project; while Rutgers University and New York University took care of the estimation of the impacts of the time of day pricing initiative on traffic and transit ridership, and the analyses of media and decision makers' reactions, respectively. Professor Ed Sullivan (California Polytechnic State University at San Luis Obispo) and Mr. Herbert Levinson played the role of external consultants to the project team.

Overall guidance and support was provided by a Steering Committee comprised of one representative from each participating agency, the PI and Co-PIs. The members of the Steering Committee were: Professor José Holguín-Veras (RPI), Professor Kaan Ozbay (Rutgers University), Mr. Mark Muriello (PANYNJ); Mr. Abbas Hirya, Mr. Chuck Grill and Ms. Swati Gandhi shared this responsibility at various times for NJDOT; Ms. Angela Jacobs (FHWA); and Dr. Allison de Cerreño (New York University).

Participating agencies and project partners provided input and guidance to the project through a Technical Advisory Group (TAG) that discussed project matters at regularly scheduled conference calls, typically once a month. The agencies represented in the TAG were: New Jersey Department of Transportation (NJDOT), Port Authority of New York and New Jersey (PANYNJ), and Federal Highway Administration (FHWA). Participants from FHWA came from the Value Pricing Pilot Program, its Regional Office, as well as FHWA’s consultants. Regular contributors to the TAG conference calls included, in addition to the members of the Steering Committee: Mr. Danny Jiji (PANYNJ), Ms. Judith Parrish (NJDOT), Ms. Miki Krakauer (NJDOT), Ms. Stephani Potapa (NJDOT), and Mr. Joung Lee (FHWA’s Regional Office).

Methodological Framework

The project had three main focus areas that could be broadly described as: *Disaggregate Behavioral Impacts*, *Aggregate Impacts on Traffic and Transit Use*, and *Public Reaction to the Time of Day Pricing Initiative*. The Rensselaer Polytechnic Institute was in charge of the first area, Rutgers University of the second; while the third area was the joint responsibility of New York University and the Rensselaer Polytechnic Institute.

The research on the subject of *Disaggregate Behavioral Impacts* was conducted in four distinct stages. The first stage consisted of conducting a set of focus groups with both passenger car users and truck dispatchers to gain insight on the impacts produced by the time of day pricing initiative, and to fine tune the survey instruments designed to gather behavioral data. On the basis of the feedback received from the focus groups major modifications were implemented in the survey instruments. For the most part, these modifications were aimed at simplifying the questions. Once the surveys were finalized, Rutger’s University Eagleton Institute was hired to gather the data by means of computer aided telephone interviews. After receiving the data from the Eagleton Institute, the project team proceeded to conduct the corresponding behavioral analyses. A separate line of inquiry focused on behavioral modeling of trucking companies’ decision to use/not to use E-ZPass. This activity took advantage of a data set already collected for the PANYNJ as part of another project.

Rutgers University was in charge of *Aggregate Impacts on Traffic and Transit Use*. As part of this task, the project team obtained a comprehensive data set with traffic counts at the various PANYNJ toll facilities. The traffic data, classified by type of vehicle and hour of the day, were used to quantify the impact of the time of day pricing initiative on overall traffic patterns, E-ZPass usage and time of day traffic changes. The project team also obtained aggregate transit ridership data from New Jersey Transit, and the PANYNJ. The data, though highly aggregate, were used to estimate the aggregate impacts of the time of day pricing initiative.

The third line of inquiry focused on *Public Reaction to the Time of Day Pricing Initiative.* This are had two major components. The first one focused on the process followed, and reactions to, the implementation of the time of day pricing initiative. As part of these analyses, the project team documented the overall process followed by the PANYNJ to make the time of day pricing initiative a reality, as well as the reactions of key stakeholders before and after the implementation. The second component consisted on the statistical analyses of the public opinion questions included in the surveys that gathered the respondents' opinions about various policy questions related to the time of day pricing initiative.

Basic research questions

In general terms, this project tried to answer a set of key questions, some of which are listed next:

- Did the time of day pricing initiative have a significant impact on traffic levels, and traffic composition by time of day (Chapter II)?
- Did the time of day pricing initiative have any appreciable impact on transit ridership (Chapter III)?
- Did the time of day pricing initiative produce behavioral changes on the users (Chapters IV thru VII)?
- What are the traffic elasticities (Chapter VIII)?
- What were the reactions of the media, decision makers and users to the time of day pricing initiative (Chapters IX and X)?

Overview of the Report and Lead Contributors

This report is the result of the hard work of all individuals involved as members of the Steering Committee, the Technical Advisory Group and the research team. More often than not, the lead authors produced a draft document that was dramatically changed on the basis of the feedback received from members of the Technical Advisory Group, whose comments significantly improved the quality of the document. The report is comprised of ten major chapters, including this introduction. A brief description of the chapters and the corresponding lead contributors are shown next.

Chapter I: Introduction (Lead contributors: Professor José Holguín-Veras, Professor Kaan Ozbay and Dr. Allison de Cerreño).

Chapter II: Traffic Impacts (Lead contributors: Professor Kaan Ozbay, Ms. Ozlem Yanmaz-Tuzel, Dr. Dilruba Ozmen-Ertekin, Ms. Jeevanjot Singh). This chapter describes the analyses pertaining to the impacts of the time of day pricing initiative on traffic at the PANYNJ facilities.

Chapter III: Impacts on Transit Ridership (Lead contributors: Professor Kaan Ozbay, Ms. Mr. Anil Yazici, Dr. Dilruba Ozmen-Ertekin) This chapter discusses the impacts of the time of day pricing initiative on transit ridership using data from the regional transit agencies.

Chapter IV: Focus Group Studies (Lead contributor: Dr. Barbara Seruya). This chapter discusses the findings from focus groups to provide qualitative information about behavioral impacts in both the passenger and the commercial sectors used to refine survey instruments.

Chapter V: Descriptive Analyses of the Impacts of the Time of Day Pricing Initiative on Passenger Travel Behavior (Lead contributors: Professor José Holguín-Veras, Mrs. Ning Xu, Mrs. Qian Wang, Professor Edward C. Sullivan, Dr. John Polimeni, Professor

Mecit Cetin). This chapter focuses on analyses of sample demographics and the passenger survey.

Chapter VI: Attitudinal Factors that Determine E-ZPass Usage by Trucking Companies (Lead contributors: Professor José Holguín-Veras and Mrs. Qian Wang). This is an important component because the time of day pricing initiative hinges on E-ZPass use.

Chapters VII: Descriptive Analyses of the Impacts on Carrier Behavior (Lead contributors: Professor José Holguín-Veras, Mrs. Qian Wang, Mrs. Ning Xu, Professor Edward C. Sullivan, Dr. John Polimeni, Professor Mecit Cetin). This chapter focuses on the analyses of the sample company attributes and the impacts of the time of day pricing initiative on carriers through the dispatcher survey.

Chapter VIII: Estimation of Traffic Elasticities from the Observed Traffic Data (Professor Kaan Ozbay. Mr. Ozlem Yanmaz-Tuzel, Dr. Dilruba Ozmen-Ertekin). This chapter discusses the observed elasticities estimated from the traffic data furnished by the PANYNJ.

Chapter IX: Media and Decision Makers' Reactions to the Time of Day Pricing Initiative (Lead contributor: Dr. Allison de Cerreño). This chapter provides key insights about the process followed by the PANYNJ in implementing time of day pricing that may prove invaluable to future implementations of time of day pricing because of the lessons learned.

Chapter X: Public Opinion (passenger and commercial sectors) (Lead contributors: Professor José Holguín-Veras, Ms. Qian Wang, Ms. Ning Xu, Professor Edward C. Sullivan, Dr. John Polimeni, Professor Mecit Cetin). This chapter focuses on the analyses of user opinions about the time of day pricing initiative.

CHAPTER II

TRAFFIC IMPACTS

Introduction

This chapter presents the results of the analyses conducted by the project team to assess the impacts of the time of day pricing initiative on traffic at the Port Authority of New York and New Jersey (PANYNJ) facilities. These analyses are based on the traffic data routinely collected by the PANYNJ at the corresponding toll lanes. The main objective is to answer some important questions highlighted below:

- Were there any changes in overall and peak/peak shoulder period E-ZPass usage after time of day pricing initiative?
- Were there any significant changes in overall traffic after time of day pricing initiative?
- Were there any significant changes in the hourly distribution of traffic volumes during the peak periods and peak shoulders after time of day pricing initiative?

Figure 2. Research questions regarding the impacts of time of day pricing initiative

The PANYNJ operates six vehicular crossings and eight toll plazas that connect New Jersey and New York City. Theses are the Outerbridge Crossing, the Goethals Bridge, the Bayonne Bridge, the Holland Tunnel, the Lincoln Tunnel, and the George Washington Bridge. As shown in Figure 2, in order to focus solely on the traffic impacts of time of day pricing initiative, the time period from January 2000 to August 2001 is analyzed, which excludes the time period after the 9/11 event. The terrorists' attacks at the World Trade Center caused a sustained period of disruption to the transportation network. The emergency response and subsequent recovery efforts required a series of facility closures and restrictions of trucks and single-occupant vehicles that caused substantial anomalies to travel patterns, including a redistribution of traffic on the roadway network, temporal modal shifts, and overall reduced demand reflecting the economic displacement from Lower Manhattan. These changes made an assessment of the reaction to the PANYNJ toll prices impossible to isolate and analyze. By August

2002, the transportation network had stabilized, reaching “new normal” traffic flow distributions among the crossings. This stabilized environment allowed the assessment of the toll pricing program to resume. [13]

In the following sections, data sources and details of the methodology used are discussed. Then, in the analysis section seasonal factor analysis and impacts of time of day pricing implementations are provided. Finally, in the last section, conclusions and discussions are presented.

Data Sources

The database used in this study was obtained from PANYNJ. [14] It includes hourly, daily, weekly, and monthly eastbound traffic counts from the toll system during weekdays and weekends for a four-year period from 2000 to 2003. However, as discussed above, the focus of this assessment is on the time period between January 2000 and August 2001. The details of the data set are provided in Table 90. The database contains a variety of information including vehicle type (Bus, Truck, and Car) and type of payment utilized (E-ZPass, Cash). The weekday data were collected for three days: Monday, Wednesday, and Friday. Weekend data were collected for both Saturday and Sunday. All data are for trips from New Jersey to New York, since tolls are collected only in the Eastbound (New York bound) direction on the PANYNJ facilities.

Table 2. Data Sources [14]

Time Period	Day Type	Vehicle Type	Payment Type	Location
Jan 2000 – Aug 2001	Weekday, weekend	Cars, buses, trucks	Cash, E-ZPass	GWB_lower, GWB_upper, GWB_PIP HT, LT, BB, GB, OC

GWB: George Washington Bridge
PIP: Palisades Interstate Parkway
OBX: Outerbridge Crossing
HT: Holland Tunnel
LL: Lincoln Tunnel
BB: Bayonne Bridge
GB: Goethals Bridge

Methodology

The main purpose of this chapter is to investigate the facility-specific traffic patterns and impacts of the time of day pricing initiative on the traffic flow of PANYNJ facilities for the time period **January 2000-August 2001** where the normal traffic patterns were not disrupted due to facility closures, operational restrictions and regulations, following 9/11/2001. The steps followed throughout the analysis are summarized below.

- Analyses of variations at individual facilities to differentiate the facility specific seasonal changes in traffic levels (for different time periods when no external factor, i.e., new toll schedule, is imposed to the system), from the changes in the travel patterns due to time of day pricing initiative.
- Analysis of cash and E-ZPass usage trends before and after the time of day pricing initiative, which could be crucial to draw valid conclusions about the impact of the time of day pricing program on E-ZPass usage.
- Before-after analysis, to determine the change in travelers' behavior during peak and peak shoulder periods using hourly traffic data before and after the time of day pricing initiative.
- Application of statistical significance tests to determine the significance level of the changes in traffic after the time of day pricing initiative.

Seasonal Factor Analysis

While investigating the travel patterns at PANYNJ facilities, it is important to differentiate the facility specific seasonal changes in traffic levels (for different time periods when no external factor, i.e., new toll schedule, is imposed to the system), from the changes in the travel patterns due to time of day pricing initiative. In this part of the analysis, the role of seasonal variations in traffic levels is investigated through a simple statistical model. It is important to note that this model does not attempt to analyze the role of the underlying economic conditions on variations in traffic levels, but treats these factors as part of the random error related to external factors. This analysis identifies three sets of factors:

(1) Factor_1: Temporal variations due to fluctuations depending on the time of the day, days of the week, and months of the year.

(2) Factor_2: Fluctuations in traffic among years for a specific time period of a day due to the changes in tolls, or travel time

(3) Other random errors: Fluctuations due to external factors difficult to capture such as, economic growth, and sampling errors.

The statistical model representing the traffic flow can be given by: (15)

$$y_{ij} = \mu + \alpha_i + \beta_j + \varepsilon_{ij} \tag{1}$$

where;

y_{ij}: Observed percent share of traffic at level *i*, *j*

μ: Mean of all observations y_{ij}

α_i: Effect of Factor_1 at level *i*

β_j: Effect of Factor_2 at level *j*

ε_{ij}: Random error term

To eliminate the fluctuations depending on peak and off-peak periods, AM/PM and peak/off-peak period traffic flows are investigated separately. In addition, to eliminate variations in demand due to toll changes, years with fixed tolls and typical work days are selected. Moreover, traffic is represented in terms of percentage share with respect to total daily traffic, in order to reduce external factors. To fully determine the effects of these factors on traffic, two-way ANOVA test is employed by constructing a two-factor full factorial design without replications using data sets, shown in Figure 3.

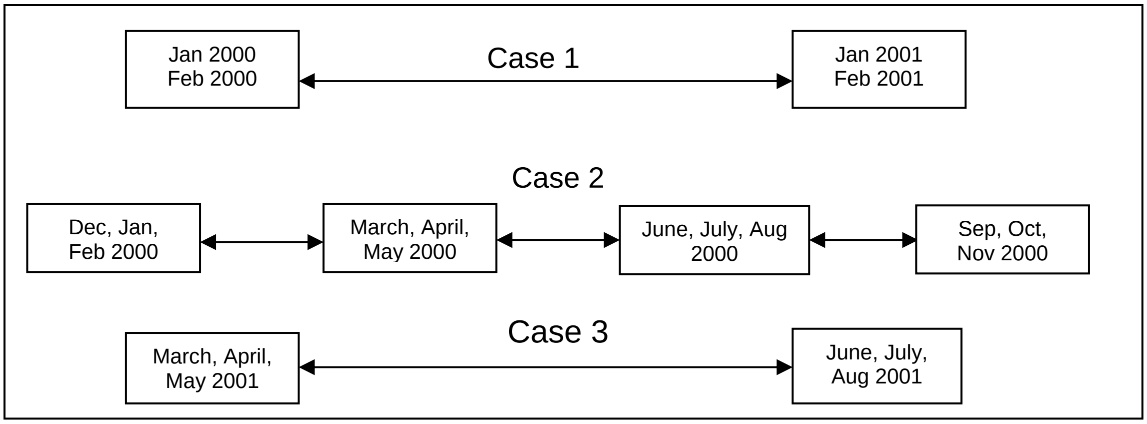

Figure 3. Cases for the ANOVA test for seasonal variations

An Analysis of Variance (ANOVA) test is closely related to the well-known and widely used t-test. The major difference lies in the fact that the t-test measures the difference between the means of two groups, whereas an ANOVA test compares the difference between the means of two or more groups. The main advantage of using ANOVA test instead of multiple t-tests is that it reduces the probability of rejecting the null hypothesis that is true, thus committing a type-I error. The main reason behind this is that by making multiple comparisons using t-test, one increases the alpha value automatically. This, in turn, increases the likelihood of making a type-I error. ANOVA test is also called F test that tells if there is a statistically significant difference between groups.

While conducting two-way ANOVA test, the data points are divided into relatively homogenous subgroups and significance tests are conducted within and across each homogenous group. The key idea is to determine the effect of each subgroup to the total variation. The percent share of each data type is calculated using Equation 2.

$$y_{ij} = \frac{M_{ij}}{\sum_i M_{ij}} * 100 \qquad (2)$$

where:

i: Time period index, *j*: Month index

y_{ij}: Percent share of period *i* on month *j*,

M_{ij}: Average traffic during period *i* on month *j*

During the seasonal variation analysis three different types of cases are considered for each time period of day (AM peak, PM peak and off-peak) and each crossing, as shown in Figure 3. In Case 1, monthly data pairs in years 2000 and 2001, both of which are before the time of day pricing initiative are compared. This case is developed to understand the impacts of economic changes between year 2000 and 2001 on the traffic flows when everything else in the system remained unchanged. The ANOVA structure for Case 1 is presented in Table 3.

Table 3. Two-way ANOVA structure for Case 1

January 2000	February 2000
January 2001	February 2001

Changes among years

Changes within months

In Case 2 monthly variation among the months of year 2000, before the time of day pricing is investigated. This case provides information regarding seasonal variation among months/seasons of year 2000, when everything else in the system is fixed. The ANOVA structure for Case 2 is presented in Table 4.

Table 4. Two-way ANOVA structure for Case 2

December 2000	January 2000	February 2000
March 2000	April 2000	May 2000
June 2000	July 2000	August 2000
September 2000	October 2000	November 2000

Changes among the seasons

Changes within the seasons

And finally, in Case 3, monthly variation among the months of year 2001, after the time of day pricing, is investigated. This case provides information regarding the changes among summer months in year 2001 with higher toll levels. The ANOVA structure for Case 2 is presented in Table 5.

Table 5. Two-way ANOVA structure for Case 3

March 2001	April 2001	May 2001
June 2001	July 2001	August 2001

Changes among the seasons

Changes within the seasons

Some important caveats regarding these ANOVA analyses are important to mention. In Case 1, a limited sample size of 12 weekdays and eight weekend days is used, and no formal consideration of weather-related impacts of snowfall on the sample days in 2000 to 2001 is explicitly included in the analysis. Also in Case 3, there was no explicit treatment for the underlying economic conditions. It has been documented that the New York-New Jersey regional economy entered an economic recession in the Second Quarter 2001. Finally, it should be noted that a bridge deck replacement project at the Outerbridge Crossing required overnight lane closures in the westbound (non-toll) direction during the analysis period. While traffic levels in the measured direction were not directly impacted, any residual traffic diversion impacts is captured in the random error term only.

ANOVA Test Results for Seasonal Variation

The project team conducted ANOVA tests for the entire data set and all facilities. As indicated before, the main reason for the limited number of time periods used in this analysis is due to the need to avoid using data affected by 9/11.

The analysis results for which there is a statistically significant variation are shown in Table 6. The complete results of the two-way ANOVA test are provided in Appendix 1.

The ANOVA test results for Bayonne Bridge indicate that during 2000 there is a statistically significant seasonal variation in the traffic during PM peak hours. For all other time periods and cases, the fluctuation among months and years are statistically insignificant. It can be concluded that prior to the time of day pricing, there is a seasonal variation at Bayonne Bridge, and that this variation exhibits the same trend among years.

As shown in Table 6, the analysis results for Goethals Bridge demonstrate that there is a statistically significant variation in the traffic during PM peak and off-peak hours for Cases 2 and 3 during years 2000 and 2001. For all other time periods and cases, the fluctuation among months and years are statistically insignificant. These results indicate that, there is a seasonal variation in the traffic flow of Goethals Bridge, before and after the time of day pricing.

At Lincoln Tunnel, as shown in Table 6, a similar trend to Bayonne Bridge is observed, such that during 2000 there is a statistically significant seasonal variation in the traffic flow during PM peak hours. For all other time periods and cases, the fluctuation among months and years are statistically insignificant. Lastly, ANOVA test results for Outerbridge Crossing indicate that, during AM peak and off-peak hours, the seasonal variation among months is statistically significant between March 2001 and August 2001, after the time of day pricing initiative.

Table 6. Seasonal variation analysis results

Crossing	Time Period	Case	Type of Variation	F value	F critical value	Significance
Bayonne Bridge	PM peak	Case 2 (Before VP)	within seasons	0.1244	5.1432	No
			among seasons	7.1217	4.7571	**Yes**
			random error			
Goethals Bridge	PM peak	Case 2 (Before VP)	within seasons	0.2524	5.1432	No
			among seasons	6.6618	4.7571	**Yes**
			random error			
		Case 3 (After VP)	within seasons	1.1595	19.0000	No
			among seasons	63.2101	18.5128	**Yes**
			random error			
	Off-peak	Case 2 (Before VP)	within seasons	0.7111	5.1432	No
			among seasons	5.5969	4.7571	**Yes**
			random error			
		Case 3 (After VP)	within seasons	5.1031	19.0000	No
			among seasons	32.3083	18.5128	**Yes**
			random error			
Lincoln Tunnel	PM peak	Case 2 (Before VP)	within seasons	0.1009	5.1432	No
			among seasons	6.9363	4.7571	**Yes**
			random error			
Outerbridge Crossing	AM peak	Case 3 (After VP)	within seasons	8.4792	19.0000	No
			among seasons	34.2978	18.5128	**Yes**
			random error			
	Off-peak	Case 3 (After VP)	within seasons	14.5988	19.0000	No
			among seasons	51.9269	18.5128	**Yes**
			random error			

In summary, prior to the toll pricing, there is a seasonal variation in the traffic flow at Bayonne Bridge, Goethals Bridge and Lincoln Tunnel during only PM peak hours. For all other facilities, the seasonal variation is statistically insignificant at all time periods. After the time of day pricing initiative, there is statistically significant seasonal variation only for Goethals Bridge (PM peak and off-peak hours), and Outerbridge Crossing (AM peak and off-peak hours). These analysis results indicate that each bridge and tunnel has its own specific seasonal variation trend. Therefore the traffic impact analysis should be done for each crossing and time period separately, considering the seasonal variations.

E-ZPass Usage as a Function of Time of Day

Another critical issue to be considered is the trend in E-ZPass ownership by time of day. The analyses of time series of E-ZPass and cash transactions would help to understand whether the changes in E-ZPass usage after the time of day pricing initiative are due to the new toll schedule, as opposed to being part of the natural trend. In order to see the cash vs. E-ZPass usage trends over time, the percent share of cash and E-ZPass users for each crossing are calculated by considering all weekdays and all vehicle types. Since toll increase mostly affects the behavior of users traveling at peak hours and peak shoulders, time periods between 5:00 AM–10:00 AM and 3:00 PM–8:00 PM are considered. Pre-peak hours refer to the time periods from 5:00 AM to 6:00 AM in the morning and time periods from 3:00 PM to 4:00 PM in the afternoon. Post-peak hours refer to the time periods from 9:00 AM to 10:00 AM in the morning and time periods from 7:00 PM to 8:00 PM in the afternoon. Similarly, peak hours refer to the time periods from 6:00 AM to 9:00 AM in the morning and time periods from 4:00 PM to 7:00 PM in the afternoon. The weekday sample data were used to conduct this analysis. The percent share of traffic at each specific period is calculated as the ratio of traffic during that time period to the traffic during entire time period. During the analysis of E-ZPass ownership as a function of time of day, the data set described in Table 90 is utilized.

The average percent share of users traveling at peak shoulders is shown in Figure 4, and average percent share of users traveling at peak periods is shown in Figure 7. In addition, analysis results for crossings experiencing the highest change among the time period from January 2000 to August 2001 are shown in Figure 5 and Figure 6 for peak shoulders and in Figure 8 and Figure 9 for peak periods. The analysis results for other crossings can be found in Appendix 2. As can be observed in the figures, each crossing exhibits a similar trend in time in terms of cash versus E-ZPass usage. These findings regarding E-ZPass usage as a function of time of day are consistent with the results discussed by Muriello et al. [16] The results depending on time of day and E-ZPass ownership can be summarized as follows.

Percent of Cash Users Traveling at the Peak Shoulder Periods

Analysis results for cash users traveling at peak shoulders are presented from Figure 4 through Figure 6. Cash users of each crossing represent a similar behavior during pre-peak hours and post-peak hours. These periods share the least portion of the traffic flow. The general trend of this time period is a decreasing trend, such that percent share of cash users traveling during peak shoulder periods decreased from January 2000 to August 2001. As shown in Figure 4, on the average the percent share of cash users traveling at post-peak period reduced to 5.66 percent (August 2001) from 7.15 percent (January 2000); whereas the percent share of cash users traveling at pre-peak period reduced to 4.93 percent (August 2001) from 6.13 percent (January 2000). Moreover, two distinct time periods with considerable reduction in percent share of cash user traffic with respect to total daily traffic are observed. The first of these time periods begins in October 2000, and the second begins in April 2001. Both periods are related to the introduction of E-ZPass discounts. In October 2000, news of the PANYNJ's toll increase plans and public stakeholder briefings began to be publicized by the media. The news of planned higher cash toll rates ($7.00 in the initial public plan) and deep E-ZPass discounts may have spurred many cash-paying PANYNJ customers to switch to E-ZPass at this time. In addition, in September 2000, time of day pricing was initiated at the New Jersey Turnpike, as well as the introduction of E-ZPass technology. E-ZPass users traveling on the New Jersey Turnpike started to pay discounted tolls during off-peak hours. As shown in Figure 4, after the time of day pricing initiative at New Jersey Turnpike, the percent share of cash users traveling at peak shoulder periods reduced by 1 percent from the time period January-September 2000 to the time period October 2000-March 2001, on the average. It is likely that the users traveling at both facilities started to obtain E-ZPass tags in order to take advantage of the discounted tolls, and more importantly, expedited crossing at the toll booths. Similarly, in March 2001 after the time of day pricing initiative at PANYNJ facilities went into effect, the percent share of cash users traveling at peak shoulder periods from the sample data set reduced by 1.32 percent from the time period October 2000 -March 2001 to the time period April - August 2001. These discounted toll levels for E-ZPass users may have attracted cash commuters traveling on PANYNJ facilities to use E-ZPass as well.

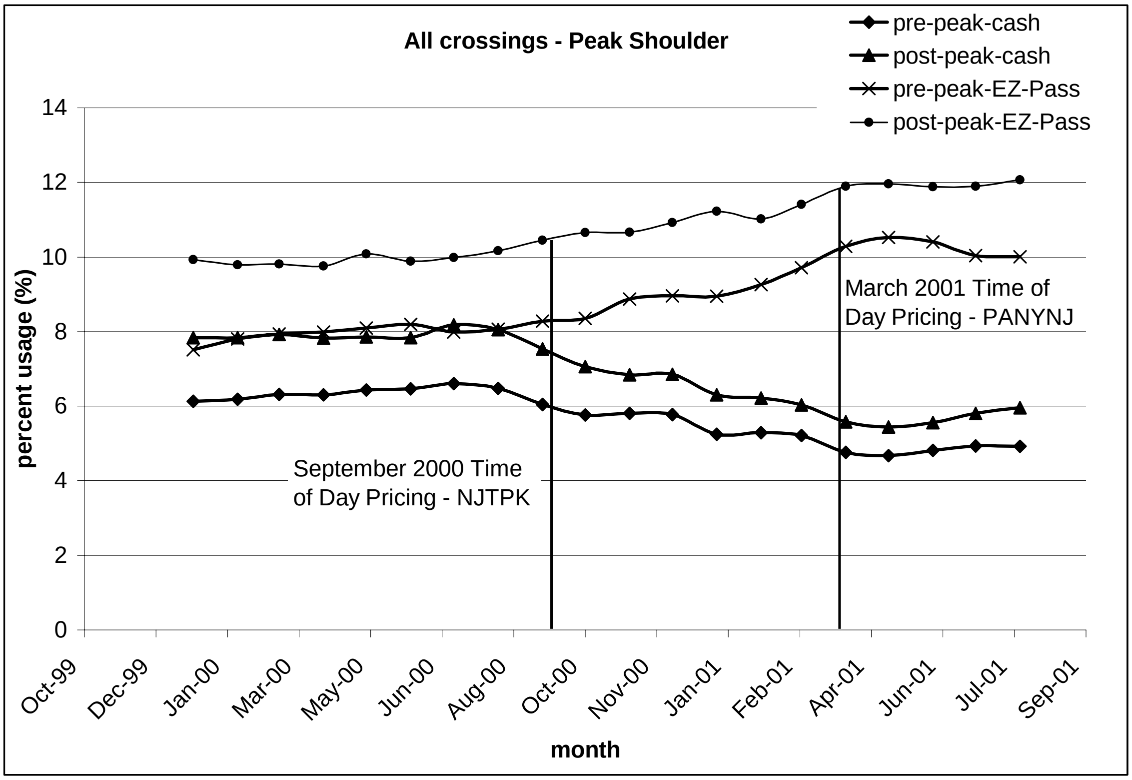

Figure 4. Cash versus E-ZPass usage over time – all crossings, peak shoulders

In addition, as shown in Figure 5, and Figure 6, the highest reduction in percent share of cash users traveling at pre-peak and post-peak hours is observed at Holland Tunnel and Lincoln Tunnel. The PANYNJ offers that these observed increases in E-ZPass use at the Tunnels suggest that prior to the toll increase peak-period drivers realized little benefit of better traffic flow with E-ZPass due to the heavy congestion experienced at both the Holland and Lincoln Tunnels in the [peak hours. After the toll change, the incentive to use E-ZPass at the Tunnels was greatly enhanced by virtue of the deeper discount for electronic transactions. The reductions in cash user percent share at pre-peak period are 1.9 percent (from 8.46 percent to 6.56 percent) and 1.75 percent (from 6.71 percent to 4.96 percent); whereas the reductions in cash user percent share of traffic, from January 2000 to August 2001, at post-peak period are 2.8 percent (from 9.92 percent to 7.1 percent) and 2.82 percent (from 6.61 percent to 5.17 percent) for Holland Tunnel and Lincoln Tunnel, respectively. Moreover, two distinct time periods with considerable reduction in percent share of traffic with respect to total daily traffic are observed. The first of these time periods begins in October 2000 (i.e., news stories of planned PANYNJ toil increases), and the second begins in April 2001 (i.e., the first full month of the toll change). Both periods are related to the introduction of E-ZPass discounts and expedited crossing at the toll booths. As shown in Figure 6, the highest reduction is observed at Lincoln Tunnel from the time period January-September 2000 to the time period October 2000-March 2001, with a reduction of 1.41 percent. Similarly, with time of day pricing initiative at the PANYNJ bridges and tunnels for E-ZPass users, the highest reduction is observed at Lincoln Tunnel, as shown in Figure 6, with a reduction of 1.80 percent from the time period October 2000 -March 2001 to the time period April -August 2001.

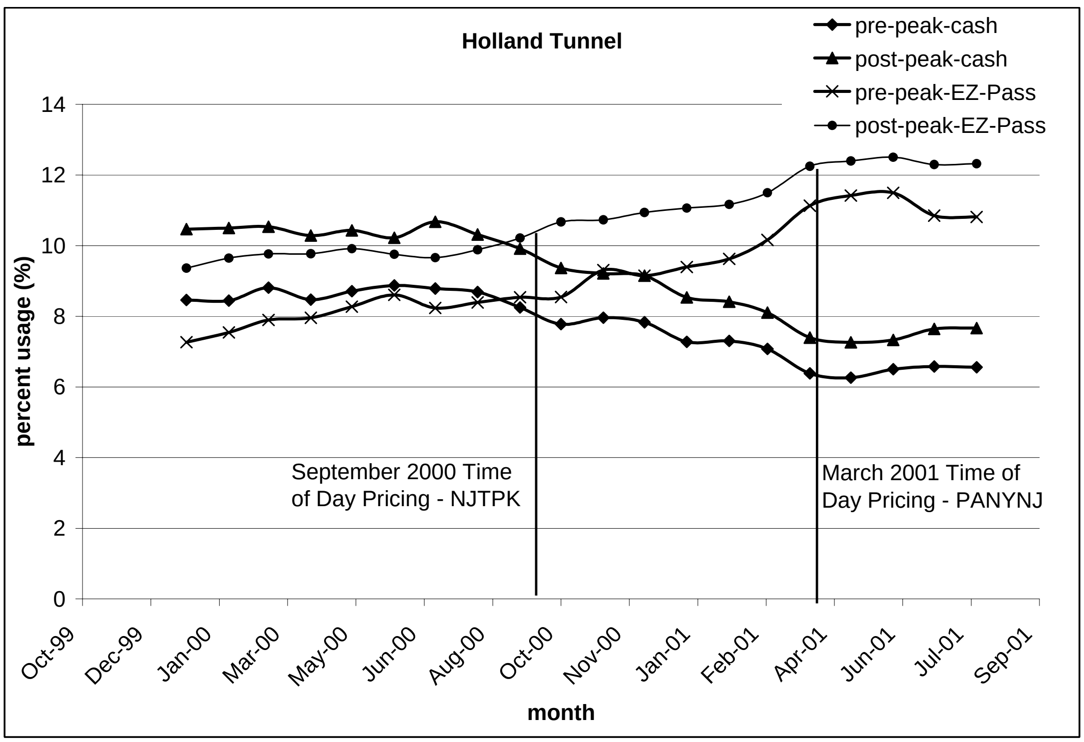

Figure 5. Cash versus E-ZPass usage over time – Holland Tunnel, peak shoulders

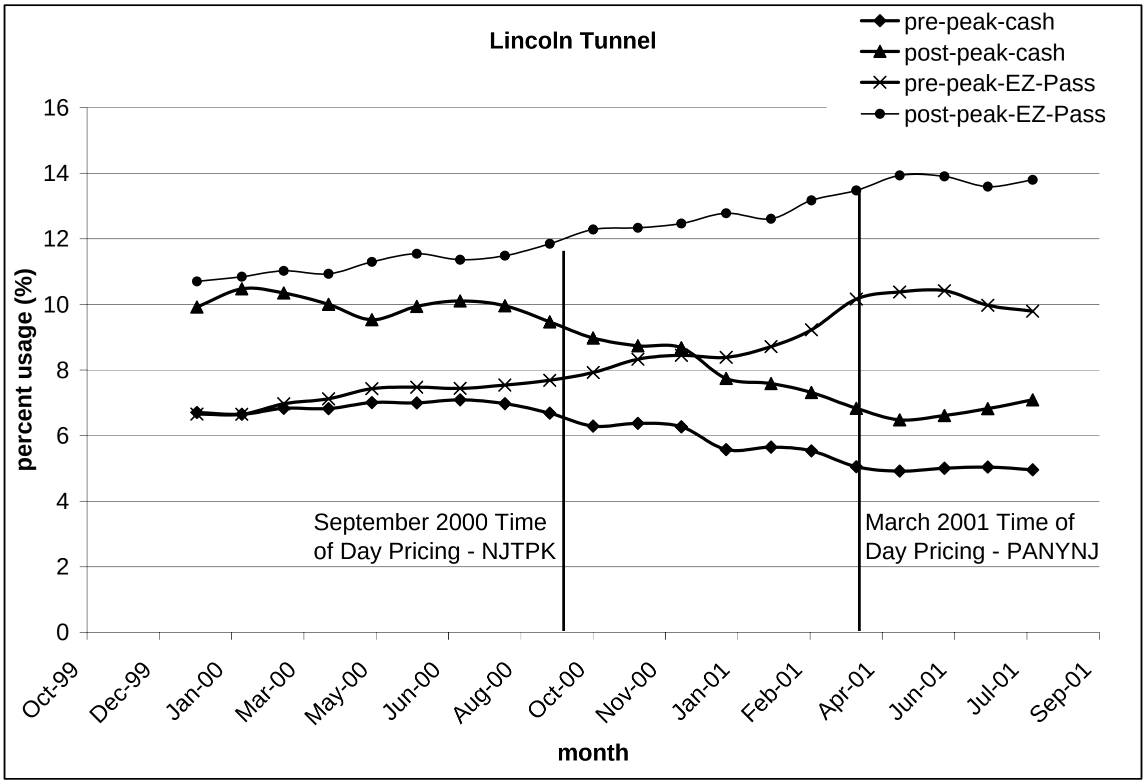

Figure 6. Cash versus E-ZPass usage over time – Lincoln Tunnel, peak shoulders

<u>Percent of E-ZPass Users Traveling at the Peak Shoulder Periods</u>

Analysis results from the sample data set used for these analyses for E-ZPass users traveling at peak shoulders are presented from Figure 4 through Figure 6. Similar to cash users, E-ZPass users at each crossing show similar behavior during pre-peak and post-peak hours. However, these periods share a higher portion of the traffic flow compared to cash users. As shown in Figure 4, on the average, the percent share of traffic flow ranges between 9.71 percent (January 2000) and 11.52 percent (August 2001). In addition, the percent share of E-ZPass users traveling during peak shoulder periods increased from January 2000 to August 2001. In addition, as shown in Figure 4, after the time of day pricing initiative at New Jersey Turnpike, the percent share of E-ZPass users traveling at peak shoulder periods increased by 1.1 percent from the time period January-March 2000 to the time period January-March 2001, on the average.

As shown in Figure 5, and Figure 6, the highest increase in percent share of E-ZPass users traveling at pre-peak and post-peak hours is observed at Holland Tunnel and Lincoln Tunnel. The increase in the percent share of E-ZPass users traveling at pre-peak period are 3.55 percent and 3.14 percent; whereas increase in the percent share of E-ZPass users traveling at post-peak period from January 2000 to August 2001 are 3 percent and 3.1 percent for Holland Tunnel and Lincoln Tunnel, respectively. Similar to the cash users traveling at peak shoulder period, two distinctive time periods are observed, for which this increase in percent share is considerable. Comparable to cash users, the first of these time periods starts in October 2000, and the second begins in April 2001. Both periods coincide with the introduction of E-ZPass discounts, for which the discounted toll levels during off-peak hours attracted users to obtain E-ZPass tag. As shown in Figure 6, the highest increase is observed at Lincoln Tunnel with an increase of 1.78 percent from the time period January-September 2000 to the time period October 2000-March 2001. Similarly, with time of day pricing initiative at the PANYNJ bridges and tunnels for E-ZPass users, the highest reduction is observed at Holland Tunnel, as shown in Figure 5, with an increase of 1.88 percent from the time period October 2000 -March 2001 to the time period April -August 2001.

<u>Percent of Cash Users Traveling at the Peak Periods</u>

Analysis results from the sample data set used for these analyses for cash users traveling at peak hours are presented from Figure 7 through Figure 9. During peak periods, a behavior similar to the one observed in peak shoulders is observed for cash users. However, as shown in Figure 7, the percent share of cash users traveling at peak periods is higher compared to cash users traveling at peak shoulders. The general trend of this time period is a decreasing trend like the trend in peak shoulders. However, the reduction in percent share of cash users traveling at peak periods is higher compared to the reduction in peak shoulders. As shown in Figure 7, on the average the percent share of cash users traveling at peak hours reduced to 17.7 percent (August 2001) from 25.1 percent (January 2000). Moreover, like users traveling at peak shoulders, two distinct time periods with considerable reduction in percent share of peak traffic with respect to total daily traffic are observed. The first of these time periods begins in October 2000, and the second begins in April 2001. Both periods are related to the introduction of E-ZPass discounts and expedited crossing at the toll booths. As shown in Figure 7, after the time of day pricing initiative at the New Jersey Turnpike, the percent share of cash users traveling at peak periods reduced by 2.83 percent from the time period January-September 2000 to the time period October 2000-March 2001, on the average. It is likely that the users traveling at both facilities started to obtain E-ZPass tags in order to take advantage of the discounted tolls, and more importantly, expedited crossing at the toll booths. Similarly, after the time of day pricing initiative at PANYNJ facilities, the percent share of cash users traveling at peak periods reduced by 3.49 percent from the time period October 2000 -March 2001 to the time period April - August 2001. These discounted toll levels for E-ZPass users may have attracted cash commuters traveling on PANYNJ facilities to use E-ZPass as well.

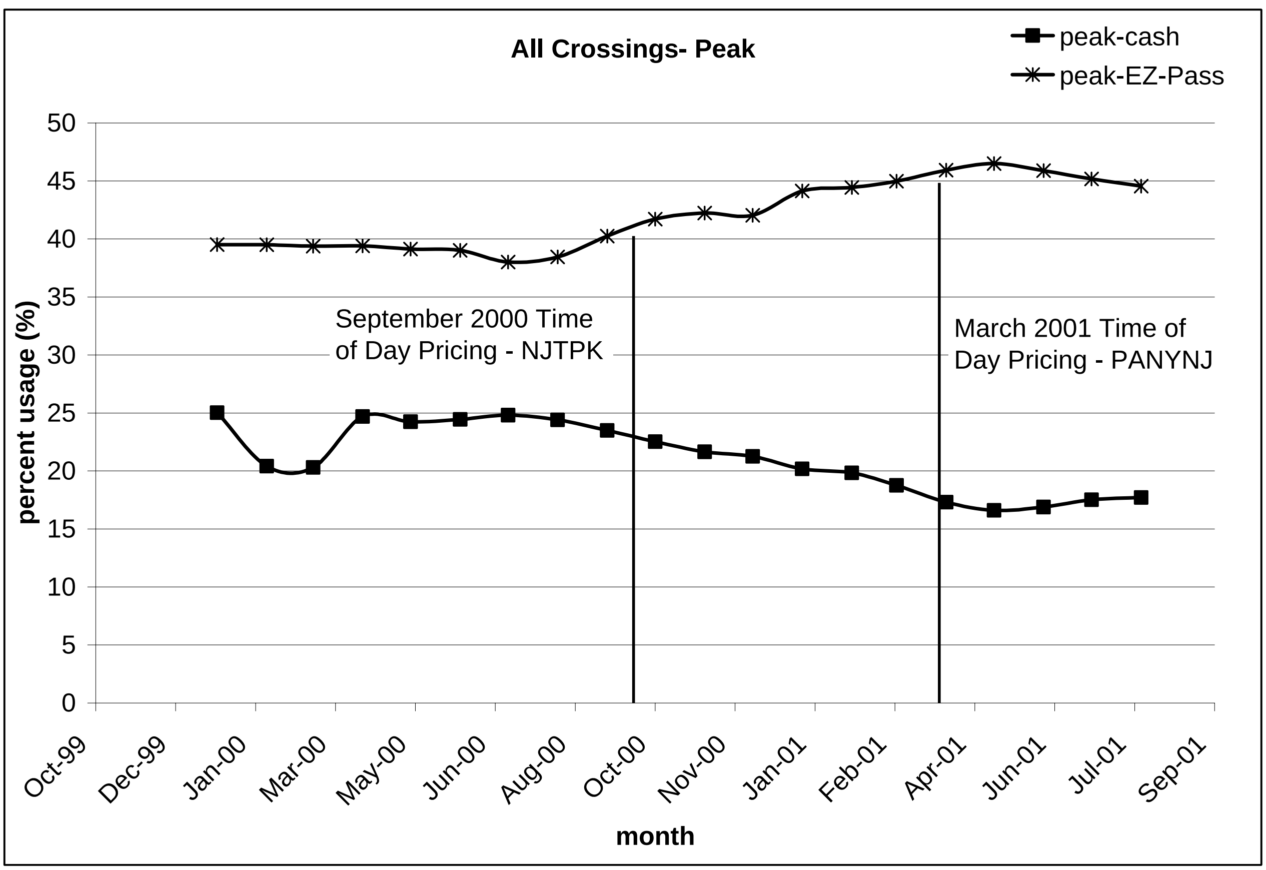

Figure 7. Cash versus E-ZPass usage over time – all crossings, peak

In addition, as shown in Figure 8, and Figure 9, the highest reductions in percent share of cash users traveling at peak hours are observed at Holland Tunnel and Lincoln Tunnel. The reductions in peak hour percent share, from January 2000 to August 2001, are 10.1 percent and 9.8 percent for Holland Tunnel and Lincoln Tunnel, respectively. Moreover, the reduction in percent share of cash users traveling at peak hours after September 2000 is much higher than the reduction in percent share of cash users traveling at peak shoulder. As shown in Figure 8, the highest reduction is observed at Holland Tunnel with a reduction of 4.75 percent from the time period January-September 2000 to the time period October 2000-March 2001. Similarly, with time of day pricing initiative at the PANYNJ bridges and tunnels for E-ZPass users, the highest reduction is observed at Lincoln Tunnel, as shown in Figure 8, with a reduction of 4.97 percent from the time period October 2000-March 2001 to the time period April -August 2001.

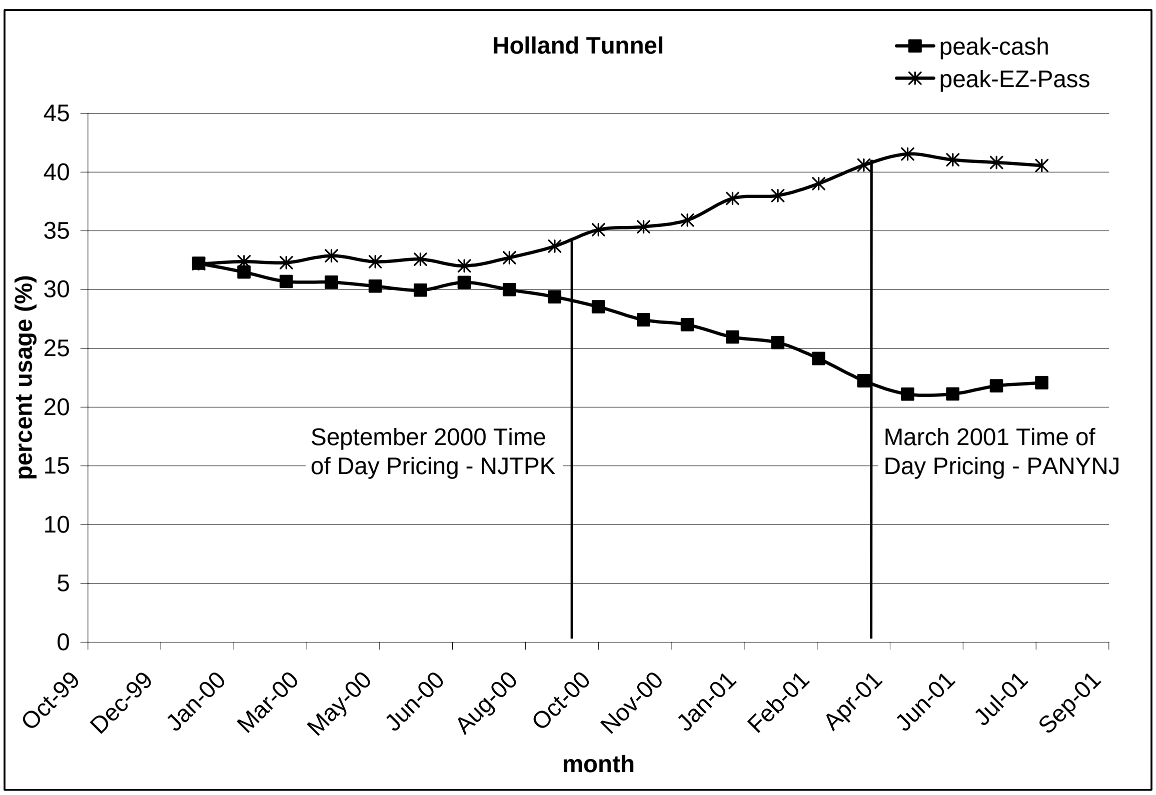

Figure 8. Cash versus E-ZPass usage over time – Holland Tunnel, peak

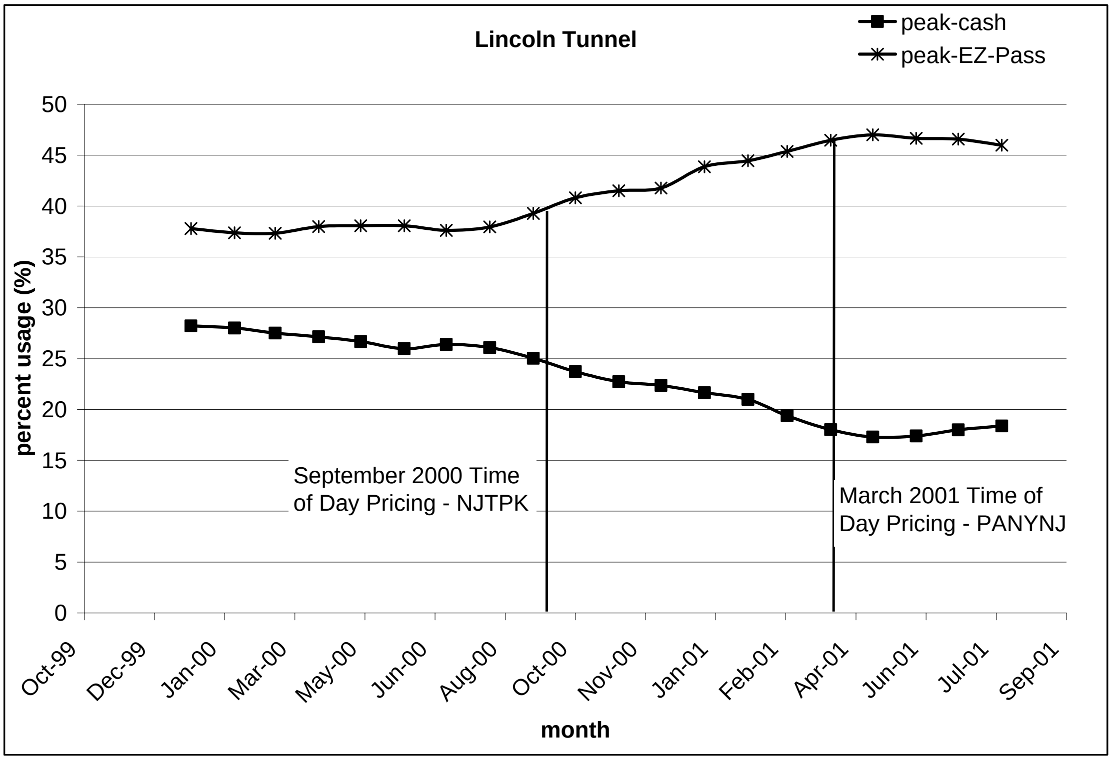

Figure 9. Cash versus E-ZPass usage over time – Lincoln Tunnel, peak

Percent of E-ZPass Users Traveling at the Peak Periods

Analysis results from the sample data set employed for these analyses for E-ZPass users traveling at peak hours are presented from Figure 7 through Figure 9. E-ZPass users constitute the highest percent share of the traffic during the peak period, and there is an increasing trend in the percent share between January 2000 and August 2001 for all facilities. As shown in Figure 7, on the average the percent share of E-ZPass users traveling at peak hours increased to 43.3 percent (August 2001) from 39.2 percent (January 2000). Moreover, like users traveling at peak shoulders, two distinct time periods with considerable increase in percent share of peak traffic with respect to total daily traffic are observed. The first of these time periods begins in October 2000, and the second begins in April 2001. Both periods are related to the introduction of E-ZPass discounts and expedited crossing at the toll booths. As shown in Figure 7, after the time of day pricing initiative at New Jersey Turnpike, the percent share of E-ZPass users traveling at peak periods increased by 2.35 percent from the time period January-

September 2000 to the time period October 2000-March 2001, on the average. It is likely that the users traveling at both facilities started to obtain E-ZPass tags in order to take advantage of the discounted tolls, and more importantly, expedited crossing at the toll booths. Similarly, after the time of day pricing initiative at PANYNJ facilities, the percent share of E-ZPass users traveling at peak periods increased by 4.07 percent from the time period October 2000 -March 2001 to the time period April -August 2001. These discounted toll levels for E-ZPass users may have attracted cash commuters traveling on PANYNJ facilities to use E-ZPass as well.

In addition, as shown in Figure 8, and Figure 9, the highest increase in percent share of E-ZPass user traveling at peak hours are observed at Holland Tunnel and Lincoln Tunnel. The increases in peak hour percent share of traffic are 8.4 percent and 8.2 percent for Holland Tunnel and Lincoln Tunnel, respectively. As shown in Figure 8, the highest increase is observed at Holland Tunnel with an increase of 4.05 percent from the time period January-September 2000 to the time period October 2000-March 2001. Similarly, with time of day pricing initiative at the PANYNJ bridges and tunnels for E-ZPass users, the highest increase is observed at Lincoln Tunnel, as shown in Figure 8, with an increase of 5.03 percent from the time period October 2000-March 2001 to the time period April-August 2001.

Analysis of the Changes after the Time of Day Pricing Initiative

In this section, changes in the traffic patterns at peak and off-peak periods after the time of day pricing initiative are investigated. As seen from Table 6, showing the results of seasonal factor analysis, the seasonal variation shows differences depending on the crossing, time of day, and most crossings have their own seasonal patterns depending on time of day after the time of day pricing initiative. Therefore, in before and after analysis conducted to investigate the impacts of time of day pricing initiative, absolute and percent shares of peak/off-peak period traffic are compared separately for each facility, for the same months of years 2000 and 2001. Moreover, in “E-ZPass Usage as a Function of Time of Day” section, it is observed that apart from the time of day pricing initiative at PANYNJ in March 2001, the time of day pricing initiative at the New Jersey Turnpike in September 2000 seems to have had an impact on the traffic flow at PANYNJ facilities. After the time of day pricing initiative and introduction of E-ZPass technology, percent share of cash users traveling at peak shoulders and peak hours reduced; whereas percent share of E-ZPass users traveling at peak shoulder and peak hours increased. Therefore, the before-after analysis is conducted considering these two time periods separately, from the sample data detailed in Table 90. The methodology can be summarized as follows.

1. Analysis of total daily traffic trends among weekdays and weekends.
2. Analysis of changes in total daily E-ZPass and cash usage.
3. Analysis of changes in absolute and percent shares of AM/PM peak and peak shoulder periods traffic after the time of day pricing initiatives for weekdays/weekends and cars/trucks separately.
4. Application of statistical tests to determine the significance level of these changes.

Changes in Total Daily Traffic Distribution

In the first part of the before and after analysis, the changes in the total daily traffic is investigated. Figure 10 and Figure 11 below show the average weekday and weekend traffic trends for the PANYNJ crossings, for the period from January 2000 to August 2001. As displayed in Figure 10, the daily traffic distribution during weekdays is stable most of the time until September 2001. Besides, Figure 10 indicates that the highest traffic flow at PANYNJ facilities is at the GWB upper level with a volume of 80,000 vehicles per day, and the lowest traffic flow is at Bayonne Bridge with a volume of 10,000 vehicles per day. The second highest traffic flow is observed at GWB lower level followed by Lincoln Tunnel, Goethals Bridge, Holland Tunnel, Outerbridge Crossing and GWB Palisades Interstate Parkway (GWB_PIP).

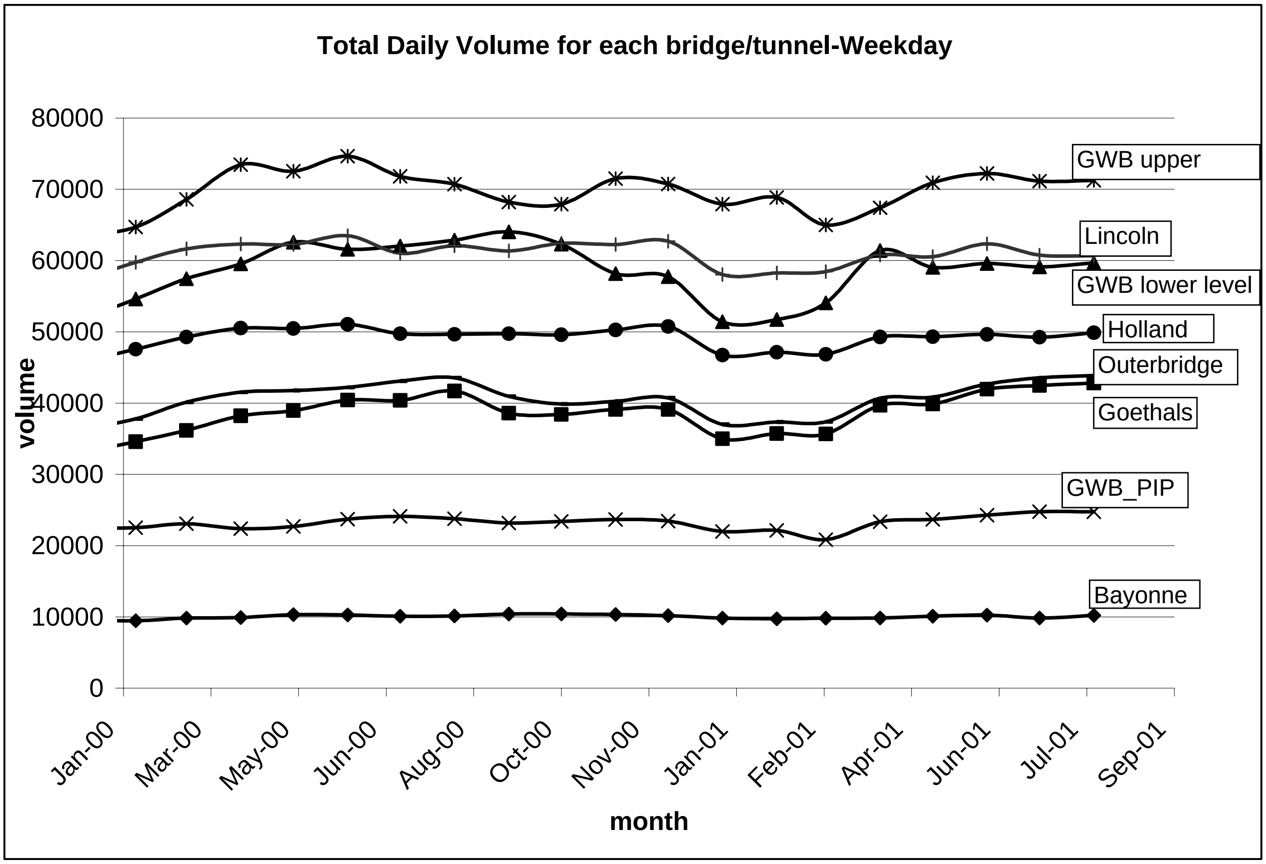

Figure 10. Average weekday traffic on PANYNJ crossings

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway

A similar behavior is observed for weekends as shown in Figure 11. However the average daily traffic flow is lower compared to weekdays. The highest traffic flow is observed at GWB upper level with a volume of 70,000 vehicles per day, and the lowest traffic flow is observed at Bayonne Bridge with a volume of almost 8,000 vehicles per day.

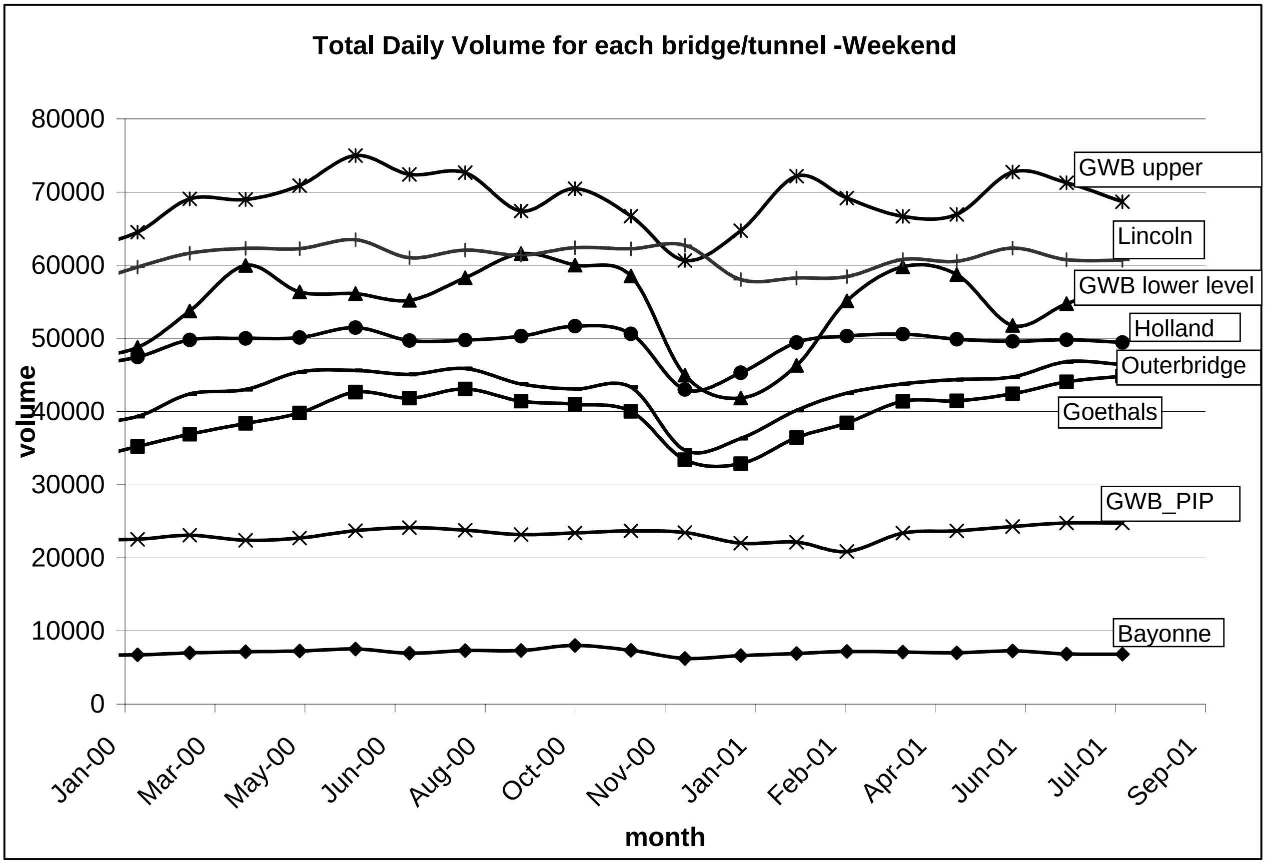

Figure 11. Average weekend traffic on PANYNJ crossings

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway

Changes in Total Daily E-ZPass versus Cash Usage

In this section, the changes in the total daily demand of cash and E-ZPass users are analyzed. During the analysis, the traffic at each crossing on Mondays, Wednesdays, and Saturdays are investigated separately for the entire time period between January 2000 and August 2001. The analysis focuses on the time periods immediately after the two time of day pricing implementations in the area, namely, September 1, 2000 (New Jersey Turnpike), and March 25, 2001 (PANYNJ).

Changes after September, 2000: New Jersey Turnpike's Time of Day Pricing Initiative

The first part of the analyses focus on the average daily traffic between January – March 2000 and January – March 2001 for E-ZPass and cash users both separately and together. Since the introduction of E-ZPass at the NJ Turnpike may have had an impact in E-ZPass usage at some of the Port Authority facilities, these analyses attempt to find out if the NJTA implementation had any noticeable impact in the traffic composition at the PANYNJ facilities. The results of this analysis are provided in Table 7, Table 8, and Table 9 for cash users, E-ZPass users and all users, respectively. For all facilities there is a decreasing trend in demand for cash users (Table 7), and an increasing trend for E-ZPass users during Wednesdays and Saturdays (Table 8). However, when overall traffic trends are compared (Table 9), it is observed that the traffic demand decreased after September 2000 on Mondays (-5.30 percent), but slightly increased on Wednesdays (1.27 percent) and Saturdays (0.30 percent). When individual facilities are investigated, it is observed that for a typical work day (Wednesdays) only GWB lower level and GWB_PIP traffic decreased. These results show that September 2000 time of day pricing initiative at the New Jersey Turnpike might have had an impact on the average daily traffic of E-ZPass and cash users. E-ZPass usage increased, and a shift between crossings occurred, while total flow at all crossings remained almost the same.

Table 7. Average daily traffic changes after September 2000, cash users

	Change in Number of Vehicles			Percent Change (%)		
	Wednesdays	**Mondays**	**Saturdays**	**Wednesdays**	**Mondays**	**Saturdays**
Bayonne Bridge	-627	-840	-793	-17.44	-24.32	-22.64
Goethals Bridge	-2155	-2742	-2929	-14.57	-18.72	-15.21
GWB Lower Level	-5430	-5971	-4972	-22.05	-24.60	-17.77
GWB PIP	-1478	-1933	-1248	-19.19	-24.91	-14.98
GWB Upper Level	-3495	-5603	-3695	-11.53	-18.52	-9.33
Holland Tunnel	-4403	-5623	-5077	-17.99	-23.11	-16.21
Lincoln Tunnel	-6621	-7551	-7938	-23.32	-27.79	-21.32
Outerbridge Crossing	-2621	-3302	-3727	-18.84	-24.13	-20.26
Total Change in Traffic Volume	**-3354**	**-4196**	**-3797**	**-18.26**	**-23.28**	**-16.39**

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway

Table 8. Average daily traffic changes after September 2000, E-ZPass users

	Change in Number of Vehicles			Percent Change (%)		
	Wednesdays	Mondays	Saturdays	Wednesdays	Mondays	Saturdays
Bayonne Bridge	1047	512	899	17.22	8.75	27.10
Goethals Bridge	3881	2400	3691	19.98	13.26	23.10
GWB Lower Level	3130	1831	2790	10.26	6.61	12.31
GWB PIP	853	-123	924	5.53	-0.66	7.85
GWB Upper Level	7927	4348	7095	22.88	13.86	27.18
Holland Tunnel	4800	2966	5595	20.90	14.40	33.83
Lincoln Tunnel	6825	3958	6959	21.41	13.53	30.63
Outerbridge Crossing	2583	787	3414	10.82	3.60	15.71
Total Change in Traffic Volume	**3881**	**2085**	**3921**	**16.76**	**9.55**	**22.44**

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway

Table 9. Average daily traffic changes after September 2000, all users

	Change in Number of Vehicles			Percent Change (%)		
	Wednesdays	Mondays	Saturdays	Wednesdays	Mondays	Saturdays
Bayonne Bridge	419.67	-328.00	105.67	4.39	-3.49	1.53
Goethals Bridge	1726.00	-342.33	761.67	5.11	-0.77	2.07
GWB Lower Level	-2299.33	-4140.33	-2182.33	-4.10	-7.55	-4.68
GWB PIP	-625.00	-2056.00	-323.67	-2.70	-9.00	-1.48
GWB Upper Level	4432.00	-1254.33	3400.00	6.91	-1.74	5.31
Holland Tunnel	397.00	-2657.00	517.67	0.89	-5.60	1.06
Lincoln Tunnel	204.00	-3592.67	-979.00	0.40	-6.08	-1.68
Outerbridge Crossing	-38.00	-2514.67	-312.33	0.04	-6.59	-0.85
Total Change in Traffic Volume	**527.04**	**-2110.67**	**123.46**	**1.27**	**-5.30**	**0.30**

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway

Changes after March 25, 2001: Time of Day Pricing Initiative at PANYNJ

An analysis similar to the one conducted for the time of day pricing initiative at NJ Turnpike in September 2000, is conducted for the time of day pricing initiative at PANYNJ facilities in March 25, 2001. For this time period, average daily traffic between April – August 2000 and April – August 2001 is compared for E-ZPass and cash users, both separately and jointly. The results for this analysis are shown in Table 10, Table 11, and Table 12 for cash users, E-ZPass users and all users, respectively. The results show that the impacts of the time of day pricing initiative in March 25, 2001, are similar to the impacts of the NJ Turnpike time of day pricing initiative in September 2000.

However, the increase in E-ZPass usage is much higher after March 2001 compared to September 2000. As shown in Table 11, after the introduction of the PANYNJ time of day pricing program, E-ZPass usage increased more than 20 percent for each day type, on average. Although there were traffic flow fluctuations for individual facilities, as shown in Table 12, the overall traffic volume practically remained constant, experiencing a slight decreased of almost 0.61 percent.

Table 10. Average Daily Traffic Changes after March 2001, Cash users

	Change in Number of Vehicles			Percent Change (%)		
	Wednesdays	**Mondays**	**Saturdays**	**Wednesdays**	**Mondays**	**Saturdays**
Bayonne Bridge	-1196	-1121	-1223	-32.23	-31.80	-33.29
Goethals Bridge	-3523	-3297	-3682	-20.62	-18.86	-16.02
GWB Lower Level	-8139	-7857	-7041	-30.57	-29.10	-21.88
GWB PIP	-2528	-2760	-2514	-31.79	-33.13	-27.26
GWB Upper Level	-8826	-7749	-8598	-25.54	-22.20	-19.42
Holland Tunnel	-7069	-7010	-6878	-28.09	-27.54	-21.41
Lincoln Tunnel	-8917	-8345	-8496	-31.29	-30.25	-23.28
Outerbridge Crossing	-3900	-3859	-4568	-25.77	-25.11	-22.35
Total Change in Traffic Volume	**-5512**	**-5250**	**-5375**	**-27.79**	**-26.29**	**-21.36**

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway

Table 11. Average Daily Traffic Changes after March 2001, E-ZPass users

	Change in Number of Vehicles			Percent Change (%)		
	Wednesdays	**Mondays**	**Saturdays**	**Wednesdays**	**Mondays**	**Saturdays**
Bayonne Bridge	1176	1094	997	18.32	18.24	28.02
Goethals Bridge	5042	5027	5375	23.26	23.69	29.65
GWB Lower Level	6108	6854	6334	18.21	21.28	25.37
GWB PIP	3286	3200	2813	21.19	20.54	24.09
GWB Upper Level	6376	6385	5876	16.99	18.05	21.28
Holland Tunnel	6253	5847	6532	25.25	25.41	36.12
Lincoln Tunnel	7938	7589	8660	23.26	24.06	35.86
Outerbridge Crossing	4121	3854	4798	15.52	14.68	19.56
Total Change in Traffic Volume	**5037**	**4981**	**5173**	**20.81**	**20.07**	**27.03**

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway

Table 12. Average Daily Traffic Changes after March 2001, all users

	Change in Number of Vehicles			Percent Change (%)		
	Wednesdays	Mondays	Saturdays	Wednesdays	Mondays	Saturdays
Bayonne Bridge	-19.60	-27.20	-225.60	-0.18	-0.26	-3.09
Goethals Bridge	1519.60	1730.40	1693.40	3.94	4.45	4.20
GWB Lower Level	-2030.80	-1003.40	-707.60	-3.24	-1.66	-1.25
GWB PIP	758.20	440.00	299.20	3.26	1.81	1.70
GWB Upper Level	-2450.60	-1363.20	-2722.80	-3.31	-1.92	-3.79
Holland Tunnel	-816.80	-1163.40	-346.40	-1.63	-2.39	-0.67
Lincoln Tunnel	-979.40	-756.00	164.20	-1.56	-1.25	0.28
Outerbridge Crossing	220.80	-4.80	230.20	0.50	-0.05	0.53
Total Change in Traffic Volume	**-474.83**	**-268.45**	**-201.93**	**-0.61**	**-1.06**	**-0.46**

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway

Statistical Testing of the Changes in the Peak Shoulder Traffic after Time of Day Pricing Initiatives and E-ZPass Usage

In order to determine whether or not the change in peak shoulder percent share of traffic at each crossing is statistically significant, one-tailed paired two-sample t-tests are conducted at 95 percent confidence level. The analysis was performed for each crossing, each vehicle type (cars, and trucks), each day type (weekdays, weekends) separately. Since overall traffic and E-ZPass trends indicate that each time of day pricing initiative in September 2000 and March 2001 had an impact on PANYNJ facilities, statistical tests were conducted for each of these time periods separately.

Since the main objective of the analyses is to assess whether or not time of day pricing was able travelers to shift from peak to peak shoulder periods, the alternate hypothesis is that the percent share of peak shoulder traffic after the time of day pricing initiative is larger than the percent share of the peak shoulder traffic before the time of day pricing. This hypothesis can be tested by conducting one tailed t test. In mathematical terms: [15]

$$\begin{aligned} H_0 &: (\mu_{i.})_{before} - (\mu_{i.})_{after} = 0 \\ H_1 &: (\mu_{i.})_{after} - (\mu_{i.})_{before} > 0 \end{aligned} \qquad (3)$$

where;

$(\mu_{i.})$= mean percent share of period i for each vehicle type at each crossing,

i: 1=AM pre-peak, 2=AM post-peak, 3=PM pre-peak shoulder, 4=PM post-peak shoulder

before: Time period from April to August 2000

after: Time period from April to August 2001

For weekday analysis, pre-peak hours, and post-peak hours during both morning and afternoon are analyzed separately for each vehicle type at each crossing. For each peak shoulder period a one hour time period considered. For the weekdays peak hour tolls are effective from 6:00 AM to 9:00 AM in the morning and from 4:00 PM to 7:00 PM in the afternoon. Therefore, “AM pre-peak” is taken as 5:00 AM – 6:00 AM, “AM post-peak” is taken as 9:00 AM – 10:00 AM, “PM pre-peak” is taken as 3:00 PM – 4:00 PM, and “PM post-peak” is taken as 7:00 PM – 8:00 PM On the other hand, weekend peak hour tolls are effective from 12:00 PM to 8:00 PM Therefore, for the weekend study two hours of off-peak analysis, time period 11:00AM - 12:00PM is taken as pre-peak and 8:00 PM – 9:00 PM is taken as post-peak.

In the following sections, the significance level of the changes in peak and peak shoulders periods after the time of day pricing initiative along with the introduction of E-ZPass technology at the NJ Turnpike in September 2000, and the time of day pricing initiative at PANYNJ in March 25, 2001 are determined using one tailed t tests.

Statistical Testing of the Changes in Peak Shoulder Traffic after September 2000

For the analysis of the first time of day pricing initiative by the New Jersey Turnpike in September 2000, the time period between January 2000 – March 2000 is compared with the time period between January 2001– March 2001. For each data set nine data points are considered (three months with three weekdays in each) for weekday analysis. In the case of weekends, the number of data points is six. In order to decrease the seasonal variations, same months are compared and percent share of periods are used, instead of absolute traffic flows for each time period considered. While applying the statistical significance tests, the hypothesis given in Equation 3 is utilized, using the data sets provided in Table 90.

Table 13 and Table 14 summarize the significance testing analysis results for each crossing for the weekday and weekend car, and trucks traffic, after the time of day pricing initiative at the New Jersey Turnpike in September 2000. In each table p-values for the t-tests are presented. P value in a statistical test gives the significance level of the difference between two data sets compared. Since t-tests in this study are conducted at 95 percent confidence level, the p values smaller than 0.05 indicate that the difference between two data sets are statistically significant. In these analyses, this result means that for the cases where p values are smaller than 0.05, the mean percent share of traffic at a specific time period after the time of day pricing initiative increased statistically significantly compared to the mean percent share of traffic at that time period before the time of day pricing initiative.

Based on the analysis shown in Table 13, it is concluded that car traffic presents a similar behavior at all crossings such that, only the change in traffic flow during AM pre-peak period is statistically significant for all crossings except Outerbridge Crossing. For other time periods and day types there are no statistically significant changes in the passenger car traffic flow.

Table 13. P-values for car peak shoulder traffic increase after September 2000, starting date of time of day pricing initiative and E-ZPass usage at the NJ Turnpike

Facility	Weekday				Weekend	
	5 – 6 AM	9 – 10 AM	3 – 4 PM	7 – 8 PM	11 AM – 12 PM	8 – 9 PM
Bayonne Bridge	0.0416 (S)[a]	0.053 (NS)[b]	0.342389 (NS)	0.284 (NS)	0.433 (NS)	0.418 (NS)
Goethals Bridge	0.0163 (S)	0.934076 (NS)	0.090546 (NS)	0.010259 (S)	0.353 (NS)	0.254 (NS)
GWB Lower Level	0.0348 (S)	0.245 (NS)	0.201 (NS)	0.24656 (NS)	0.359 (NS)	0.189 (NS)
GWB PIP	0.0129 (S)	0.15574 (NS)	0.289 (NS)	0.3049 (NS)	0.1006 (NS)	0.3425 (NS)
GWB Upper Level	0.02123 (S)	-0.5396 (NS)	0.1418 (NS)	0.096 (NS)	0.492 (NS)	0.4797 (NS)
Outerbridge Crossing	0.301045 (NS)	0.101444 (NS)	0.132131 (NS)	0.254601 (NS)	0.185 (NS)	0.4401 (NS)
Holland Tunnel	0.010184 (S)	0.3278 (NS)	0.0317 (S)	0.1051 (NS)	0.151594 (NS)	0.4671 (NS)
Lincoln Tunnel	0.0076 (S)	0.109 (NS)	0.0618 (NS)	0.272285 (NS)	0.2296 (NS)	0.2267 (NS)

[a] (S) stands for significant, meaning null hypothesis can be rejected. [b] (NS) stands for not significant, meaning null hypothesis cannot be rejected
GWB: George Washington Bridge, PIP: Palisades Interstate Parkway

On the other hand, as shown in Table 14, the change in truck traffic flow shows differences depending on crossing and weekday/weekend. Table 14 indicates that, on weekdays, the changes in traffic at Holland Tunnel, Lincoln Tunnel and Goethals Bridge are found to be statistically significant during AM pre-peak periods. On weekends, during AM pre-peak period, the change in traffic only at GWB lower level is statistically significant, whereas during PM post-peak period, the changes in traffic at Bayonne Bridge and Holland Tunnel are found to be statistically significant. For all other crossings and time periods, the changes in the traffic are found to be statistically insignificant.

Table 14. P-values for truck peak shoulder traffic increase after September 2000, starting date of time of day pricing initiative and E-ZPass usage at the NJ Turnpike

Facility	Weekday				Weekend	
	5 – 6 AM	9 – 10 AM	3 – 4 PM	7 – 8 PM	11 AM – 12 PM	8 – 9 PM
Bayonne Bridge	0.0649 (NS)	0.193 (NS)	0.462 (NS)	0.496 (NS)	0.4451 (NS)	0.0491 (S)
Goethals Bridge	0.0207 (S)	0.0548 (NS)	0.286 (NS)	0.372 (NS)	0.3205 (NS)	0.0792 (NS)
GWB Lower Level	0.1053 (NS)	0.020431 (S)	0.3762 (NS)	0.4595 (NS)	0.04057 (S)	0.1858 (NS)
GWB Upper Level	0.1544 (NS)	0.1484 (NS)	0.1563 (NS)	0.1330 (NS)	0.1457 (NS)	0.220162 (NS)
Outerbridge Crossing	0.0744 (NS)	0.1815 (NS)	0.2947 (NS)	0.3367 (NS)	0.3617 (NS)	0.1225 (NS)
Holland Tunnel	0.0197 (S)	0.3952 (NS)	0.3232 (NS)	0.4805 (NS)	0.2179 (NS)	0.0333 (S)
Lincoln Tunnel	0.0157 (S)	0.1887 (NS)	0.3027 (NS)	0.3478 (NS)	0.1441 (NS)	0.0625 (NS)

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway

It is important emphasize that the impact of the introduction of E-ZPass in conjunction with time of day pricing program at the NJ Turnpike in September 2000, mentioned above is just a hypothesis. In fact, the statistical significance of the impact of this event on the traffic patterns and characteristics at the PANYNJ facilities does not prove a cause and effect relationship. As in any other statistical analysis, it only shows that the hypothesis tested is statistically significant at a certain level. More importantly, when interpreting the results of the statistical analysis, one should be cognizant of the possibility of committing Type 2 error given the type of statistical test and significance level used in the analysis. On the other hand, the hypothesis tested is a simple and intuitive one that is proposed to test the existence of a possible impact of a significant change at a neighboring facility on the PANYNJ facilities. More detailed network-wide analysis and possibly surveys would be needed to establish a definite cause and effect relationship which is not possible to do given the limited scope of this study.

Statistical Testing of the Changes in Peak Shoulder Traffic after March 2001, Starting Date of the PANYNJ Time of Day Pricing Initiative

For the analysis of the PANYNJ time of day pricing initiative in March 2001, time period between April 2000– August 2000 is compared with the time period between April – August 2001. This pre-9/11 data set helps the research team to isolate the impacts of 9/11 tragedy from the impacts of time of day pricing initiative. For each data set, 15 data points are considered (five months with three weekdays in each) for weekday analysis. In the case of weekends, the number of data points is 10. In order to decrease seasonal variations, same months are compared and percent share of periods are used, instead of absolute traffic flows. While applying the statistical significance tests, the hypothesis given in Equation 3 is utilized, using the data sets provided in Table 90.

Table 15 and Table 16 summarize the statistical significance tests results for each crossing for the weekday and weekend car and trucks traffic after the March 25, 2001 time of day pricing initiative by PANYNJ. In each table p-values for the t-tests are presented.

The analysis results for passenger cars, as shown in Table 15, indicate that, during AM pre-peak period the increase in percent share of car traffic flow is statistically significant for all crossings except Outerbridge Crossing, whereas during AM post-peak period the increase in percent share of car traffic flow is statistically significant for GWB lower level, Holland Tunnel and Lincoln Tunnel. For the weekday PM period, as shown in Table 15, the percent share of pre-peak period increased in a statistically significant way for Bayonne Bridge, Goethals Bridge, Holland Tunnel, and Lincoln Tunnel, whereas the percent share of post-peak period increased for Goethals Bridge, GWB PIP and Outerbridge Crossing. In addition, the smallest change in the traffic flow after the time of day pricing initiative is observed at Outerbridge Crossing and GWB upper level, whereas the highest change is observed for Holland Tunnel, Lincoln Tunnel, and Goethals Bridge during weekdays. These results for weekday car traffic indicate that for all facilities there is a statistically significant change in different peak shoulder periods. As it is observed from Table 15, the increase in percent share of car traffic occurs during pre-peak periods for most of the crossings. Unlike the weekday traffic patterns, the weekend traffic flow analysis indicates that the peak shoulder car traffic did not change in a statistically significant way for any of the crossings, except GWB PIP after the time of day pricing implementation in March 25, 2001.

Table 15. P-Values for car peak shoulder traffic increase after March 2001 starting date of time of day pricing initiative at PANYNJ

Facility	Weekday				Weekend	
	5 – 6 AM	9 – 10 AM	3 – 4 PM	7 – 8 PM	11 AM – 12 PM	8 – 9 PM
Bayonne Bridge	0.017 (S)	0.1555 (NS)	0.0034 (S)	0.150 (NS)	0.468 (NS)	0.494 (NS)
Goethals Bridge	0.021 (S)	0.4045 (NS)	0.029 (S)	0.011 (S)	0.096 (NS)	0.219 (NS)
GWB Lower Level	0.0028 (S)	0.0295 (S)	0.0762 (NS)	0.138 (NS)	0.089 (NS)	0.4563 (NS)
GWB PIP	0.0057 (S)	0.2995 (NS)	0.0986 (NS)	0.029 (S)	0.0226 (S)	0.111 (NS)
GWB Upper Level	0.00011 (S)	0.2256 (NS)	0.3101 (NS)	0.0768 (NS)	0.077 (NS)	0.151 (NS)
Outerbridge Crossing	0.0871 (NS)	0.3766 (NS)	0.4523 (NS)	0.0107 (S)	0.080 (NS)	0.2799 (NS)
Holland Tunnel	0.00194 (S)	0.0495 (S)	0.0144 (S)	0.115 (NS)	0.054 (NS)	0.1464 (NS)
Lincoln Tunnel	0.00038 (S)	0.0064 (S)	0.0008 (S)	0.102 (NS)	0.285 (NS)	0.199 (NS)

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway

The significance test results for truck traffic are shown in Table 16. As shown in Table 16, most of the changes are observed during AM pre-peak periods and PM post-peak periods. The highest changes are observed at Goethals Bridge and Lincoln Tunnel during weekdays. Unlike the weekday traffic, the weekend traffic analysis for trucks indicates that the peak shoulder traffic did not change in a statistically significant manner for any of the crossings, except Goethals Bridge after the time of day pricing initiative.

Table 16. P-Values for truck peak shoulder traffic increase after March 2001, starting date of time of day pricing initiative at PANYNJ

Facility	Weekday				Weekend	
	5 – 6 AM	9 – 10 AM	3 – 4 PM	7 – 8 PM	11 AM – 12 PM	8 – 9 PM
Bayonne Bridge	0.0354 (S)	0.0503 (NS)	0.3697 (NS)	0.0165 (S)	0.4281 (NS)	0.0569 (NS)
Goethals Bridge	0.1746 (NS)	0.0065 (S)	0.0130 (S)	0.0026 (S)	0.0215 (S)	0.0714 (NS)
GWB Lower Level	0.0494 (S)	0.3261 (NS)	0.3969 (NS)	0.0606 (NS)	0.0661 (NS)	0.2046 (NS)
GWB Upper Level	0.0011 (S)	0.0829 (NS)	0.3510 (NS)	0.0429 (S)	0.538 (NS)	0.2408 (NS)
Outerbridge Crossing	0.3368 (NS)	0.1821 (NS)	0.0164 (S)	0.0057 (S)	0.1853 (NS)	0.0679 (NS)
Holland Tunnel	0.0074 (S)	0.1662 (NS)	0.2423 (NS)	0.0006 (S)	0.3318 (NS)	0.4247 (NS)
Lincoln Tunnel	0.0018 (S)	0.0010 (S)	0.0294 (S)	0.1871 (NS)	0.1414 (NS)	0.3086 (NS)

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway

These findings obtained from before and after statistical tests, indicate that the time of day pricing initiative in March 25, 2001 resulted in an increase on the percent share of peak shoulder traffic for both cars (Table 15) and trucks (Table 16) during weekdays for most of the crossings. Specifically, for most of the crossings the percent share of pre-peak period car traffic increased after the implementation of the NY/NJ Port Authority time of day pricing program. Moreover, the truck traffic percent share experienced statistically significant changes during AM pre-peak and PM post-peak periods during weekdays; although, it is observed that during weekends, time of day pricing did not have a statistically significant impact on the peak shoulder car/truck traffic percent shares for almost all of the crossings.

Statistical Testing of the Changes in the Peak Traffic after PANYNJ Time of Day Pricing Initiative

This section analyzes the changes in peak period percent share at each crossing by examining the traffic data by vehicle type vehicle type (cars, and trucks), and each day type (weekdays, weekends) separately. In order to determine whether or not the change in percent share of peak period traffic, is statistically significant, one-tailed paired two-sample t-tests are conducted at 95 percent confidence level. As before, the alternate hypothesis claims that the percent share of peak period after the time of day pricing initiative is smaller than the percent share of the peak traffic before the time of day pricing. Mathematically: [15]

$$\begin{aligned} H_0 &: (\mu_{i.})_{before} - (\mu_{i.})_{after} = 0 \\ H_1 &: (\mu_{i.})_{after} - (\mu_{i.})_{before} < 0 \end{aligned} \tag{4}$$

where;

$(\mu_{i.})$= mean percent share of period i for each vehicle type at each crossing,

i: 1=AM pre-peak, 2=AM post-peak, 3=PM pre-peak shoulder, 4=PM post-peak shoulder

before: Time period from April 2000 to August 2000

after: Time period from April 2001 to August 2001

For weekday analysis, peak hours during both morning and afternoon are analyzed separately for each vehicle type at each crossing. For the weekdays peak hour tolls are effective from 6:00 AM to 9:00 A.M in the morning and from 4:00 PM to 7:00 PM in the evening. Therefore for weekday study two separate tests (morning and afternoon) both of which include three hours of peak are conducted for each crossing and vehicle type. On the other hand, since weekend peak hour tolls are effective from 12:00 PM to 8:00 PM the weekend analyses include eight hours of peak traffic for each crossing and vehicle type.

The analysis results for weekdays and weekends are shown in Table 17, which provides p values for the t test conducted to compare the peak period percent share of car traffic before and after the time of day pricing initiative. For each crossing and time period the direction of change in the percent share after the time of day pricing initiative is also provided; such that if the peak period percent share reduced after the program initiative it is denoted as “decrease”, similarly if the peak period percent share increased after the program initiative it is denoted as “increase”. In the first part of the analyses, the facilities that experienced reductions on their peak period percent share of car traffic after the time of day pricing initiative are investigated followed with the analyses of facilities that experienced increased peak period percent share of car traffic after the time of day pricing initiative.

As it is observed from Table 17, on weekday peak periods the percent share of car traffic decreased for all crossings except Bayonne Bridge (PM peak), Holland Tunnel (AM peak, and PM peak) and Lincoln Tunnel (AM peak, and PM peak). Among the crossings for which the percent share of peak period car traffic reduced, only the reductions in GWB lower level and GWB upper level are statistically significant. For all other crossings the decrease in percent share is statistically insignificant on weekdays. These results indicate that for some crossings the peak period percent share of car traffic increased after the time of day pricing initiative, and for the crossings where a reduction is observed, the decrease in peak period percent share of car traffic is not statistically significant for most of the crossings and time periods on weekdays.

On weekends, as shown in Table 17, the peak period percent share of car traffic reduced for all crossings except Bayonne Bridge, Holland Tunnel and Lincoln Tunnel. Moreover, among the crossings for which a reduction in percent share of peak period car traffic is observed, the decrease at GWB lower level and GWB upper level is statistically significant.

These results indicate that the travel patterns during peak period show the same trend for weekdays and weekends. Although, the percent share of peak period car traffic reduced at all crossings except Bayonne Bridge, Holland Tunnel and Lincoln Tunnel both on weekdays and weekends, this reduction is statistically significant for all crossings except GWB lower level and GWB upper level. This indicates that even if time of day pricing had an impact on reducing the peak period traffic demand, this reduction is not statistically significant for most of the crossings.

Table 17. P-Values for car peak traffic increase after March 2001, starting date of time of day pricing initiative at PANYNJ

Facility	Weekday 6 – 9 AM P-value	Weekday 6 – 9 AM direction of change	Weekday 7 – 8 PM P-value	Weekday 7 – 8 PM Direction of change	Weekend 12 PM – 8 PM P-value	Weekend 12 PM – 8 PM Direction of change
Bayonne Bridge	0.00072 (S)	decrease	0.0072 (S)	increase	0.0065 (S)	increase
Goethals Bridge	0.0998 (NS)	decrease	0.2323 (NS)	decrease	0.0767 (NS)	decrease
GWB Lower Level	0.4930 (NS)	decrease	0.0444 (S)	decrease	0.0223 (S)	decrease
GWB PIP	0.0645 (NS)	decrease	0.4274 (NS)	decrease	0.2279 (NS)	decrease
GWB Upper Level	0.1328 (NS)	decrease	0.0029 (S)	decrease	0.0322 (S)	decrease
Outerbridge Crossing	0.3814 (NS)	decrease	0.0649 (NS)	decrease	0.1619 (NS)	decrease
Holland Tunnel	0.0879 (NS)	increase	0.0160 (S)	increase	0.0696 (NS)	increase
Lincoln Tunnel	0.4700 (NS)	Increase	0.3153 (NS)	increase	0.3458 (NS)	increase

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway

After investigating the travel patterns at the crossings for which the peak period percent share declined the analyses focus on the crossings for which there is an increase in peak period percent share after the time of day pricing initiative. As it is observed from Table 17, the peak period percent share of car traffic increased for Bayonne Bridge (PM peak, weekend), Holland Tunnel (AM peak, PM peak, weekend), and Lincoln Tunnel (AM peak, PM peak, weekend). Among these crossings only the change in Bayonne Bridge (PM peak, weekend) and Holland Tunnel (PM peak) are statistically significant. At first glance, these results are counterintuitive based on the main incentive of time of day pricing which aims to decrease the peak period traffic. In order to incorporate these results with the time of day pricing the increase in the peak shoulder periods for these specific crossings should be analyzed, as well. If the increase in peak shoulder percent share of car traffic at these crossings are higher compared to the increase in the peak period percent share of car traffic, it can be claimed that, the percent share of these specific crossings are increasing irrespective of the time of day pricing initiative. However the peak shoulder percent share of traffic is increasing at a higher rate compared to peak period percent share of traffic, indicating that time of day pricing is effective in spreading the traffic demand to peak shoulders.

Therefore, in Table 18 the comparison of the increase in peak and peak shoulder period percent share of car traffic on weekdays is provided. The peak shoulder percent share of traffic is calculated as the sum of percent share of traffic at pre-peak hours and post-peak hours, since the users shifting from peak period can either prefer pre-peak hours or post-peak hours. The analysis results indicate that for all crossings the increase in peak shoulder percent share of car traffic is much higher compared to the increase in the peak period percent share of car traffic. This result supports the hypothesis that the peak shoulder percent share of traffic is increasing at a higher rate compared to peak period percent share of traffic, and the time of day pricing is effective in spreading the traffic demand to peak shoulders.

Table 18. Comparison of weekday peak and peak shoulder car traffic after the time of day pricing initiative at PANYNJ

	% Demand During Morning						% Demand During Afternoon					
	peak %		peak shoulder %		% Change		Peak %		peak shoulder %		% Change	
	Bef.	Aft.	Bef.	Aft.	Peak	peak sh.	Bef.	Aft.	Bef.	Aft.	Peak	peak sh.
Bayonne	-	-	-	-	-	-	32.79	33.97	7.36	7.73	3.60	5.03
Holland	16.67	16.78	8.73	9.30	0.66	6.53	15.89	16.38	10.11	10.56	3.08	4.45
Lincoln	23.53	23.61	9.85	10.55	0.34	7.11	11.86	11.90	9.85	10.55	0.34	7.11

Similarly in Table 19, the comparison of the increase in peak and peak shoulder period percent share of car traffic on weekends is provided. Like weekdays, peak shoulder percent share of traffic on weekends is calculated as the sum of percent share of traffic at pre-peak hours and post-peak hours. The analysis results indicate that similar to weekdays on weekends, for all crossings the increase in peak shoulder percent share of car traffic is higher compared to the increase in the peak period percent share of car traffic. However, the increase in weekend percent share of peak and peak shoulder car traffic is much lower compared to the weekday percent share of traffic. This result supports the hypothesis that the peak shoulder percent share of traffic is increasing at a higher rate compared to peak period percent share of traffic, and the time of day pricing is effective in spreading the traffic demand to peak shoulders. However the increase in both peak and peak shoulder percent share of traffic is statistically insignificant on weekends.

Table 19. The Comparison of weekend peak and peak shoulder car traffic after the time of day pricing initiative at PANYNJ

	% Demand					
	Peak %		Peak shoulder %		% Change	
	Bef.	Aft.	Bef.	Aft.	Peak	peak sh.
Bayonne	49.48	50.04	10.47757	10.65681	1.13177041	1.710626411
Holland	42.83	43.2	10.71127	10.92406	0.86388046	1.986653011
Lincoln	46.81	46.95	11.1133	11.20245	0.29908139	0.802172689

After analyzing passenger car travel patterns during peak periods, the truck travel patterns are investigated. The results are shown in Table 20. Unlike car traffic, the truck traffic decreased for all time periods at all crossings after the time of day pricing initiative, which is expected under time of day pricing. In addition, the decrease in weekend traffic is statistically insignificant. Moreover, on weekdays for all crossings the decrease in morning peak period is statistically significant. Given the fact that trucks started to pay the lowest toll values between 00:00 AM and 6:00 AM, this decrease in morning peak period is expected. This result is supported more with the statistical test results for pre-peak morning period in Table 16, showing that the pre-peak percent share of truck traffic increased during 5:00 AM – 6:00 AM after the time of day pricing initiative. The PANYNJ suggests that the declining truck traffic observed may have also been a precursor to the economic recession that began in the New York-New Jersey region in 2001.

Table 20. P-Values for truck peak traffic change after March 25, 2001

Facility	Weekday				Weekend	
	6 – 9 AM		4 – 7 PM		12 PM – 8 P.M	
	P-value	direction of change	P-value	direction of change	P-value	direction of change
Bayonne Bridge	0.0204 (S)	decrease	0.0477 (S)	decrease	0.292 (NS)	decrease
Goethals Bridge	0.0492 (S)	decrease	0.0015 (S)	decrease	0.1822 (NS)	decrease
GWB Lower Level	0.0444 (S)	decrease	0.3384 (NS)	decrease	0.1273 (S)	decrease
GWB Upper Level	0.0480 (S)	decrease	0.3494 (NS)	decrease	0.0487 (S)	decrease
Outerbridge Crossing	0.0248 (S)	decrease	0.0076 (S)	decrease	0.1898 (NS)	decrease
Holland Tunnel	0.0020 (S)	decrease	0.0649 (NS)	decrease	0.0919 (NS)	decrease
Lincoln Tunnel	0.0347 (S)	decrease	0.1297 (NS)	decrease	0.0686 (NS)	Decrease

Conclusions

The traffic analyses discussed here have attempted to gain insight into the behavior of users as response to time of day pricing.

While investigating the travel patterns at PANYNJ facilities, the project team tried to differentiate seasonal traffic changes taking place at each (when no external factors like a new toll schedule imposed to the system), from changes in travel patterns due to the time of day pricing initiative. Second, the trend in E-ZPass use by time of day was investigated to understand whether the changes in travel patterns were due to the difference of toll discounts between cash and E-ZPass users, and more importantly, expedited crossing at the toll booths. Then, based on the findings obtained from facility-specific properties, a before and after analysis is performed for daily average traffic and hourly traffic for each of PANYNJ facility. The summary of the findings are presented below.

1. Seasonal factor analyses show that, before the time of day pricing, there is a seasonal variation in the traffic for Bayonne Bridge, Goethals Bridge and Lincoln Tunnel during only PM peak hours. For all other facilities, the seasonal variation is statistically insignificant at all time periods. On the other hand, after the time of day pricing there is statistically significant seasonal variation only for Goethals Bridge (PM peak and off-peak hours), and Outerbridge Crossing (AM peak and off-peak hours). These results indicate that each bridge and tunnel has its own specific seasonal variation trend depending on time of day. Therefore the traffic impact analysis is done for each crossing and time period separately, considering the seasonal variations.
2. The travel behavior based on E-ZPass usage indicates that there are two distinct time periods for which change in the E-ZPass usage on PANYNJ facilities is observed. These periods are September 1, 2000 (the New Jersey Turnpike time of day pricing initiative), and March 25, 2001 (PANYNJ time of day pricing initiative).
3. Before 9/11 both time of day pricing initiatives (NJ Turnpike and PANYNJ) caused a reduction in the percent share of cash users and an increase in the percent share of E-ZPass users. For both peak periods and peak shoulders, E-ZPass users share a higher percent of the total traffic than cash users. During peak shoulders for each crossing, cash user percent share ranges between 6 percent and 8 percent with a decreasing trend; whereas E-ZPass user percent share ranges between 10 percent and 15 percent with an increasing trend. A similar trend is observed in the E-ZPass share of traffic during peak periods as well. For every crossing analyzed in this study, E-ZPass user percent share ranges between 44 percent and 55 percent, the highest percent share, and cash user percent share ranges between 18 percent and 30 percent. Like peak shoulders, there is an increasing trend in E-ZPass user share, and a decreasing trend in cash user share.
4. The before and after analysis conducted to investigate the impacts of the each of two distinct time periods on the traffic of each crossing show that both time of day pricing implementations had an impact on the average daily share of E-ZPass

and cash user traffic. E-ZPass usage increased, and cash usage decreased while total flow at all crossings remained almost the same, before September 11, 2001.

5. For all the crossings, the time of day pricing initiative at PANYNJ facilities appears to have succeeded in spreading of demand to peak shoulders between time period April 2000 – August 2000 and time period April 2001 – August 2001 during weekdays. The reduction in peak period percent share of traffic is ranging between -0.06 percent to -6.78 percent. This observation is supported by the findings of Muriello et al. [16], which indicate that from 2000 to 2001, 6:00-7:00 AM traffic volume declined by 5.7 percent. A similar trend is observed in weekends as well, apart from the fact that, reduction in peak period percent shares are lower in weekends compared to weekday traffic. The reduction in peak period percent share of weekend traffic is ranging between -0.28 percent to -2.50 percent.
6. In order to test the significance of the changes in the amount of off-peak traffic as a result of time of day pricing and introduction of E-ZPass at the NJ Turnpike, several tests of hypothesis were performed. Based on the analysis conducted for the impact of the NJ Turnpike time of day pricing initiative and introduction of E-ZPass technology in September 2000, it is concluded that car traffic presents a similar behavior at all of the crossings, such that only the change in traffic flow during AM pre-peak period is statistically significant for all crossings except Outerbridge Crossing. For other time periods and day types, there is no statistically significant change in the share of car traffic. On the other hand, the change in truck traffic shows differences depending on crossing and weekday/weekend.
7. The findings obtained from the before and after statistical tests for the time of day pricing initiative of the PANYNJ crossings indicate that the time of day pricing instated in March 25, 2001 resulted in an increase on the percent share of peak shoulder traffic for both trucks and cars during weekdays. Specifically, for most of the crossings, the percent share of pre-peak period (AM and PM) car traffic increased after the time of day pricing. Moreover, truck traffic percent share

experienced statistically significant changes during AM pre-peak and PM post-peak periods during weekdays. However, it is observed that during weekends time of day pricing did not have a statistically significant impact on the peak shoulder car/truck traffic percent shares for almost all of the crossings.

8. Peak period percent share analysis after the time of day pricing initiative in March 25, 2001 for car traffic on weekday and weekends indicate that car traffic at peak periods shows a similar trend on weekdays and weekends. Among the crossings for which the percent share of peak period car traffic decreased, only the decrease in GWB lower level and GWB upper level is statistically significant. In addition, the peak percent share of car traffic increased at Bayonne Bridge, Holland Tunnel and Lincoln Tunnel. A closer look to the travel patterns in peak and peak shoulder periods for these crossings show that, the rate of increase of percent share of peak shoulder car traffic is higher compared to the rate of increase of percent share of peak period car traffic. These results support that the time of day pricing had an impact on spreading the peak period traffic to peak shoulder car traffic. This impact is mostly statistically insignificant on weekends.
9. The analysis results for peak period truck traffic show that, unlike car traffic, the truck traffic decreased for all peak time periods at all crossings after the time of day pricing initiative in March 25, 2001, which is expected under time of day pricing. In addition, the decrease in weekend peak traffic is statistically insignificant. Moreover, on weekdays for all crossings the decrease in morning peak period is statistically significant. Given the fact that trucks started to pay the lowest toll values between 00:00 AM and 6:00 AM, this decrease in morning peak period is expected. This result is supported more with the statistical test results for pre-peak morning period in Table 16, showing that the pre-peak percent share of truck traffic increased during 5:00 AM – 6:00 AM after the time of day pricing initiative.

CHAPTER III

IMPACTS ON TRANSIT RIDERSHIP

Introduction

As part of the traffic impact assessment, the project team analyzed transit ridership data for travel between New York City and New Jersey, before and after the implementation of Port Authority's time of day pricing initiative. The assessment of the impacts on transit ridership focuses on the period March-August 2001, though the transit ridership data corresponding to the period 1992 through 2004 are analyzed to provide a long term view of transit ridership trends.

The findings of the statistical analyses of aggregate transit ridership indicate no statistically significant change in transit ridership levels and the PANYNJ time of day pricing initiative. While the research team would have liked to have more detailed transit ridership data for this assessment, the aggregate level results suggest that transit ridership is very dependent on underlying economic factors, with no statistically significant relationship to the toll pricing changes.

The chapter begins with a review of the findings from similar studies to provide the general background to this chapter. Then, a brief description of the transit system in the study area is provided; followed by a brief discussion of the aggregate transit ridership data used in the analyses. This aggregate data is then analyzed to understand the relationship between the time of day pricing and transit ridership. In addition to the PANYNJ time of day pricing initiative, the impact of various other factors such as the natural growth of E-ZPass usage, economy of the region, and the impacts of 9/11 are also discussed.

It is important to emphasize the fact that the data used in the analysis are aggregate, monthly or yearly, and thus it cannot be used for the analysis of the time of day transit ridership changes as a response to the time of day pricing. However, descriptive and statistical analysis of the aggregate transit data described in detail this chapter enabled us to underline several key factors that appear to have impacted the transit demand including economic factors and events of 9/11 in addition to the time of the PANYNJ day pricing initiative. Thus, a summary of the detailed discussion of economic factors coupled with the impact of the events of 9/11 is given to shed light onto the observed transit ridership trends for the period after 2001. Finally, a summary of the conclusions with respect to those external factors that affected the transit ridership is presented.

Findings from Other Studies

The literature review suggests that the impacts of road pricing on transit ridership are rather limited. Research results in the United States seem to indicate that road pricing tend to impact mostly departure times and route choice with a modest impact on high occupancy vehicle (HOV) usage. The results in Europe and Asia similarly indicate shifts in travel time and routes, and, more importantly, shifts to HOVs and a small shift to transit. This is likely due to more widespread transit systems in Europe and Asia. (17)

San Diego's value pricing project (FasTrak Express Lanes) on Interstate 15, a three-year demonstration that allows single-occupant vehicles (SOVs) to use the existing high occupancy vehicle (HOV) lanes on I-15 for a fee, has experienced the greatest success in promoting bus usage, through new express bus service being supported with revenue raised from the ExpressPass/FasTrak program. The new route has provided expedited service for existing transit users, but has not attracted peak direction travelers from the I-15 main lanes. (17) In San Diego, improving bus service with revenues provided an alternative travel option to I-15 travelers, which makes it different from the New York City case (in which no new transit alternatives were created). Although using FasTrak revenue to improve transit service along the I-15 corridor was one of the San Diego demonstration project’s objectives, only a very small percentage of respondents to a telephone survey of 1500 commuters supported funding transit. One year later, the Fall of 1998, the survey was re-conducted and 5 percent of respondents indicated that FasTrak revenue should be used to fund the Inland Breeze express bus or other transit service in the I-15 corridor. (18)

No transit ridership effects have been noted for the Lee County (Florida) LeeWay variable pricing program or Houston Texas' QuickRide program. Similarly, the conclusion of the SR-91 study is that the Express Lanes have had no perceptible effect on either commuter bus or commuter rail traffic in the corridor. [(19)]

As far as the European experience is concerned, following the implementation of the Trondheim (Norway) toll ring in 1991, there was a 10 percent decrease in traffic passing the ring both in the peak and non-peak charging hours. The traffic increase in the evenings and weekends (with no fees) was slightly above eight percent. Travel surveys indicated a slight increase in the use of public transport and cycling. (The toll ring effects are difficult to single out because of parallel improvements in public transport and in the bicycle road network. [(20)])

Data Analysis

This section provides brief descriptions of the transit system and the data used in the analyses. Then a descriptive an statistical analysis of the data is performed to study the transit ridership trends over time, possible impacts produced by the time of day pricing initiative, economy and E-ZPass on transit ridership. This chapter is concluded with a qualitative discussion of the most important factors that have shown to affect transit demand based by the past studies.

Description of the Transit System: Infrastructure and Ridership

The transit systems that can be used as an alternative to the PANYNJ facilities are New Jersey Transit's commuter rail and Interstate bus services linking New Jersey and New York City and the Port Authority's Trans Hudson (PATH) system. There are numerous commuter bus services provided by private bus carriers, as well as several ferry routes that also service as a potential substitute for private automobile use. New Jersey Transit serves almost all major population centers in New Jersey (Figure 12). The New Jersey Transit lines are heavily used by workers living in New Jersey and commuting to New York City. The last station of New Jersey Transit lines serving to New York City is New

York Penn Station, which is at 32^{nd} street, between 7^{th} and 8^{th} avenues in Manhattan. Although PATH serves relatively smaller area compared to New Jersey Transit, many riders use PATH because of its direct access to downtown Manhattan. That is why, riders going to downtown Manhattan may even prefer using PATH lines, changing from New Jersey Transit to PATH at Newark. The preference of New York bound transit riders for PATH is also clearly observed after 9/11. Due to the lack of direct access to downtown Manhattan, PATH Newark ridership faced the highest percentage of decrease after the destruction of WTC station and closing down of the Exchange Place station serving to downtown (Figure 13). Figure 14 and Figure 15 illustrate the physical changes that occurred in PATH before and after 9/11. After 9 /11, PATH riders, had to switch either to New Jersey Transit and access downtown via local subway, or use ferry. As a result, ferry lines, serving from New Jersey to New York between various points experienced a sharp ridership increase after September, 2001. Ferry lines have relatively much less demand compared to New Jersey Transit and PATH services but it is still important to include the ferry line ridership in this analysis since it helps to partially explain the shift of PATH riders after the events of 9/11 resulting in the destruction or closing down of some major PATH stations. These ridership trends will be discussed in detail in this report. Finally, the ferry routes of New York Waterway, which is an important carrier between New York and New Jersey are also shown in Figure 16.

The analyses are based on three distinct data sets. The first one was provided by New Jersey Transit, and consists of monthly, and route based bus and railway ridership data from 1986 to 2004. The second data set contains ferry ridership data consisting of monthly route based ridership data from 1999 to 2004. The third data set is comprised of PATH ridership data, which is more aggregate compared to the other two sets. PATH data is available yearly, without any route specific information for a time period between 1987 and 2003, and weekday station based averages for years 2000 through 2003. The second and third data sets were provided by the PANYNJ. The following subsections present a more detailed description of these data sets.

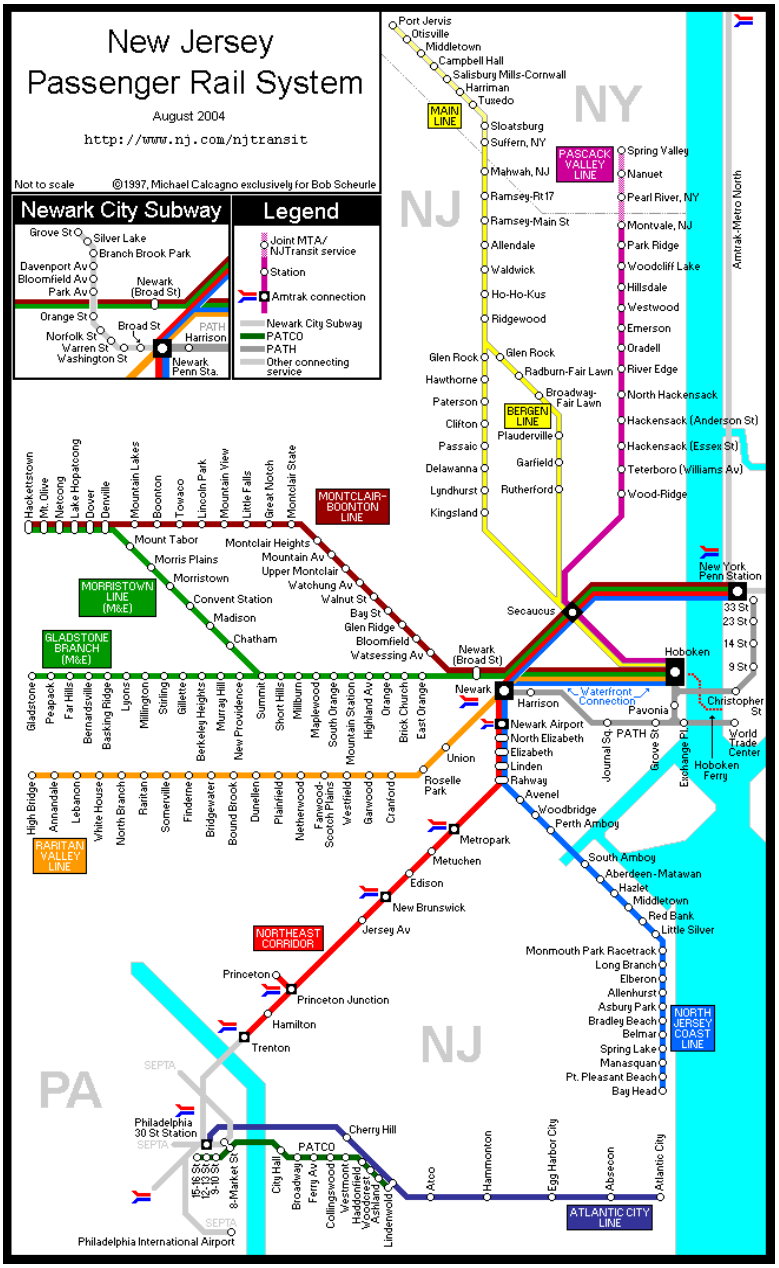

Figure 12. New Jersey Transit's passenger rail system (Source: New Jersey Transit[21])

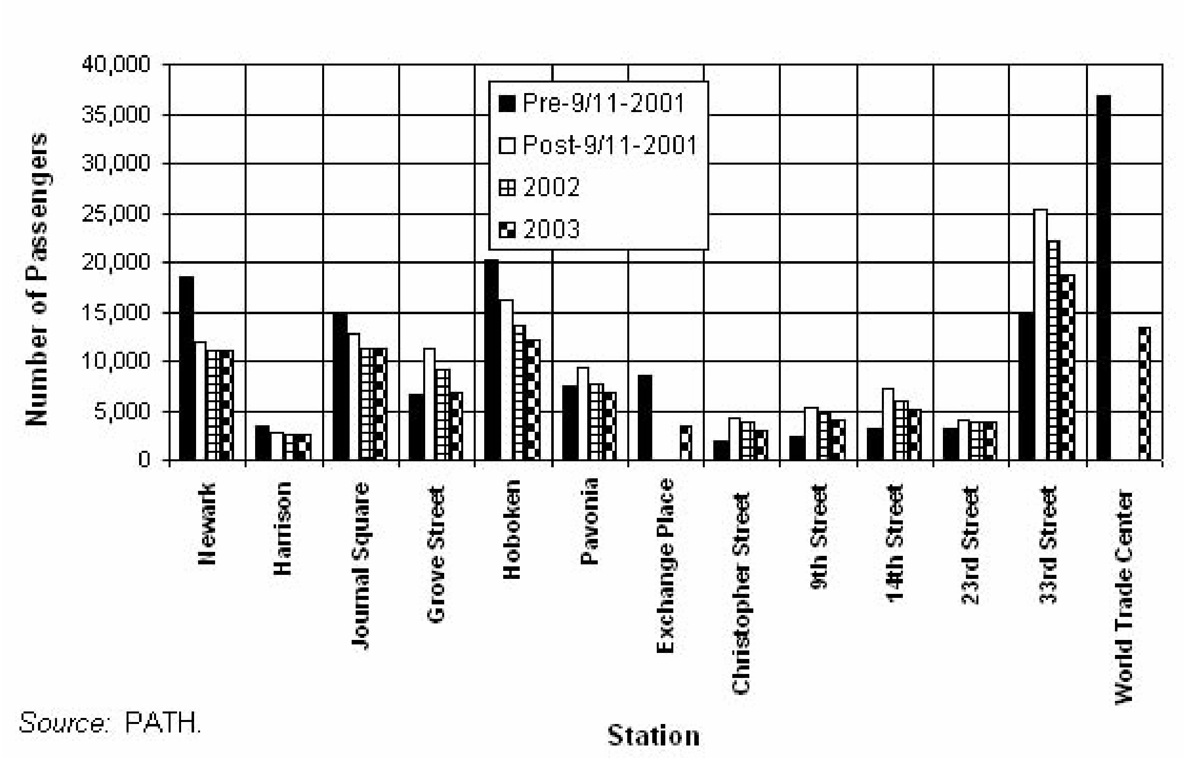

Figure 13. Path ridership numbers before and after 9/11 (Source: PATH, obtained from Travel Trends Newsletter [(22)])

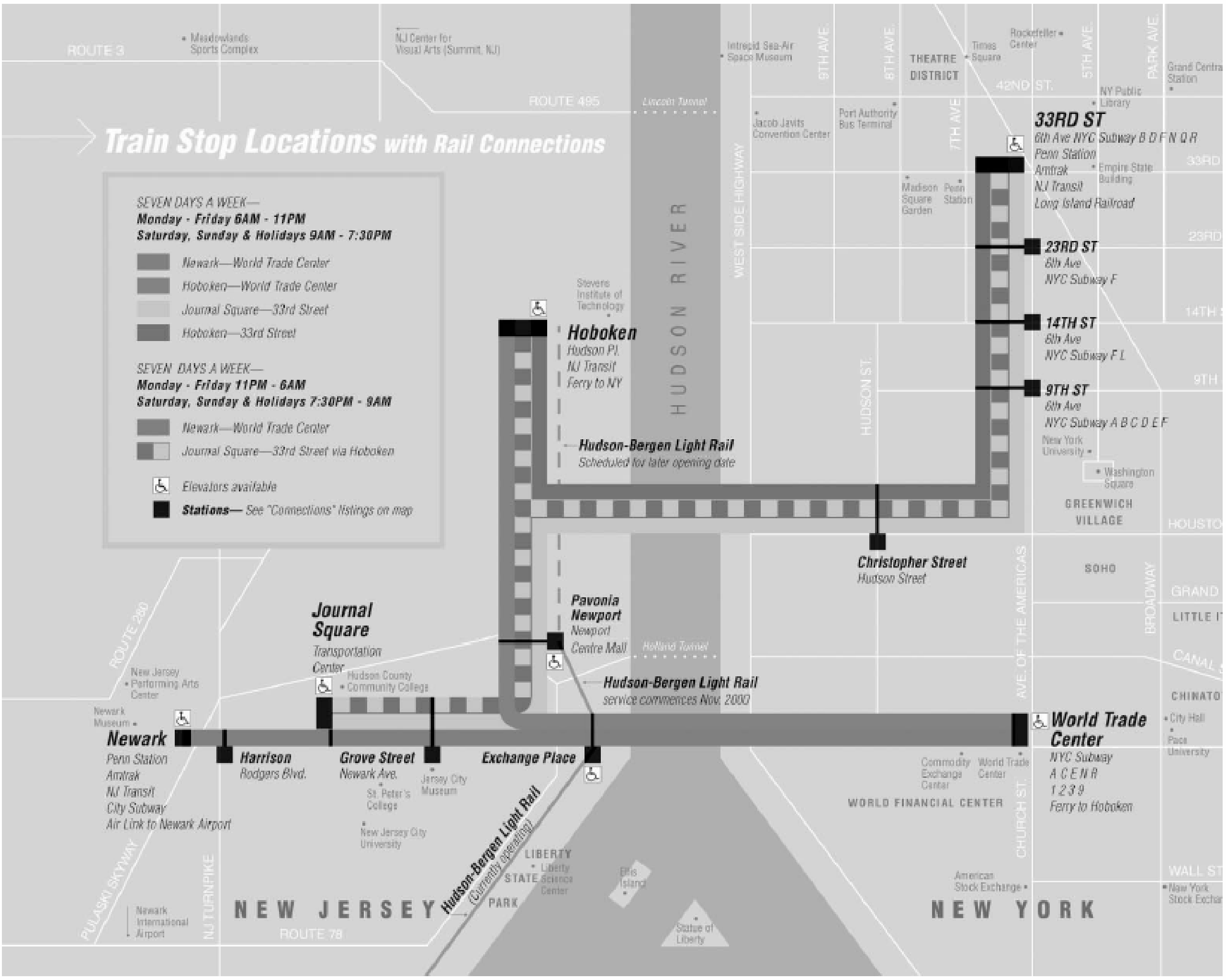

Figure 14. PATH map before September 11, 2001 (Source: PATH, obtained from Travel Trends Newsletter [22])

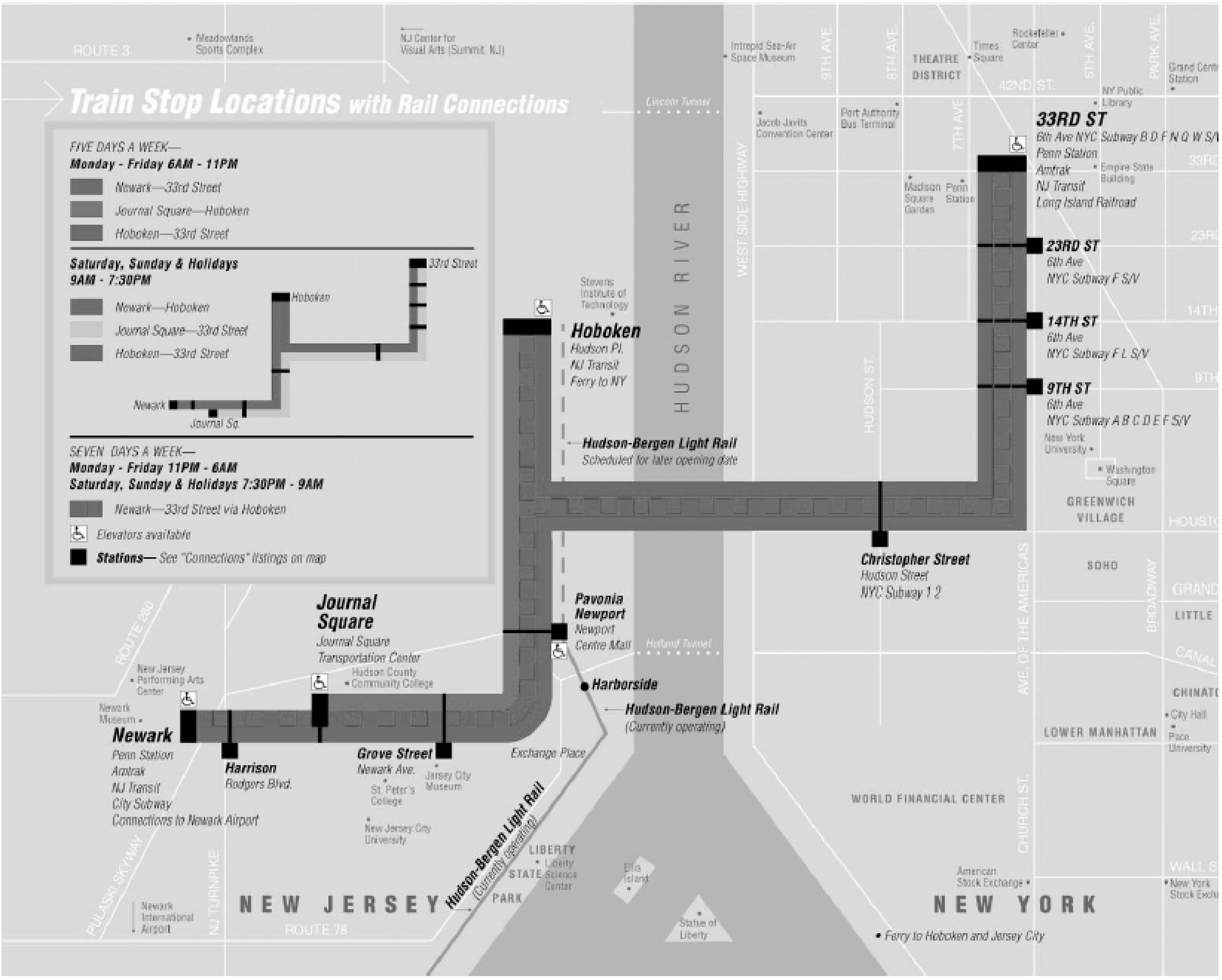

Figure 15. PATH map after September 11, 2001 (Source: PATH, obtained from Travel Trends Newsletter [22])

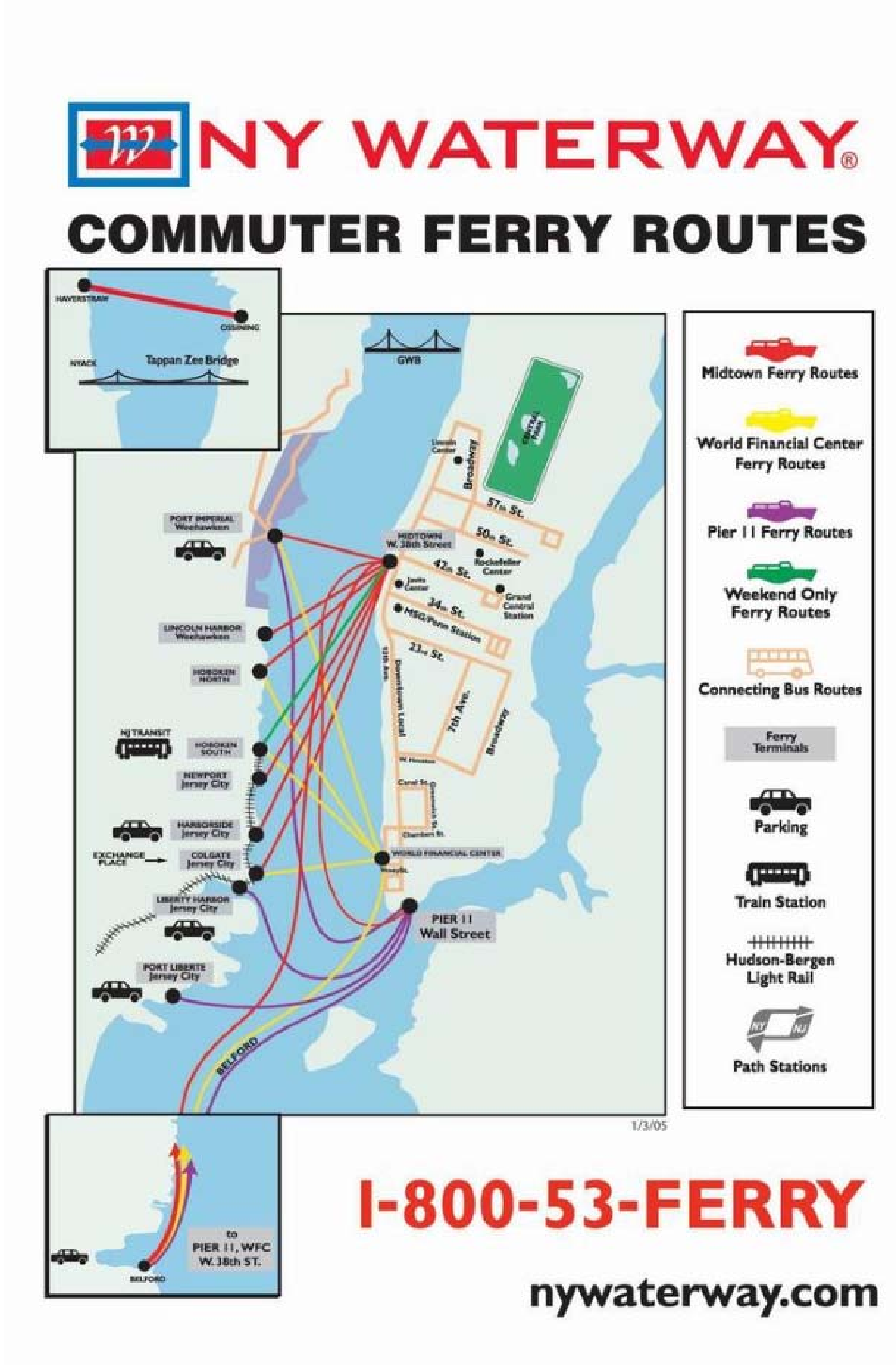

Figure 16. New York Waterway ferry routes (Source: New York Waterway [23])

New Jersey Transit Ridership Data

As indicated before, transit ridership data were obtained from New Jersey Transit [1]. This database includes monthly and quarterly ridership counts from 1986 to 2004 for services including bus and commuter rail services from New Jersey to New York.

Table 21. A Sample from the New Jersey Transit ridership database

(Interstate ridership in thousands)

ROUTE	JUL 02	AUG 02	SEP 02	OCT 02	NOV 02
MORRIS & ESSEX					
Morristown	919.7	882.1	910.3	946.3	912.8
Gladstone	133.7	126.7	132.4	152.8	132.6
MAIN LINE BERGEN COUNTY	378.2	364.8	376.8	392.2	376.5
MONTCLAIR-BOONTON					
Boonton	137.6	132.6	134.6	140.1	133.0
Montclair	36.0	33.8	37.7	64.3	65.2
PASCACK	100.0	96.8	99.5	104.1	100.3
NORTH EAST CORRIDOR	2204.8	2202.2	2183.6	2248.2	2224.1
COAST LINE	731.6	715.2	669.0	674.4	661.7
RARITAN VALLEY	388.2	378.9	382.5	394.6	384.5
ATLANTIC CITY RAIL LINE	94.1	94.6	85.3	82.3	80.6
TOTAL NEW JERSEY TRANSIT RAIL	**5124**	**5028**	**5012**	**5199**	**5071**
NORTHERN DIVISION	9778.9	9814.2	9764.3	10577.8	9349.6
SOUTHERN DIVISION	2054.1	2089.5	2020.0	2093.5	1881.5
CONTRACT	570.8	615.3	605.5	660.3	649.9
TOTAL NEW JERSEY TRANSIT BUS	**12404**	**12519**	**12390**	**13332**	**11881**
NEWARK CITY SUBWAY	373.7	392.3	379.6	408.9	362.5
HUDSON BERGEN LIGHT RAIL	288.8	287.6	286.1	386.3	354.6
TOTAL NEW JERSEY TRANSIT LIGHT RAIL	**663**	**680**	**666**	**795**	**717**
NEW YORK WATERWAY	1415	1420	1343	1474	1280
SEASTREAK	81	85	74	63	55
NEW YORK FAST FERRY	40	34	29	29	22
LIBERTY PARK WATER TAXI	22	22	18	20	17
NEW YORK WATER TAXI	0	0	0	6	4
TOTAL FERRY	**1558**	**1561**	**1464**	**1592**	**1378**

[1] Data obtained from Mr. Jerry Lutin from NJ Transit.

Table 21 illustrates the raw sample of the database (for rail services only). The original, which was route based, was processed for New York City bound routes, excluding the lines that do not serve New York City.

Ferry Ridership Data

Ferry ridership data were obtained from PANYNJ. This database includes monthly ridership counts from 1999 to 2004 for services including the ferry operation services from New Jersey to New York as well as inter-state ferry routes for New York. The data are available in route-based format including information for weekdays and weekends separately. For the analyses, the routes not serving New Jersey to New York City were not considered in order to solely focus on the specific trips between New York City and New Jersey.

PATH Ridership data

The project team obtained PATH (aggregate) ridership data, in two different formats [2]:

1) Annual Total Passenger Traffic for an 11 even year time period between 1992 and 2003, as shown in Table 22.

2) Weekday Annual Average of Passenger Traffic between 2000 and 2002. These data are shown in Table 23.

Unfortunately, monthly PATH data were not available, thus PATH had to be excluded from monthly tables, figures and analysis throughout the report. It is important to highlight two main issues related to the use of these data sources. The first issue arises because the PATH data contain trips within New Jersey, as well as New York City bound trips. Unfortunately, since the data is not route based, it is not possible to accurately separate New York City bound trips from New Jersey to New Jersey trips Moreover, the main PATH stations in New Jersey also serve as connecting hubs

[2] PATH Data was obtained from Vorhees Transportation Center at Rutgers University

between ferry and bus services for riders that are traveling to New York City. [24,25] Thus, these trips constitute a portion of trips from New Jersey to New York City (and vice versa for the opposite direction). It is thus reasonable to assume that New York City bound trips to be the major part of the PATH ridership. In summary, since there are no data that could be used to extract New Jersey to New Jersey trips from the PATH data set, the project team decided to use the raw data without attempting to make assumptions about the percentages of these two types of trips namely, New Jersey to New York City and New Jersey to New Jersey. However, due to the reasons described above and the close interaction between PATH and other transit modes serving New York City, using total PATH ridership data can be considered to be the most straightforward approach that does not employ any assumptions that cannot be easily supported in the absence of reliable origin-destination data for PATH trips.

Descriptive Analysis

Two different types of analyses were conducted to assess the impacts of the time of day pricing initiative on transit ridership:

1. **Analysis of Annual Transit Ridership**: The purpose of this approach is to compare annual ridership data and identify the trends in transit demand on an annual basis.
2. **Analysis of Monthly Transit Ridership**: Raw monthly data is considered in order to take a closer look at the changes in transit ridership on a monthly basis for the months between 2000 and 2002.

<u>Analysis of Annual Ridership</u>

With the robust growth of New City employment in the 1990's, the demand for trans-Hudson traffic continued to increase steadily. This increasing demand is also true for transit ridership as shown in Figure 17. By the end of 2000, transit demand to and from New York City peaked. According to a recent report published by Vorhees Transportation Institute at Rutgers University "in 2001 NJ Transit ridership reached an all-time high for New York bound commuter rail service- an average of 90000 daily riders (more specifically for the financial year defined between July 1, 2000 and June 30, 2001), including the transfers from Newark and Hoboken to NYC.[22] The Same study states that in 2000, “total annual ridership on the PATH system peaked at 74 million trips. This was its highest level since PATH took over the operations of the Hudson and Manhattan Railroad in 1962. In 2001, ridership was expected to surpass the level reached in 2000.” In March 2001, following the introduction of the PANYNJ’s time of day pricing initiative, the increasing trend in transit demand continued. Yearly total transit ridership numbers presented in Table 22 show a 5.5 percent increase in 2000 and subsequently this value drops to approximately 1 percent, –6.6 percent, -2.88 percent in 2001, 2002, and 2003 respectively. In fact, in 2001 all transit modes serving New York City, except PATH, continued to show a positive increase, which can be interpreted as a result of the continuation of the year 2000 growth trend during the first eight months of 2001, until the events of 9/11. From the data, it is quite clear that transit ridership peaked in July 2001 (four months after the time of day pricing initiative), though its rate of growth was much lower than the ones in previous years.

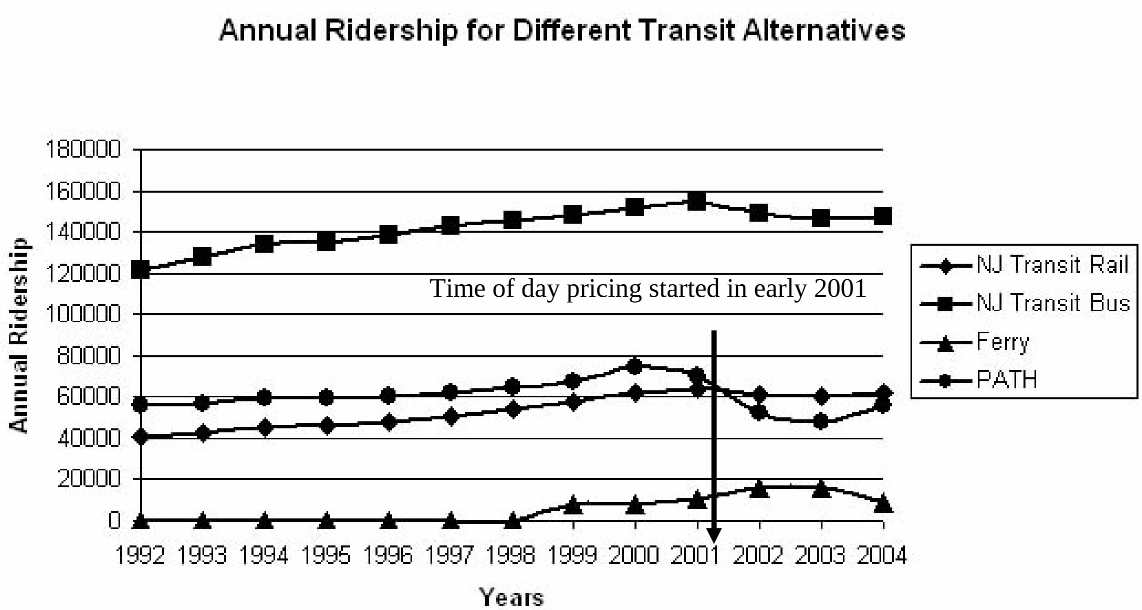

Figure 17. Total annual ridership for different transit alternatives

Table 22. Transit annual ridership (Thousands) [3]

ROUTE	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
New Jersey TRANSIT RAIL*	41160	42732	45096	45840	48036	50928	54060	57528	62124	63876	61212	60396	62256
Rail Year-to-year Change	-	3.80%	5.50%	1.60%	4.80%	6.00%	6.20%	6.40%	8.00%	2.80%	-4.20%	-1.30%	3.10%
New Jersey TRANSIT BUS	121188	128076	134160	134928	138492	142428	145620	147744	151464	153972	149124	146364	147228
Bus Year-to-year Change	-	5.70%	4.80%	0.60%	2.60%	2.80%	2.20%	1.50%	2.50%	1.70%	-3.10%	-1.90%	0.60%
New York HARBOR FERRY	0	0	0	0	0	0	0	8016	8388	10776	16380	15972	9264
FerryYear-to-year Change	-	-	-	-	-	-	-	-	5.10%	27.60%	54.10%	-2.49%	-42.00%
PATH [1]	55564	56347	59236	59317	60651	62211	64992	67332	74087	69792	51922	47885	56025 [2]
PATH Year-to-year Change		1.41%	5.13%	0.14%	2.25%	2.57%	4.47%	3.60%	10.03%	-5.80%	-25.60%	-7.78%	17%
OVERALL TRANSIT RIDERSHIP	217912	227155	238492	240085	247179	255567	264672	280620	296063	298416	278638	270617	274773
Overall Year-to-year Change	-	4.24%	4.99%	0.67%	2.95%	3.39%	3.56%	6.03%	5.50%	0.79%	-6.63%	-2.88%	1.54%

1 Includes in-New Jersey Traffic
2 Estimated Value

Table 22 and Figure 17 show the annual ridership data, which indicate that New Jersey Transit ridership began to slow down in 2001. Ferry ridership values continued to increase after 2001. Opposite to the increase in ferry ridership, PATH demand decreases after 2001. However ferry ridership experiences a sudden decrease in 2004. This can be interpreted by the full recovery of the PATH facilities by the end of 2003. This full recovery to pre-9/11 conditions may have caused the shift of PATH passengers from ferry back to PATH. The shift of PATH riders to New Jersey Transit and ferry in 2001 can be observed in Figure 17. But 2004 PATH ridership data obtained from a New Jersey Transit report were only available until June 2004. [(27)] The ridership data for the rest of the year were obtained using a simple estimation approach based on the monthly percentage trends. On the other hand, information published by PATH in its

[3] Since all the analysis in the report is performed for the calendar year instead of fiscal year, an assumption made to get the 2004 calendar year ridership. Same increase between the fiscal years were applied for calendar year ridership increase to estimate the 2004 PATH ridership. This assumption is reasonable and on the safe side assuming that the positive trend in PATH ridership will continue for the rest of the months in 2004.

news releases state that the PATH ridership has increased in year 2004 and that even exceeded the projected values after the re-opening of WTC and Exchange Place stations and PATH recovered to its pre-9/11, ridership.[26] Moreover, the New Jersey Transit Quarterly Report also used to obtain the PATH ridership data in 2004, states that PATH ridership increased 17 percent between fiscal years 2003 and 2004. [27] Thus, it is clear that the changes in transit tend to be more related to economic and other external factors such as the events of 9/11 and loss of some critical infrastructure than to the time of day pricing.

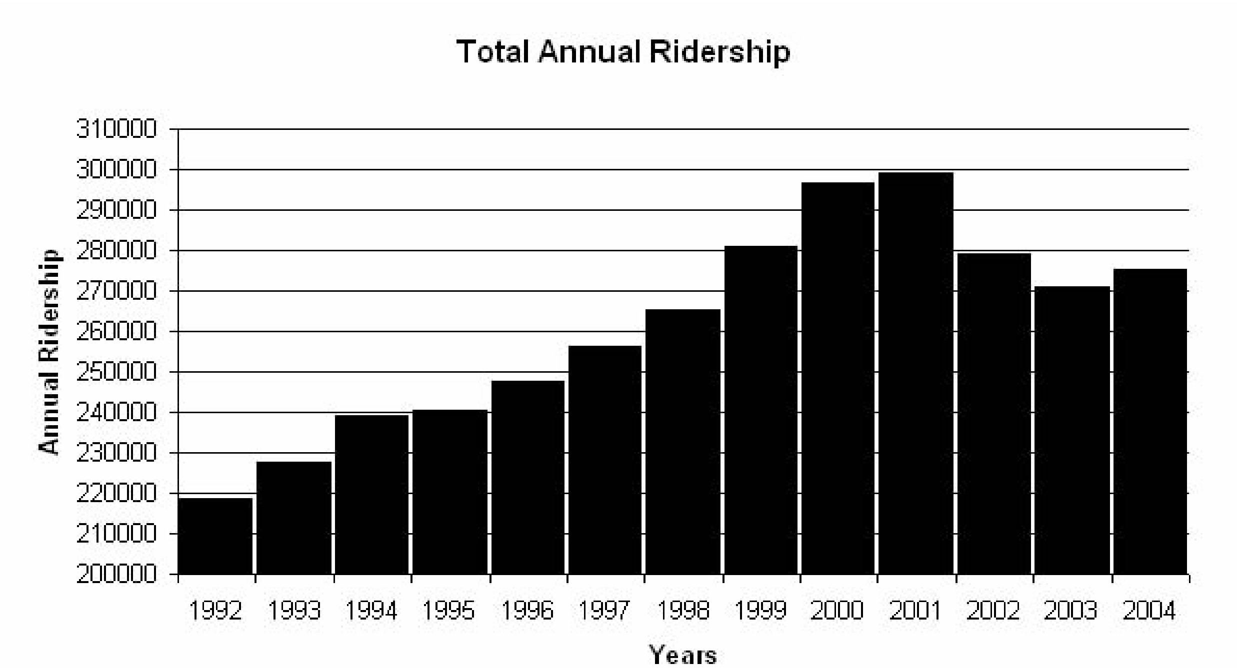

Figure 18 Total annual transit ridership

Analysis of PATH Ridership Data

As clearly illustrated in Figure 17, the demand for New Jersey Transit continued to increase until 2001. The NJT and PATH statistics that show record high values before September 2001, clearly demonstrate that ridership decrease had not been observed at least until July 2001.The 2001 economic recession, which was a continuation of the economic slowdown that started in the summer of 2000, also marks the start of the downward trend in NJ Transit ridership. The same decreasing trend after 2001 is also observed in the PATH demand as shown in Table 22 and Figure 17. In fact as shown in

Table 22, PATH demand is the only transit mode that showed a significant decrease in 2001. However, a closer look at the PATH data presented in “Travel trends” published by Vorhees Transportation Institute at Rutgers University states that “by September 2001, a total of 52 million PATH trips had been recorded— well ahead of the level reached at the equivalent time in 2000.” [24] Thus, the time of day pricing which was introduced in March 2001 did not seem to have a noticeable negative impact on transit ridership. More over, as shown in Table 23, the weekday averages in the pre 9/11 period are higher than the corresponding 2000 values. As expected, the service restrictions to New York City and the reduction in economic activities (destruction of facilities and relocation of businesses) following the events of 9/11 reduced the total PATH ridership. [28]

Table 23. PATH Weekday Annual Average of Passenger Traffic (Source: PATH)

	2000	2001	Jan-August 2001	September-December 2001	2002
WTC Station	65,777	47,230	66,932	0	0
Christopher Street	3,635	4,878	3,632	7,866	6,815
9th Street	4,253	5,768	4,132	9,691	8,533
14th Street	5,422	7,859	5,670	13,107	10,682
23rd Street	5,300	6,141	5,654	7,310	6,947
33rd Street	26,791	32,766	27,205	46,098	40,169
Exchange Place	14,661	10,954	15,523	0	0
Grove Street	12,417	14,591	12,093	20,579	16,466
Journal Square	26,877	25,775	26,783	23,360	20,579
Pavonia	12,841	14,613	13,681	16,848	14,118
Hoboken	36,791	34,431	36,593	29,247	24,782
Harrison	6,148	5,873	6,159	5,187	4,706
Newark	34,054	30,096	33,550	21,816	20,296
Total	254,967		257,607	201,109	174,093

The timing of the first decline in New Jersey Transit ridership since 1992 coincides with the beginning of the economic slowdown in the US which caused the subsequent recession, and was further compounded by 9/11. The superposition of these major events on top of the time of day pricing initiative leads to a situation in which it is impossible to differentiate the impacts of the time of day pricing initiative from those produced by the economic slowdown and/or 9/11.

Analysis of Monthly Transit Ridership

Monthly changes in transit ridership are as shown Figure 19 and Figure 20. Figure 20 show that in August 2001 overall transit ridership was increasing including the time period after the introduction of the time of day pricing on March 2001. As discussed in the annual data section above, New Jersey Transit monthly statistics show record high values before July 2001. This monthly trend clearly demonstrates that ridership decrease had not been observed at least until July 2001, four months after the initiation of the time of day pricing program.

Figure 20 shows monthly transit ridership trends for several consecutive years and depicts the existence of a seasonal trend in terms of transit demand. The demand always reaches a minimum point in winter, then by March ridership shows an increase and then stays at a relatively lower level until June but then starts an increasing trend in the Summer until Fall. Ridership reaches its high peak in fall, until September 2001 six months after the beginning of the time of day pricing. As shown in Figure 20, the monthly ridership data continue to show the same seasonal trend observed in previous years.

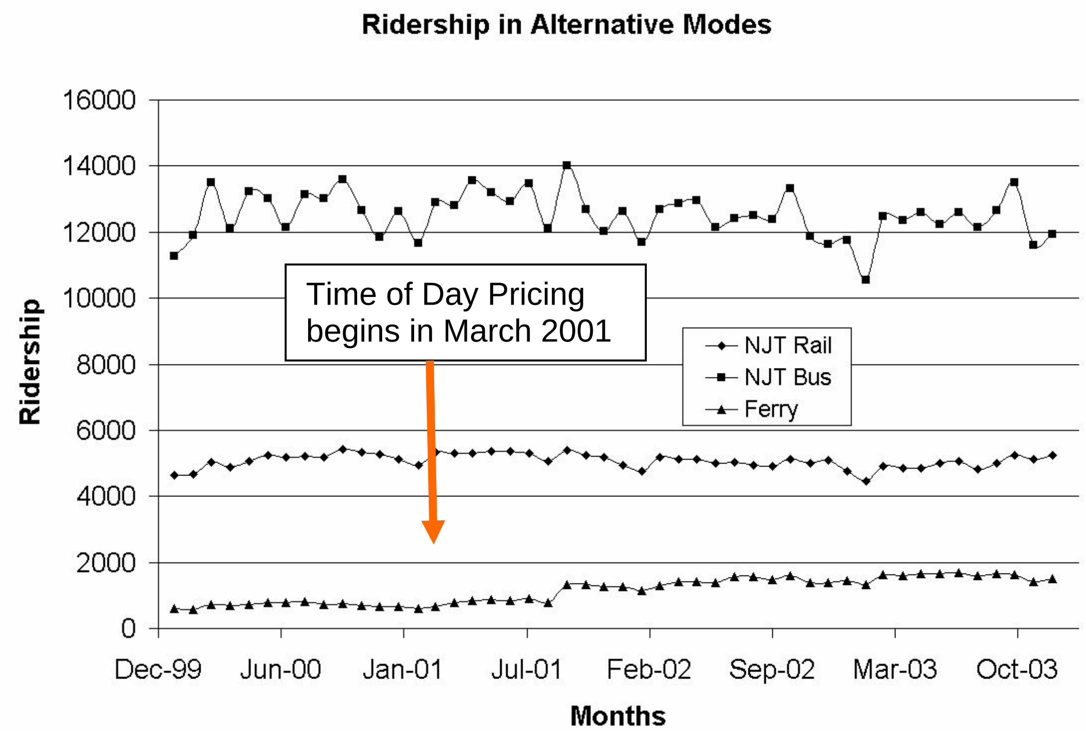

Figure 19. Monthly transit ridership trends before and after time of day pricing

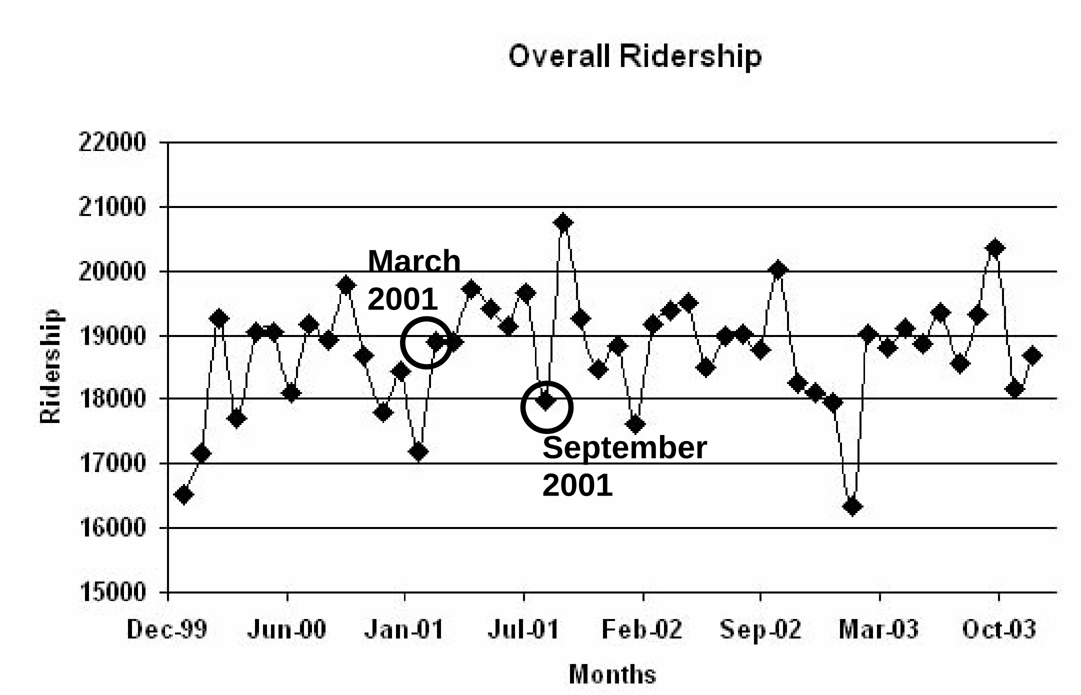

Figure 20. Monthly overall transit ridership trends before and after time of day pricing (Excluding PATH data)

However, as expected, the ridership level in September 2001 does not follow the trend seen in previous years. This abnormal behavior is also detected the ANOVA analysis described in the statistical analysis section of this chapter. It is clear that this change in trend is due to the events of 9/11.

Another way of analyzing the effect of time of day pricing is to study the distribution of the annual demand and see if there is any change in this distribution following the time of day pricing initiative. In Table 24, monthly percent demand distributions between years 1998 and 2001 were presented to see if any pattern changes occurred after March 2001. The percent distribution for each month was calculated as the ratio of the total demand for the time period considered for the specific year and the individual demand for each month. An eight-month period (January-August) for each year was employed in the calculations to eliminate the bias that will be introduced due to the unusual fluctuations in ridership for the time period after the events of 9/11. Table 24 summarizes these monthly percent changes for the pre-September period for four consecutive years.

Table 24. Changes of monthly percentages of transit ridership for 1998 to 2001

Months / Years	1998	1999	2000	2001
January	12.1%	12.3%	12.6%	14.1%
February	11.6%	12.3%	13.2%	13.2%
March	12.8%	14.0%	14.8%	14.5%
April	12.8%	13.7%	13.6%	14.5%
May	12.5%	13.4%	14.6%	15.1%
June	12.8%	14.0%	14.6%	14.9%
July	12.9%	13.7%	13.9%	14.7%
August	12.6%	13.7%	14.7%	15.1%

As seen in Table 24, the percentage shares in 2001 for all the months after March until August, with the exception of April, are either higher than or equal to the percentages of corresponding months in previous years. This observation can be used to support our previous conclusion that the time of day pricing did not cause a significant reduction in demand for the months after its initiation. In fact, the percentage of these months increased for 2001 compared to 2000. Thus, it can be concluded that time of day pricing had no negative effect on transit ridership**.**

However, the events of 9/11, as shown in Figure 20, had a drastic effect on total NJ transit ridership peaked and then dropped again. Both of these observations are mainly due to the fact that the 9/11 attacks destroyed main PATH facilities serving New York City. Subsequently PATH passengers shifted to NJ Transit and ferry services. In 2002, overall monthly ridership shows a decrease as much as -6.63 percent, (Table 22). Thus, there is an overall decreasing trend in 2002 transit ridership that can be associated with the overall economic conditions and the after-effects of 9/11.

The analysis of monthly ferry ridership provides a complementary perspective. As shown in Figure 19, ferry ridership increased after 9/11 and declined significantly after the reopening of PATH facilities in the second half of 2003.

Descriptive Analysis of the Possible Effect of E-ZPass on Transit Ridership

This section tries to assess if the introduction of E-ZPass had a noticeable impact on transit ridership. The period of interest is the one between the introduction of E-ZPass in 1997 and March 2001 (before the time of day pricing initiative). This time period was selected because it enables to isolate E-ZPass impacts on transit ridership from the impacts of the time of day pricing initiative. As shown in Figure 21, it seems that E-ZPass did not seem to have a negative impact on the transit ridership. As shown, transit ridership kept increasing well after the introduction of E-ZPass.

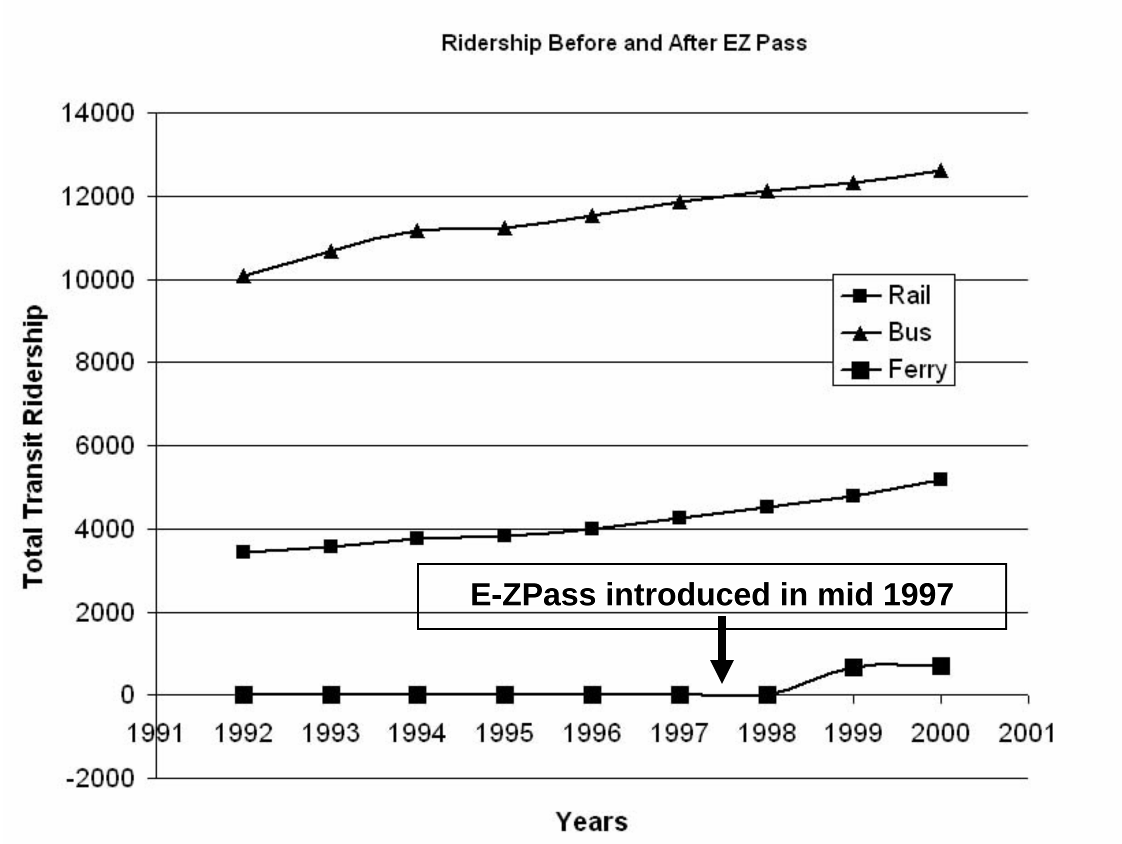

Figure 21. Transit ridership trends before and after E-ZPass

Statistical Analysis of Transit Ridership

While investigating the impacts of the time of day pricing initiative on transit ridership, it is necessary to differentiate fluctuations resulting from seasonal changes in ridership from the changes resulting from external effects such as economy, events of 9/11 or time of day pricing. To achieve this goal, statistical testing was used to investigate the following cases:

1. Case 1-Testing the changes in seasonal transit demand: This case is meant to statistically test the differences in transit demand for different seasons, such as summer, winter, autumn, and spring.
2. Case 2- Effect of economy and other changes that might affect demands on an annual basis

3. Case 3- Effect of time of day pricing: Case 3 is developed to test before and after differences in transit demand

ANOVA tests were employed for the analysis of three cases stated above. An Analysis of Variance (ANOVA) test is closely related to the well-known and widely used t-test. The major difference lies in the fact that the t-test measures the difference between the means of two groups, whereas an ANOVA tests the difference between the means of two or more groups. The main advantage of using ANOVA test instead of multiple t-tests is that it reduces the probability of rejecting the null hypothesis that is true thus committing a type-I error. The main reason behind this is that by making multiple comparisons using t-test, one increases the alpha value automatically. This, in turn, increases the likelihood of making a type-I error. ANOVA test is also called F test that tells if there is a statistically significant difference between groups.

While conducting two-way ANOVA test, the data points are divided into relatively homogenous subgroups and significance tests are implemented within and across the each homogenous group. The key idea is to determine the effect of each subgroup to the total variation. The percent share of each data type is calculated using equation below.

$$y_i = \frac{M_i}{\sum_i M_i} * 100 \qquad (5)$$

where:

i: Month index

y_i: Percent share of month *i*

M_i: Average traffic during month *i*

The simplest ANOVA test, a one-way ANOVA (single factor ANOVA) is used to test differences between groups that are only classified on one independent variable. It is also possible to use multiple independent variables and test for interactions using factorial ANOVA. Before trying to analyze the impact of time of day pricing, it is important to test the existence of seasonal variations. This analysis will explain the reason for time-dependent demand fluctuations observed in Figure 20 when monthly transit demand is studied over several years. The next section describes this analysis.

<u>Case 1: Testing the Changes in Seasonal Transit Demand</u>

In this test, the seasonal variation of the ridership was investigated for times when no major external factors (i.e., the economic recession, 9/11, time of day pricing) are present. For this purpose, two-way ANOVA test was employed by constructing a two-factor full factorial design without replications using the data sets shown in Table 25. A year was divided into seasons to check the existence of any seasonal variation. The data sets for each season consisted of percentage of monthly demands for the whole year, as stated in Equation 5 above. The main reason for using monthly demand shares, instead of absolute values of demands themselves, is to avoid biased result because of yearly demand changes. This procedure is repeated for years 1998, 1999, 2000 and 2003. 2001 and 2002 data were excluded from the analysis to isolate the analysis from both time of day pricing in 2001 and 9/11 which impacts 2001 and 2002.

Table 25. Illustration of two-way ANOVA structure of Case 1, an example for 1998

December	January	February
March	April	May
June 8	July	August
September	October	November

Changes among the seasons

Changes within the seasons

From a careful visual inspection of Figure 20, one can also visually observe a trend in the form of seasonal variations. All three years have their minimum value either in January or February, an overall increase can be seen in March-April, followed by the year's maximum in either September or October (2001 September exhibits an unusual sudden decrease because of the terrorist attacks). The period from 1998 to 2003 (excluding 2001) was analyzed in the ANOVA test. The ANOVA analysis results point to a seasonal variation for 1998, 1999 and 2003 data, with the statistical values given in Table 26.

Table 26. Summary of ANOVA test for seasonal variation

Year	Type of Variation	F value	F critical value	Significance
1998	within seasons	4.7379	5.1432	No
	among seasons	5.8575	4.7571	**Yes**
	random error			
1999	within seasons	1.4751	5.1432	No
	among seasons	6.0480	4.7571	**Yes**
	random error			
2000	within seasons	1.4978	5.1432	No
	among seasons	4.1518	4.7571	No
	random error			
2001	Excluded from the analysis			
2002	Excluded from the analysis			
2003	within seasons	3.3539	5.1432	No
	among seasons	5.3253	4.7571	**Yes**
	random error			

ANOVA test results give a statistical value found for the tested sample and a theoretical critical value according to the desired confidence level, above which a variation between the tested samples can be said to exist. In the ANOVA test done for seasonal variation a 95 percent confidence level is selected. The ANOVA tests for all the other years, except 2000, show the existence of a seasonal variation. 2003 data is more representative of normal conditions in the sense that the transit system recovered to its old condition by 2003 and economy started to pick up. 2000 data can also be seen as an exception because it marks the beginning of the economic recession. Nevertheless, year 2000 statistics are found to be very close to the critical statistical value at the 95 percent confidence level, which shows that seasonality will still be observed at a slightly lower confidence level. There are also random external effects, which cannot be quantified in this analysis. It can be concluded that there is a seasonal variation that tends to change from one year to another mainly due to other external effects. However, for 1998, 1999 and 2003 where the overall system is quite stable, the seasonal variations are observed in a consistent manner. Overall, in the absence of a major external factor between 1998 and 2003, the seasons are concluded to have similar trends for various years.

Case 2- Effect of Economy on Annual Transit Demands

Apart from the seasonal variations, transit demand may be subject to an annual change due to the natural growth of demand. In the test presented below, yearly demands were analyzed to understand if they experienced an increase for two consecutive years. Contrary to Case-3, demands were taken as their original numbers since the aim of the test is to detect any absolute demand change between two consecutive years. To investigate this hypothesis, a time period of 1998 to 2001 were analyzed. The main concern for choosing the period before 2001 period is to isolate the data from the combined effects of economy and 9/11 and time of day pricing.

Paired t-tests were employed for consecutive years to identify the existence of a statistically significant annual change in transit demand. The tested hypothesis was that there was no statistically significant demand difference between two consecutive years. For this purpose, a 12-month period was tested for 1998-1999 and 1999-2000. However, a 9-month period was tested for 2000-2001 to exclude the 9/11 effect. That also explains why the critical t-statistic and the average ridership number for this period is not consistent with 1998-1999 and 1999-2000 periods. The test results are given in Table 27.

Table 27. Results of paired t-tests for annual demand

Interval	Average Ridership	t-statistic	Critical t-statistic	Significance
1998-1999	16500 → 17640	-9.9940	1.7959	**Yes**
1999-2000	17640 → 18467	-5.9629	1.7959	**Yes**
2000-2001	18245 → 18788	-2.1483	1.8595	**Yes**

For all the pairs that were analyzed, test statistics exceeded the critical value, which shows a major difference in yearly demands, so our hypothesis of equal demand level is rejected. The existence of a statistically significant annual demand for three consecutive periods, shown in Table 27 supports the visual observation that transit ridership continued to increase after the introduction of time of day pricing initiative until 9/11. It should also be noted that the 2000-2001 period shows less growth then the previous years (sample test statistic is closer to the critical value) which can be interpreted as a direct result of economic slow-down. The effect of employment levels should also be mentioned as a major factor affecting the transit demand. The main point of the studies in this area is that a relationship exists between CBD (Central Business District) employment and interstate transit demand. Figure 22 and Figure 23 show that between 1992 and 2005, transit and employment follows a similar trend. Both continue to increase until 2000 and experience stagnation, coinciding with the economic recession in year 2000 and decreases until year 2004 when it enters an increasing trend again.

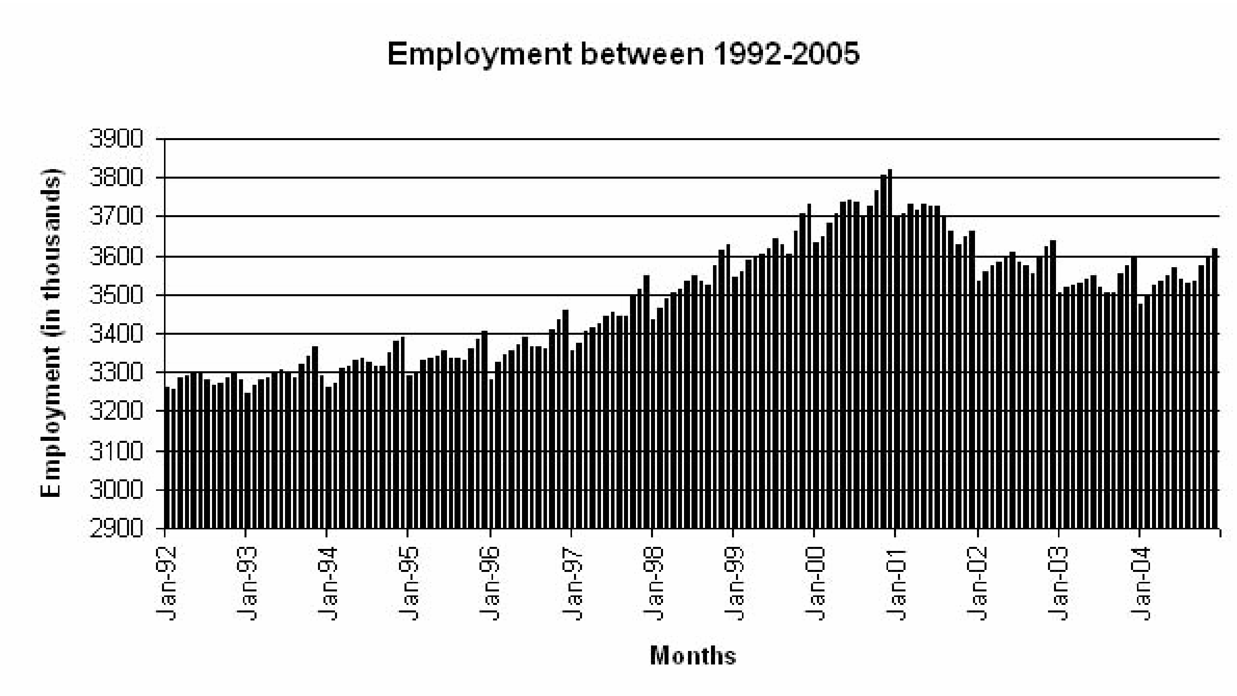

Figure 22. Monthly Employment over years 1992-2005 (Source: New York State Department of Labor[29])

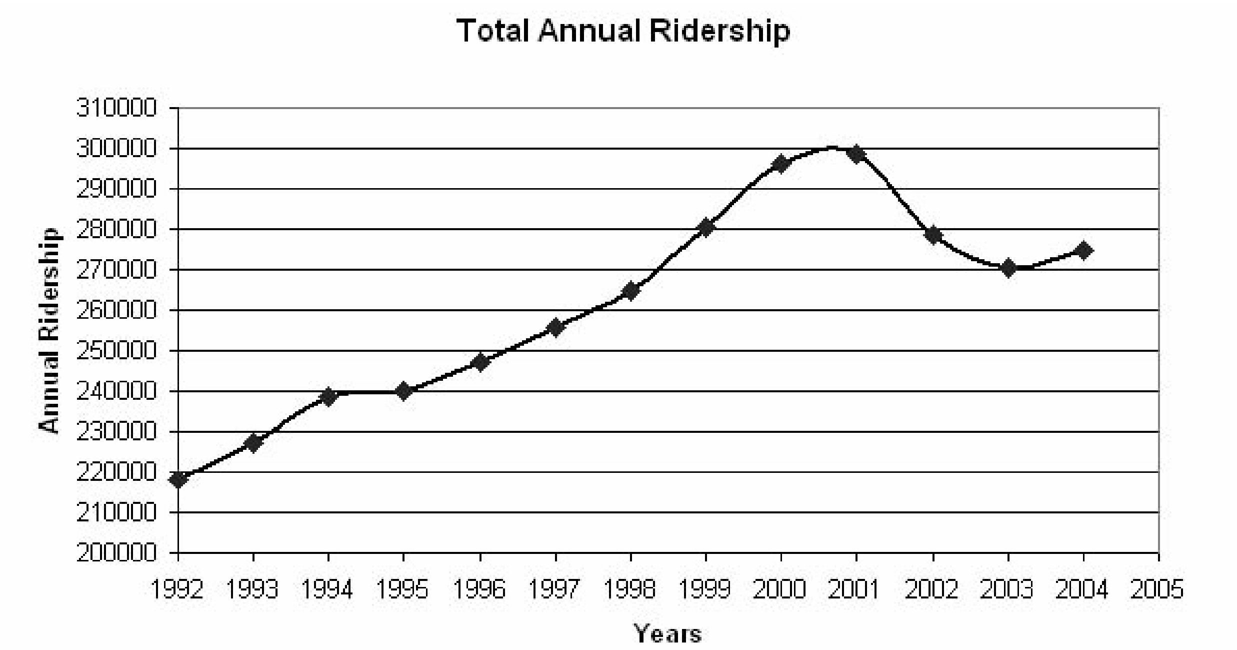

Figure 23. Total transit ridership

A least squares regression analysis between the annual employment and total annual ridership was performed, resulting in a model with an acceptable R^2 of 0.64. Thus, it can be concluded that the employment-transit ridership also described in the literature [30,31,32,33] exists in the study area and employment levels should be primarily used to explain the transit demand changes.

<u>Case 3: Impacts of Time of Day Pricing</u>

In this case, the possible effect of time of day pricing was investigated by comparing the months before and after the time of day pricing for years between 1998 and 2001. The aim was to detect if any significant change occurred in pre and post time of day pricing initiative. Similar to Case-1, monthly shares are used for the analysis to exclude the yearly demand change which was found to exist in Case-2. Again, an ANOVA test, structured as shown in Table 28 and Table 29 was performed. Also taking the seasonal factors into account, pre-time of day pricing months are chosen to be December-January-February (Table 28) and by the same consideration, post- months were chosen to be March-April-May (Table 29). To detect any further effect of time of day pricing, summer period, June-July-August (Table 30) for the same years were also analyzed. Unfortunately no further test could be performed after August since 9/11 impacted the system and no reliable statistical comparison could be performed.

Table 28. Two-way ANOVA for Pre-Time of day pricing

December 1997	January 1998	February 1998
December 1998	January 1999	February 1999
December 1999	January 2000	February 2000
December 2000	January 2001	February 2001

Changes among years

Changes within months

Table 29. Two-way ANOVA for Post-Time of day pricing

March 1998	April 1998	May 1998
March 1999	April 1999	May 1999
March 2000	April 2000	May 2000
March 2001	April 2001	May 2001

Changes among years

Changes within months

Table 30. Two-way ANOVA for Post-Time of day pricing

June 1998	July 1998	August 1998
June 1999	July 1999	August 1999
June 2000	July 2000	August 2000
June 2001	July 2001	August 2001

Changes among years

Changes within months

Table 31. The summary of ANOVA test for time of day pricing effect

Period	Type of Variation	F value	F critical value	Significance
Pre-Time of day pricing	within seasons	4.3565	5.1432	No
	among seasons	0.2523	4.7571	No
	random error			
Post- Time of day pricing (March-April-May)	within seasons	0.9552	5.1432	No
	among seasons	0.0766	4.7571	No
	random error			
Post- Time of day pricing (June-July-August)	within seasons	0.9972	5.1432	No
	among seasons	0.7727	4.7571	No
	random error			

The ANOVA results in Table 31 show that both periods before and after the time of day pricing (December to February 2001, and March to May 2001) are statistically comparable to the same periods of previous years, i.e., 1998 thru 2000. Any further effect, which might have happened in summer, also did not give a significant test statistic (Table 31). So, the statistical analyses indicate that, with a 95 percent confidence, there is no statistically significant change in transit ridership during the time period just after the implementation of time of day pricing.

Discussion and Conclusion

To further analyze possible impacts of the time of day pricing program on transit ridership, a disaggregate database containing hourly ridership data is necessary. Without a more disaggregate transit ridership database showing the breakdown of peak and off-peak period ridership separately, it is not possible to further analyze and pinpoint the time-dependent changes in transit ridership after the time of day pricing initiative. On the other hand, the aggregate level analyses conducted here shows that the drop in ridership occurred at the same time as the economic slow down. Thus a summary discussion of various factors related to economy, time of day pricing, and 9/11 that might have affected the demand for transit is provided next. The factors that were analyzed to have an impact on ridership are:

1. Effect of Economic Decline and CBD Employment
2. Physical Effects of 9/11 and Related Statistics
3. Time of day Pricing

The analyses conducted indicate that the time of day pricing initiative did not seem to have a noticeable impact on transit ridership. This claim was also verified in 95 percent confidence ANOVA test (Table 31). Transit ridership at the same time intervals (before and after time of day pricing) did not show a significant difference between 1998 and 2001. The analysis of data shows that the physical destruction of the major transit facilities caused a decline in ridership as would be expected. Those non-functioning transit lines also increased travel time and decreased the level of access to downtown Manhattan which also resulted in less ridership numbers.Physical recovery is a relatively short process. So these two factors can be used to explain short-term fluctuations in transit demand. Longer-term changes in transit demand can be mainly attributed toy economic slow-down and resulting reduction in CBD employment. In addition to economic slowdown, 9/11 attacks also caused a reduction in the number of employees working in New York City. There are several studies in the literature identifying Central Business District (CBD) employment as one of the major factors affecting the transit ridership.[30,31, 36,37,38] The decreasing trends in employment levels shown in Figure 22 coincides with the decreasing trend in transit ridership (Figure 23), which starts showing a slow-down by 2000-2001 and then decreases by 2002-2003 and shows an increasing trend with year 2004. Also businesses are relocated from CBD to other places including New Jersey, after 9/11, which further increases the CBD effect on transit.

The economic decline can be quantified in terms of employment levels over years. The overall decline in employment, combined with business re-location can explain the decrease in transit demand. Besides the improved economic situation with an increasing employment rate in New York City in 2004 (Figure 22), the decrease in transit travel times due to the restoration of transportation facilities to their pre-9/11 status (resulting in overall lower travel times and better accessibility) and recovery from post 9/11 trauma over time can all be seen as the other contributors of the increasing trend in transit ridership after 2003. (See Table 22, Figure 17, Figure 18). In conclusion, it is not possible to link the abrupt change in transit ridership to the time of day pricing changes. The New Jersey Transit and PATH statistics that show record high values before September 2001 clearly demonstrate that a significant ridership decrease had not been observed prior to July 2001 while the time of day pricing program was already active. The brief discussion presented above leads us to conclude that the transit ridership decrease is explained as a result of economic decline that started before and continued after 9/11 instead of time of day pricing.

CHAPTER IV

FOCUS GROUP STUDIES

Purpose

A qualitative approach based on focus group research was used to assess the behavioral changes that might have occurred as a result of the time of day pricing initiative. These qualitative analyses were conducted in two phases. In phase one, the response to time of day pricing was studied in the passenger car sector. In phase II, the commercial vehicle sector's response was studied. This chapter presents the findings from both passenger car and commercial sectors.

The specific goals of this task were to obtain qualitative feedback on how the time of day pricing initiative affected the behavior of passenger car drivers and those in the commercial vehicle sector. In addition, the open ended, holistic structure of the focus groups provided an opportunity to potentially learn more about what motivates passenger car drivers and commercial truckers to go the routes they take into the New York metro area; what it would take to change some aspects of their travel; to learn more about the acceptance of E-ZPass; and how reactive they are to the dollar amount of the toll. The results of this qualitative study were used to cross validate and refine the (quantitative) surveys aimed at quantifying the behavioral impacts produced by the time of day pricing initiative.

Six focus groups in total were conducted to obtain the qualitative information. Four of the groups were conducted with passenger car drivers and two groups with representatives of the commercial vehicle sector. While the qualitative project was underway the behavioral surveys to collect quantitative data about the impacts of the time of day pricing initiative were also going through prototyping and piloting. The results of the focus groups were used to refine the content, possible wording, and pacing of the surveys. Prior to the start of the focus groups, individual interviews were conducted with various stakeholder groups which would also inform the focus group work. The in depth interviews included individual interviews with for-hire carrier and private carrier trucking companies, and with shippers and receivers.

All respondents for the six groups were recruited professionally. They were screened at the time of recruitment and then re-screened the evening of the group. People were rejected if they had been in a focus group on this or related topics in the past year or if they currently worked for a transportation agency.

Phase I: The Passenger Car Sector

<u>Study Population</u>

Four groups of passenger car drivers were recruited. Three of the groups consisted of drivers who used E-ZPass to pay tolls over the PANYNJ facilities and one group consisted of passenger car drivers who paid tolls over the PANYNJ facilities using cash. All respondents had to use the PANYNJ facility at least once a week, i.e. be a regular user, and to have been using the facility since before March 25, 2001, which is the start of time of day pricing. Participants were recruited at random using telephone lists. They received an incentive to participate and were provided dinner. The facilitator was a professionally trained psychologist with a significant amount of experience in focus groups and other forms of qualitative research.

In each group there was a mix of people who traveled during peak, as well as off-peak, days and weekends. There was a mix of ages, sex, different levels of household income (which ranged from $24,000 to over $135,000 a year), education level, and ethnic background. The purpose of their trips would vary from work, recreation, education, to socializing etc. The passenger focus groups were:

- Group one: George Washington Bridge regular users who pay by E-ZPass.
- Group two: Holland and Lincoln Tunnel regular users who pay by E-ZPass.
- Group three: Staten Island Bridge regular users who pay by E-ZPass.
- Group four: Cash toll payers who use one of the above facilities regularly.

Procedure

The first two groups were conducted at the beginning of the first week of December 2003 and the second two groups conducted at the end of that week. The groups met for approximately one hour forty-five minutes each.

Each group was led through a warm up exercise that was geared towards helping them to relax and develop into more of a working group. It was also used as a form of guided memory recall starting with remembering items from their childhood. This was to assist in exploring their recall of when time of day pricing was started.

The moderator then guided them back in time starting from the millennium New Year's celebration to 2001. Since respondents from the first two groups were unable or unwilling to substantively discuss events of 2001, the memory recall procedure was modified for the last two groups to stimulate their individual thoughts first and to reduce the impact of 9/11 on their recalled memories. In these groups, respondents were asked to write down three positive things and three negative things that happened in 2001, starting with the spring of 2001, then the summer of 2001, the fall of 2001, and the winter of 2001. They were next asked to focus on travel conditions in the spring and fall of 2001 to spontaneously elicit any sign that they had changed their travel behavior at that time (following the time of day pricing initiative) for whatever conscious or unconscious reason.

Respondents were then asked to recall what happened around March 25, 2001 as a way to assess awareness of the introduction of variable tolls. They were cued in about E-ZPass if they still had trouble recalling. They were asked to indicate if they were aware of any toll changes and what their reactions were to the toll changes. Respondents then discussed their reactions to the concept of tolls in general and variably priced tolls. Group members then were directly asked if the toll changes had influenced in any way how they traveled into the New York area after March 25, 2001.

Next, respondents were asked how they traveled into the New York City area today. Efforts were made to understand how they decided on their travel strategy given all the roads, tunnels, bridges, and mass transit at their disposal. Factors that influenced their choice of route, time of day, etc. were explored. During the discussions, the facilitator did not prompt time of day pricing. Group members were also probed for their reactions to the amount of toll they paid and how much of a price difference would induce them to alter in any way the manner by which they traveled. Specific discount percentages were expressed but most felt no amount of discount would influence them to change. Figures were not written down by participants

Finally, group members were asked about name recognition of the PANYNJ and their awareness that the six facilities discussed in the group were part of their system. Respondents were also asked if they had any other experience with time of day pricing and E-ZPass systems outside of the New York area and if so, how they compared with the PANYNJ facilities.

Summary of Opinions Expressed During the Passenger Car Groups

- It was difficult for most of the participants to remember details of their travel behavior in 2001. They could answer basic questions about travel patterns, which was required for their inclusion in the group.
- The trauma of 9/11 seemed to have eclipsed most of their memories of non-personal events of 2001 in the group discussion.
- Very few people were aware of the amount of tolls they paid and toll policies prior to March 25, 2001 and after that date.
- Few respondents knew the background of E-ZPass including why and when it was created.
- Those people currently using E-ZPass seemed committed to continue using it because of its convenience, the absence of waiting in line, and ability to drive through while paying tolls.
- Participants had very few conscious recollections of the introduction of the time of day pricing initiative.

- Up to the focus group discussion most of the respondents seemed to be unaware or confused about the time of day pricing program with its system of tolls and discounts.
- When the time of day pricing initiative was explained to the participants their reactions ranged from neutral to disinterest to veiled irritation that they were being manipulated by the agency running the facilities on which they traveled.
- The passenger car drivers rejected off-peak toll discounts if it required altering their plans for the trip in any way. Altering plans could cost more money and mental energy, and inconvenience than the benefit of the discount offered.
- Group members felt that the amount of the discount was too small to alter behavior and didn’t see the added advantage over and above the E-ZPASS discount.
- Almost all the participants resented having to pay tolls and did not feel they got much value for their toll dollars.
- In terms of their reactions to tolls, cash and E-ZPass users were virtually the same.
- Cash users declined using E-ZPass mostly because they felt they did not travel often enough to make it worthwhile financially, and worth overcoming fears of loss of privacy.
- The frequency of travel into New York City among cash users was similar to that of the E-ZPass user groups.
- Very few of the participants expressed environmental concerns or saw the benefit of traveling off-peak as a way to address traffic congestion.
- Less than one half of the passenger car drivers identified the PANYNJ as running the facilities discussed in the groups.
- The PANYNJ E-ZPass system compared mostly favorably to the few other systems around the country that the respondents knew about. The PANYNJ had a similar feel to it and ease of use to it as the other systems. A few others, such as the New Jersey Turnpike, and Delaware, and Boston were perceived to be slightly better because you barely slowed down to go through the toll. A toll system was also perceived as better if it didn’t have toll gates.

The detailed findings from the passenger car focus groups are shown in Appendix 3.

Phase II: The Commercial Truck Sector

Study Population

In phase two, the commercial vehicle sector, two focus groups of truck dispatchers were conducted. The project team decided to focus on dispatchers because their position in their companies enables them to interact with both drivers and upper management, and to be aware of both company operations and the overall business sector in which the company operates.

Group five consisted of truck dispatchers from for-hire carriers (those that sell transportation service to the open market) of small, medium and large sizes. The majority of dispatchers came from companies whose size ranged from 0 to 50 employees and some from companies that were 50 to 500 employees in size. There was a mix of dispatchers whose truck drivers use E-ZPass or cash, and those who travel peak or off-peak. There was also a mix of gender, age, ethnic background, and education as well. Most companies represented used E-ZPass and traveled over the George Washington Bridge or Lincoln and Holland Tunnels.

Group six consisted of truck dispatchers from private carriers (those that perform transportation service to a different unit of a parent company) of small, medium and large companies. There was a mix of dispatchers who use E-ZPass or use cash, and who travel peak or off-peak. There was a mix of gender, age, and ethnic background, and education. Similarities and differences between the needs and perceptions of private carriers versus for-hire carriers were explored. An equal number used E-ZPass vs cash. The majority of companies were either small or medium sized. Most tended to travel over the George Washington Bridge most, followed by the Lincoln and Holland tunnels and then the Staten Island bridges.

Procedure

The two groups were conducted on the evening of January 20, 2004. Despite the length of time allotted to recruit members for these two groups they were quite challenging to recruit. Recruiters indicated that the dispatchers were protected at work from any disturbance and therefore hard to reach. Prior research on the trucking industry also suggested that they might be reluctant to participate in a focus group although the trucking companies did not know who exactly was sponsoring the research.

The groups each met for approximately one hour forty-five minutes. The groups were audio taped and videotaped with their awareness and permission in an identical fashion as with the passenger car groups.

In parallel with the passenger car focus groups, each commercial group was led through the same warm up exercise that was geared towards helping them to relax, to develop into more of a working group, and to be used as a form of guided memory recall to help remember items from their past. This was to assist in exploring their recall of when time of day pricing was started.

As done before with the passenger focus groups, the moderator then talked them back in time starting from the millennium New Year’s celebration to 2001. To stimulate their individual thoughts first and to reduce the impact of 9/11 on their recalled memories these group respondents were also asked to write down three positive things and three negative things that happened in 2001, starting with the spring of 2001, then the summer of 2001, the fall of 2001, and the winter of 2001. Staying within the year 2001, the moderator then asked how were business conditions in the spring of 2001 and then in the fall of 2001, in terms of routing trucks over the six PANYNJ facilities.

A large portion of time was dedicated to exploring their awareness and understanding of E-ZPass. Another major portion of time was spent on their awareness and reactions to the time of day pricing initiative of the PANYNJ. Respondents were asked directly and indirectly in what ways they might have altered their travel decisions as a result of the time of day pricing initiative.

Next respondents discussed their reactions to tolls in general. Prior research by Dr. Holguín-Veras on the trucking industry had suggested that the travel patterns of truckers were determined by the interactions between the shippers, truckers and receivers. An attempt was made in the focus groups to understand those dynamics via a mock debate. One-third of the truck dispatchers were asked to debate some questions as if they were the shippers, another third were asked to discuss as truckers and another third to take on the role of receivers. They were asked a series of questions and told to respond in their roles but they could also challenge the responses of the other subgroups. Some questions asked were: “who really has most control over the trip time”, and “do discounts on tolls influence your travel decisions?”

After the group was reconstituted as a whole group they were asked if they felt that the issues and concerns of the private carriers were any different from those of the for-hire carriers. They were also asked if the concerns of small companies were different from those of the larger companies.

Next, group members were asked how they would improve the time of day pricing system. At the end, the groups were asked about their awareness of the PANYNJ and comparison of it to other time of day pricing toll systems around the country.

Summary of Opinions Expressed by the Commercial Groups

The opinions expressed at the two commercial groups and the four passenger car groups were quite similar:

- While almost all participants could remember New Year’s 2000 and 2001 most had difficulty recalling other non- personal events except for 9/11.
- Prior to 9/11 business was going well but after 9/11, for the majority, business sharply declined.

- For most companies business has picked up to the pre 9/11 level but costs are up and business is more competitive.
- Even though dispatchers coordinate the trucker's schedule and route, very few dispatchers were aware of the time of day pricing program at the time it was initiated or at the present time.
- Use of E-ZPass was more prevalent in the for-hire carrier group than private carrier group and was the choice over cash for the majority of group members.
- Associations to E-ZPass were basically positive because it allowed the trucker to save time and possibly make more deliveries. For the company, it reduced paper work and allowed for tracking of drivers.
- Billing errors and tracking were the main concerns by some of those trucking companies. They did not want to be tracked since they were afraid that they could not speed as fast as they needed for their delivery schedules if they were tracked by E-ZPass transponders.
- Those who recollected anything about time of day pricing dismissed it as inconsequential. The discounts were too small and they did not feel they had the flexibility to travel off-peak.
- Truck dispatchers perceived that they planned truck routes and schedules the same today as before March 25, 2001.
- Truck dispatchers felt that they would make more money by traveling the fastest route even if the tolls were higher on that route.
- Truck dispatchers were resigned to and less concerned about the price of tolls because increases were passed on to the customer.
- Similar to the passenger car drivers, few thought in terms of traffic congestion impacting on the environment.
- In contrast to passenger car groups, most of the truck dispatchers realized that the PANYNJ ran the facilities discussed in the focus group.
- The PANYNJ facilities were perceived more positively in the private carrier group than the common carrier group, some of whom saw this system as somewhat antiquated.

- The private carrier participants perceived the PANYNJ as comparable to the Maryland and Delaware facilities and better than the New Jersey system.
- The participants indicated that time of travel decisions are, in essence, determined by customer needs and various operational constraints. As a result, without receivers willing to accept off peak deliveries, the truckers cannot switch to the off peak hours unilaterally.
- Their biggest wish is for high-speed lanes that are exclusively for trucks. In general, because of their high value of time, they are willing to pay more in tolls as long as they save time.

The detailed findings from the commercial focus groups are shown in Appendix 4.

Conclusions

Most of the passenger car drivers had a partial understanding of E-ZPass. They stated that they did not remember the start of the time of day pricing initiative. They are still unable to articulate what this program is about and exactly how much they pay in tolls.

From what they say about their travel attitudes and travel behavior the time of day pricing initiative has not been very successful. Of course, how passenger car drivers verbally describe their behavior needs to be corroborated by other objective measures including the analyses of traffic data and the (quantitative) behavioral surveys.

The findings suggest that the larger behavioral survey needed to address difficulties in recall and awareness of the program which would affect participants answering the relevant questions.

Three hypotheses could explain the participants' lack of awareness of the time of day pricing program and the three may not be mutually exclusive. One is that the program was not marketed effectively enough for it to be remembered. The second hypothesis is that people are more likely to remember events that have significant personal meaning for them. They may also tend to repress negative events over which they have little control. The third hypothesis is that these respondents may have been confused between toll changes at the PANYNJ facilities with others such as those at the MTA, which manages other toll facilities in the New York City area.

The second hypothesis is based on a psychological understanding of memory processes. Verbalizations of the participants in the groups and non-verbal behavior in the groups lend support for these hypotheses. Participants had trouble remembering 2001 but with some assistance could remember many personally meaningful events. The event of 9/11 was too massive an event to be forgotten. However, items like tolls were small, personally irritating items grudgingly accepted as part of the price for living in and around New York City. In addition, the time of day pricing initiative enacted fare increases (for some users) simultaneously with fare discounts that may have confused people and even engendered feelings of being tricked in some people, which they then tried to block out of consciousness.

Marketing the time of day pricing program is made more complex by E-ZPass itself. E-ZPass users are more disconnected from the toll paying process, especially if they pay by credit card or get statements by mail. Most participants in these groups did not scrutinize their bills. Therefore, marketing via their bill may not have enough of an impact. E-ZPass may also be reducing the impacts of toll discounts and travel off-peak. By being disconnected from their bills, drivers have even less a sense of what the true, complete costs are to drive a car into the city. Future marketing may need to be more explicit about how much each trip actually costs, especially compared to off-peak or compared to using alternate modes of transportation.

The PANYNJ may be more effective in influencing travelers' behavior if it actively portrays a more positive image in the eyes of the passenger car driving public, as well as differentiating itself more from other similar organizations. This may influence the behavioral changes the PANYNJ wants to make. The public may need more knowledge of what the PANYNJ does and where the public's money goes regarding transportation.

In the detailed findings included in Appendix 3, the respondents offer their suggestions of how to improve the driving experience for them. Based on their wish to travel as fast as they can with little traffic congestion, one might consider offering high-speed lanes for which they would probably be willing to pay more money rather than use toll discounts to alter their driving behavior.

Similar to the passenger car groups the dispatchers reported that they were unaware of the time of day pricing program when it was initiated and are unclear about it today. The findings of these two commercial groups suggest that the time of day pricing did not alter their travel behavior either, whether or not they were consciously aware of time of day pricing. Their reasons for their lack of recall may be explained by the same reasons hypothesized for the passenger car drivers. In addition, toll increases were passed along to the client, which probably discouraged them from going after toll discounts and trying going off-peak. Truckers indicated that they made more money even when paying peak tolls to get to their destination most directly and on time than the money they saved by traveling off-peak. They literally found no value in time of day pricing. However, some dispatchers were willing to try to dispatch trucks to travel off-peak if receivers would cooperate with their delivery schedules. It partially depended on the kinds of commodities being delivered.

E-ZPass was viewed as a way to travel more quickly to and from deliveries. However, E-ZPass had drawbacks for some dispatcher / drivers who had concerns about their movements being tracked. Overall, the participants in these groups seemed to express a strong desire to travel when they wanted to and to maintain their privacy. Control and autonomy seemed quite important to them.

In the case of the commercial groups, continuing existing marketing efforts simply to heighten awareness of the time of day pricing program may not be effective for the small amount of off-peak discount obtained (although group participants theorized that this program might be of more interest to the largest companies for whom the volume of the discount might make it worthwhile).

Prior survey research in 2003 for the PANYNJ on the trucking industry's response to E-ZPass and time of day pricing suggested that there was a lot of turnover in the industry and language barriers to truckers adopting E-ZPass and time of day pricing. [1] Therefore, it is suggested that marketing be done continually, and presented in a way that responds to some of the truckers' specific interests, fears, and language skills.

In addition, the PANYNJ may consider reaching out more to organizations of shippers and receivers to convince them to permit more truck deliveries off-peak. From discussions with the truck dispatchers, during and after the focus groups, came some negative expression on the part of the trucking industry towards the PANYNJ and other organizations like it. Their very subjective experience was that they were not treated well by these organizations. To the extent these sentiments are prevalent in the trucking industry; perhaps some outreach with this industry might facilitate adoption of new programs in the future.

The main purpose of the current qualitative research project was to assess how passenger car drivers and those in the commercial sector were responding to the time of day pricing initiative of the PANYNJ. In addition, efforts were made to identify those factors that would motivate these two groups to modify their traveling behavior. The findings from the current research, based on six groups, is that while there is some baseline awareness and fairly solid acceptance of E-ZPass, there is little awareness and interest in the time of day pricing program the way it is currently constructed.

For the variety of ways in which the passenger car drivers use their cars in one day alone, changing travel plans for off-peak hours or resorting to car pooling were restrictive options on their agendas, and not considered worthwhile given the discounts offered. Furthermore, rather than expressing an interest in a discount, truck dispatchers and drivers were clear that it was worth paying maximum tolls. Current and discounted tolls of the PANYNJ were discussed] for the additional time saved and convenience it gave them to do their work. Appeals to people about travel congestion and its impact on the environment had little effect in these groups.

CHAPTER V

DESCRIPTIVE ANALYSES OF THE IMPACTS OF THE TIME OF DAY PRICING INITIATIVE ON PASSENGER TRAVEL BEHAVIOR

Introduction

This chapter describes the descriptive analyses of the impacts of the 2001 Port Authority of New York and New Jersey's (PANYNJ) time of day pricing initiative on passengers' travel behavior. The data used in the analyses were collected by means of a survey instrument that included questions pertaining to the socio-economic profile of respondents, how users reacted to the time of day pricing initiative, as well as a set of hypothetical toll scenarios (stated preference), among others. The survey instrument was designed by the project team in close consultation with the project partners (i.e., Federal Highway Administration, PANYNJ, and New Jersey Department of Transportation) who provided invaluable comments and suggestions. Rutgers University's Eagleton Institute was in charge of conducting the computer aided telephone interviews (CATI) and submitting a clean data set to the project team. The CATI were conducted from the beginning of June to the middle of July, 2004.

In order to maximize the efficiency of data collection, the survey instrument and the overall data collection process were designed in conjunction with a sister project, i.e., the *Evaluation Study of New Jersey's Turnpike Authority Time of Day (Value) Pricing Initiative.* The resulting survey instrument had two branches: one that focused on the PANYNJ and the other that focused on New Jersey Turnpike Authority (NJTA) project. The target population was defined as all individuals who have used any of these toll facilities on a regular basis (at least once per week) since the time of day pricing implementation in March 2001 (current regular users); and those individuals that regularly used toll facilities before March 2001 and stopped doing so about that time (former regular users). However, cost considerations suggested collecting the sample from those areas that concentrate the majority of users. As a result, the sampling process focused on residents of New Jersey and Staten Island for the PANYNJ survey; and residents of New Jersey for the NJTA survey. The small sample from Staten Island users was included because prior PANYNJ research suggested that this user segment has different demographics and behaviors requiring separate treatment.

Once valid respondents were identified during the screening process, the survey branched out to either the PANYNJ or the NJTA version depending on which facility the respondents used the most. The surveys focused on regular users, i.e., individuals that used the facility at least once a week. Sporadic users (i.e., those using the facility less than once a week) were screened out of the survey. The surveys made a distinction between: (a) current regular users who have continued using the toll facilities on a regular basis (at least once per week) since before March 2001; and (b) former regular users who regularly used toll facilities before March 2001 and stopped doing so about that time. The data collected for the PANYNJ passenger survey contain 505 complete observations. Among them, 467 respondents (92.5 percent) are current regular users, and 38 respondents (7.5 percent) are former regular users. Of those surveyed, 392 respondents (77.6 percent) reside in New Jersey; while 113 respondents live in Staten Island (22.4 percent).

This chapter describes the survey methodology used, and the key findings from the analyses. Following the summary, detailed descriptions of the results are discussed.

Overview of the Data Collection Process

This section discusses the survey instrument, the sampling procedure, and the sample expansion process used. The last sub-section focuses on the process of adjusting the data to represent respondents' actual usage of the PANYNJ toll facilities.

<u>Survey Instrument</u>

The PANYNJ passenger survey is included in Appendix 9, which had eight major sections as shown in Figure 24:

(1) <u>Screening Section</u>: This section gathered general information about the respondents and determined if the respondent: (a) is indeed a valid respondent as defined in this study; and (b) could be best classified as a PANYNJ or a NJTA user.

(2) <u>Characteristics of the Most Recent Car Trip</u> (for current regular users): This section collected information about the most recent car trip that the current regular users made using any of the PANYNJ facilities. The information gathered in this section included:

trip purpose, trip frequency per month, time of travel, departure and arrival time, flexibility of departure and arrival time, tolls and other travel costs paid, among others.

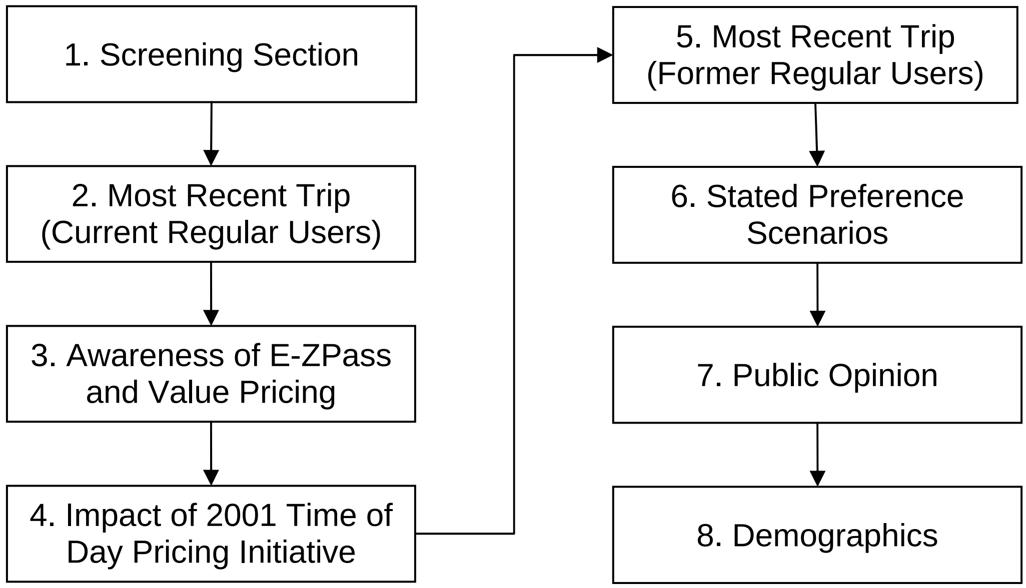

Figure 24. Outline of survey instrument

(3) Awareness of Time of Day Pricing and Toll Discounts: These sections contained questions to assess the respondents' level of awareness of tolls, the time of day pricing program and other toll discount programs.

(4) Impacts of 2001 Time of Day Pricing Initiative: This important section gathered data about the behavioral changes produced by the time of day pricing initiative. It includes questions about trips made before and after the time of day pricing initiative, focusing on trip frequency, mode choice, trip purpose, time of travel, and payment technology used, among others.

(5) Characteristics of the Most Recent Transit Trip (for former regular users): This section is similar to (2), except that it targeted former regular users and their most recent transit trips.

(6) Stated Preference Scenarios: This section was intended to assess the impact of different hypothetical combinations of toll rates and travel time savings on respondents' decisions about E-ZPass usage and travel schedules.

(7) Public Opinion: This section gathered respondents' input regarding the fairness of tolls, and other related issues. The analysis of this section is presented in a separate chapter on public opinions (Chapter X).

(8) Demographics: This section collected socio-economic data that characterize the respondents, including gender, age, education, household structure, and household income, among others.

Sampling Procedures and Data Collection

The data were collected by means of a single stage random sample using random digit telephone calls. As indicated before, the population of interest included current and former regular users. However, due to the cost constraints and the inherent difficulty of finding suitable respondents from New York and other areas, the data collection focused on current and former regular users from New Jersey and Staten Island. As a consequence, the sample does not necessarily represent the geographic distribution of typical bridges and tunnel users that may include thru trips originating and with destinations in other states.

The small sample from Staten Island users was included because this user segment was assumed to exhibit a different behavior. There are some factors suggesting explicit consideration of Staten Island users. First of all, by virtue of living on an island, the dependence on car and toll bridges by many Staten Island residents is stronger than other New York City and New Jersey residents. Transit alternatives (buses and ferries), though available, do not reach the same level of coverage and quality of service of other parts of New York City. Recognizing this, a special frequent usage discount plan was provided exclusively to passenger vehicles enrolled through a valid E-ZPass^{sm} account for use at the Bayonne Bridge, the Goethals Bridge, and the Outerbridge Crossing. Under this plan, the pre-registered E-ZPass users prepay \$50.00 for up to 20 trips in advance, to be used within a 35–day period, making the cost per trip as low \$2.50. This rate is much lower than the amount other users are currently paying (\$4.00 or \$5.00 for E-ZPass depending on time of day or \$6.00 cash at all times.)

Sample Expansion

Ideally, a sample, such as the one collected in this project, is to be expanded so that it represents the collective behavior of the universe of users. This is usually accomplished by means of an expansion procedure using a set of control totals (classified by one or more socio-economic attribute) and the number of observations for each stratum. For instance, if the number of users for each income level is known, the corresponding expansion factors could be estimated as the ratio between these control totals and the number of observations in each income level. Unfortunately, the project team did not have data that could be used as control totals (an estimate of the statistical universe) for the expansion procedure.

After considering different alternatives, the project team decided to expand the sample using the trip frequencies for each user as the expansion factor. In this way, the expanded sample represents the entire set of trips made by the respondents. As a result, the expanded sample provides an indication of the attributes of the collection of users using the facilities (in which the same individual or company uses the facility numerous times during a given time period). In other words, the responses are weighted in proportion to the respondent's trip frequency. Therefore, responses of those people who travel more often are counted more heavily than responses of people who travel less often. It is important to remember this later in the paper because it implies that the metric used in the analyses are based on user-trips; as opposed to one based on individual users. The response rate was 22 percent (all cooperative contacts divided by all good telephone numbers) and after eliminating non-contacts and “dead" contacts from the denominator, the response rate rose to 28 percent. After sample expansion, the original 505 observations were found to represent 4294 trips/month, as shown in Table 32.

Table 32. Raw and expanded sample breakdown

Areas	Raw Sample				Expanded Sample (Trip-based)			
	Current regular users		Former regular users		Current regular users		Former regular users	
	Responses	%	Responses	%	Responses	%	Responses	%
New Jersey	362	71.7%	30	5.9%	2998	69.8%	299	7.0%
Staten Island	105	20.8%	8	1.6%	931	21.7%	65	1.5%
Total	467	92.5%	38	7.5%	3930	91.5%	364	8.5%

Note: the raw sample was expanded by each respondent's reported trip frequency (trips/month) so as to represent these respondents' actual usage of the PANYNJ toll facilities.

These behavioral surveys generally represent a small sample of travelers, and do not necessarily represent the geographic distribution of PANYNJ bridge and tunnel users. The data expansion methodologies that have been employed to grow the sample size to reflect trip frequency of respondents have not attempted to address the issue of response bias that may result from this approach.

Summary of Findings

This section provides a brief summary of the key findings from the descriptive analyses. More detailed information can be found in the specific sections discussing the data.

Socio-economic Attributes of Sample

Questions in the demographics section captured the socio-economic profile of the respondents in terms of both individual and household characteristics. The weighted sample indicates that the typical respondent is a middle-aged white man with above average education level and household income: the average age of respondents is 43.7 years old (see Table 33); 63.5 percent are white (Table 35); 58.5 percent are males (see Table 34); 79.4 percent received some college or higher education degrees (see Figure 25); and have household incomes higher than the State median ($95,178 for New Jersey users vs. $55,932 from the population in New Jersey and $80,944 for Staten Island users vs. $58,667 from the population in Staten Island) [44, 45] (see Figure 26). These results are not surprising because experience shows that the population segment most likely to participate in telephone surveys is the group of middle-aged white males with above average education level and household income. However, the lack of recent data on the demographics of actual PANYNJ users (as opposed to demographics of New Jersey and New York residents) prevented the use of weights to correct potential biases in the survey. Meanwhile, the relatively high household income, considered as a determinant factor of price elasticity, suggests that these individuals are inelastic towards small changes in tolls or other travel costs.

In addition to household income, the passenger survey gathered data about household structure and car ownership, among others. These households captured in the survey have relatively small families with 2.5 adults and 1.1 children on average, and the average licensed drivers in household is 2.3 (see Table 38). More specifically, the dominant group of households is the one with two adults which account for almost half of the entire sample (48.6 percent). The number of licensed drivers in household follows the similar distribution as the number of adults. The largest group (49.2 percent) are these that have two licensed drivers. Respondents from New Jersey and Staten Island share similar distributions of household structure.

Behavioral Impacts of 2001 Time of Day Pricing Initiative

In general terms, users of the PANYNJ facilities tend to exhibit an inelastic behavior with respect to tolls. The data indicates that 35 respondents changed behavior because of the Time of Day Pricing Initiative, accounting for 7.4 percent of the entire reported passenger trips. The majority of the individuals (28 out of 35 individuals) who changed behavior still travel through the six PANYNJ toll facilities on regular basis (at least once per week) after they adjusted their travel patterns due to time of day pricing. These individuals account for 4.6 percent of the entire reported passenger trips. In contrast, the other group of individuals reporting behavioral changes (seven out of 35 individuals) switched to public transportation and reduced their car trips to less than once per week. They account for 2.7 percent of the entire reported passenger trips (Table 40). It is interesting to note that, when asked a follow up question about the main reason why they switched to transit, only two out the seven individuals mentioned toll costs. This may suggest that there are other factors, in addition to tolls, that played a role in their mode choice decisions. It needs to be noted that the most significant changes are increasing the use of public transportation, decreasing car trips rather than shifting time of travel.

Users that did not change behavior indicated that the key reasons for not changing behavior include *they have no choice*, *no flexibility to change* (45.5 percent among respondents who did not change their behavior), followed by *they should travel whenever they want to* (32.4 percent). Other respondents felt that *the toll difference was not enough to justify a change*, or *it was paid by their employers*, and some said that *they did not use the facilities enough in order to change* (Table 42).

Awareness and Usage of E-ZPass and Toll Discount Programs

The data in this section, again, refer to the trips taken by the sample respondents, rather than to the individual respondents themselves. The majority of respondents' trips are E-ZPass transactions (78.3 percent), which in 79.2 percent of the cases have been using it for three or more years (Table 43). However, this high level of E-ZPass usage does not translate into a corresponding high level of awareness of the toll discount programs. Although 62.7 percent of respondents' trips reflect an awareness that there are some toll discounts provided exclusively to E-ZPass users, the awareness of specific toll discount programs is much lower. For instance, only 17.0 percent of respondents' trips were made with an awareness of the time of day discount program (20.3 percent in New Jersey and 6.0 percent in Staten Island) (Table 44). Even among E-ZPass users' trips, the percentage is only around 21 percent (Table 45). Furthermore, awareness of toll discounts for cash users' trips is much lower than among E-ZPass users' trips (Figure 28). Low awareness of the toll discounts available to E-ZPass users may constrain the level of penetration of E-ZPass and the effectiveness of time of day pricing to balance traffic throughout the day. It suggests a need for continuing outreach to provide public information about PANYNJ E-ZPass discounts, and to distinguish them in motorists' minds from other agencies' E-ZPass discounts.

The reasons why these individuals do not use E-ZPass can be broadly classified in five major categories (Table 46). *Concerns about reliability and privacy* is the most important group, cited in 56.5 percent of the responses. The second category, *General lack of interest*, received 51.0 percent of responses. This group may correspond to users that may benefit from using E-ZPass, but do not have a strong compelling reason to do so. *Small perceived benefits* ranks third with 49.2 percent, followed by *Negative perceptions about the system* (39.4 percent) and *Dissatisfaction with the system* (31.9 percent). (The percentages do not add to 100 percent because multiple responses were allowed.)

The vast majority (78.4 percent) of E-ZPass users identified saving time as the key benefit of using E-ZPass (Table 47). It is worthwhile to note that *not having to carry cash,* with 12.2 percent of responses, ranked slightly higher than *Saves money, cheaper than cash toll* (12.0 percent), which again suggest the small role played by the 2001 time of day pricing initiative. The issues the respondents care most about are making the system more efficient, quicker, and making transponders more reliable (Table 49).

Characteristics of the Most Recent Car Trips (Appendix 5)

There are 467 current regular users in the sample, which account for 3930 trip-weighted responses after using the reported monthly trip frequency as the expansion factor. **The following analyses are based on <u>weighted responses</u>** instead of individual observations.

The majority of current regular users (74.8 percent) used E-ZPass to pay tolls for their most recent car trips.

The current regular users' <u>most recent car trips</u> tend to have the following attributes:

- The reported time of travel flexibility is within 20 minutes on average for all trips. The relatively small flexibility indicates current regular users have constraints that make it difficult to shift their current time of travel (Table 111 and Figure 99 through Figure 102).

- Interestingly enough, regardless of trip purpose, the percentage of car trips having flexibility of 30 minutes or more is roughly 10 percent. This group of current users could be the target of the time of day pricing initiative since they have the flexibility to shift their current time of travel (Figure 99 through Figure 102).
- Current regular users reported more flexibility to arrive earlier than later no matter regardless of trip purpose, which indicates that users usually prefer being earlier to being late (Figure 99 through Figure 102).
- The majority of most recent trips (61.5 percent) passing through the PANYNJ facilities were made for work-related purposes, either commuting to work (46.3 percent) or traveling for job (15.2 percent) (see Figure 94).
- Consistent with the dominance of work-related trips, vehicular traffic levels through the toll lanes in the eastbound direction is heaviest on weekdays, Fridays being the busiest days, followed by Thursdays and Wednesdays (see Figure 95 through Figure 97).
- Peak-hour trips, based on the PANYNJ's peak toll hours (weekdays 6-9 AM, 4-7 PM, weekends noon-8 PM), account for more than half of the reported trips (54.1 percent), though off-peak trips are also significant (45.9 percent) (Table 109 and Figure 98).
- Work related trips were more likely to be made in weekday peak hours than trips with other purposes. On the other hand, trips for recreational/shopping purpose were more likely to happen in the less congested time periods, i.e., weekday off-peak hours, or weekends (Figure 98).
- Work schedule (48.4 percent) or to make an appointment (22.3 percent), rather than cheaper toll (0.3 percent), are the main reasons reported for travel at the stated time (Table 110).

The survey also asked current regular users how much they paid for tolls during their most recent trip, to assess respondents' knowledge about the tolls they paid. The differences between stated and actual tolls indicate that cash users know much better how much they paid than E-ZPass users (Figure 103). The majority of cash users (60.5 percent) correctly reported the toll rates, while only 17.4 percent of E-ZPass users did so. This could be due to the fact that many E-ZPass users pay the total tolls by credit card every month and tend to ignore the amount of tolls paid (as discussed in the qualitative analysis of Chapter IV). This is a key point since E-ZPass participants comprise more than 70 percent of the users, and are the ones who can take advantage of time of day discounts. This low awareness of the actual tolls, and by extension of the off-peak discounts, may weaken the effectiveness of time of day pricing to balance traffic between peak and off-peak hours.

Nearly 74 percent of travelers stated that they did not pay for parking when they traveled to New York City most recently (because it was free or paid by someone else). The rest paid $16.40 on average, an amount more than three times greater than tolls paid during the trip. In this context, one would expect that regular users paying for parking are relatively inelastic to small toll changes. Detailed findings are shown in Appendix 5.

Characteristics of Most Recent Transit Trips (Appendix 8)

Former regular users are those individuals that regularly used toll facilities before March 2001 and stopped doing so about that time. These users were included in the survey in an effort to consider the role that the new toll pricing may have played in behavioral change, such as switching to transit. Since the survey found only 38 former regular users that account for 364 weighted trip responses, it is not possible to draw statistically solid conclusions about the socio-economic profiles of these users, though these observations may be considered qualitatively. Seven out of the thirty-eight former regular users indicated behavioral changes because of the time of day pricing initiative. Two out of the seven individuals mentioned toll costs as the key reason to switch to public transportation. The remaining five former regular users (who switched to transit) cited factors other than toll costs as the primary reason to change mode (though they had indicated that they changed behavior because of the time of day pricing initiative). The reasons given include *to adapt to their work schedule*, *to make an appointment*, *or to avoid congestion*. Detailed findings are shown in Appendix 8.

Demographics

Questions in the demographics section captured the socio-economic profile of the respondents in terms of both individual and household characteristics (e.g., gender, age, education level, household income and car ownership). This section is divided into two subsections: the first discusses the characteristics of individuals, and the second focuses on the household data. All 505 respondents, who account for 4294 weighted trip-based responses, answered the demographics questions. In terms of geographical distribution, respondents from New Jersey and Staten Island represent 3297 and 997 weighted trip-based responses respectively. The following analyses are based on weighted trip-based responses instead of the (raw) individual observations.

Characteristics of Individuals

The data indicate that the typical respondent is a middle-aged white man with above average education level. These results are consistent with the experience that shows that the population segment most likely to participate in telephone surveys is the group of middle-aged white males with above average income and education level.

As shown in Table 33, middle-aged individuals dominate the sample. The average age is 43.7 years old. Meanwhile, passengers with their ages ranging from 30 to 49 years old are the largest group, which account for almost half of weighted responses (48.3 percent). Respondents from New Jersey and Staten Island follow similar age distributions.

Table 33. Distribution of age in the weighted sample

Age	New Jersey	Staten Island	Entire Weighted Sample
18 ~ 20	3.3%	3.8%	3.4%
21 ~ 24	3.8%	11.9%	5.7%
25 ~ 29	8.2%	8.2%	8.2%
30 ~ 39	29.5%	12.0%	25.5%
40 ~ 49	19.4%	34.3%	22.8%
50 ~ 59	18.3%	16.2%	17.8%
60 ~ 64	7.1%	9.4%	7.7%
>64	6.6%	4.2%	6.1%
Do not Know/ Refused	3.7%	0.0%	2.8%
Total	100.0%	100.0%	100.0%
Based on weighted responses of	**3297**	**997**	**4294**
Average age (years)	**44.0**	**42.7**	**43.7**

More than half of respondents (58.5 percent) in the sample are male (Table 34). The proportion of male respondents (64.7 percent) from Staten Island is higher than the one among New Jersey respondents (56.6 percent).

Table 34. Gender in the weighted sample

Gender	New Jersey	Staten Island	Entire Weighted Sample
Male	56.6%	64.7%	58.5%
Female	43.4%	35.3%	41.5%
Total	100.0%	100.0%	100.0%
Based on weighted responses of	**3297**	**997**	**4294**

As shown in Table 35, White people (63.5 percent) are the dominant group among respondents, followed by Blacks (11.6 percent) and Hispanics (10.6 percent), among others. The percentage of White people among Staten Island respondents (77.0 percent) is higher than the one among New Jersey respondents (59.4 percent).

Table 35. Race in the weighted sample

Race	New Jersey	Staten Island	Entire Weighted Sample
White	59.4%	77.0%	63.5%
Black	11.5%	12.0%	11.6%
Hispanic	12.4%	4.4%	10.6%
Asian	7.4%	2.3%	6.2%
Other	2.0%	0.0%	1.5%
Do not Know / Refused	7.3%	4.2%	6.6%
Total	100.0%	100.0%	100.0%
Based on weighted responses of	**3297**	**997**	**4294**

The data also show that respondents have an above average level of education. As shown in Figure 25, more than three-quarters of respondents (79.4 percent) received some college or higher education, which is consistent for both the New Jersey and Staten Island sub-samples. The differences are that the percentages of four-year college graduates and above in New Jersey are higher than those of Staten Island.

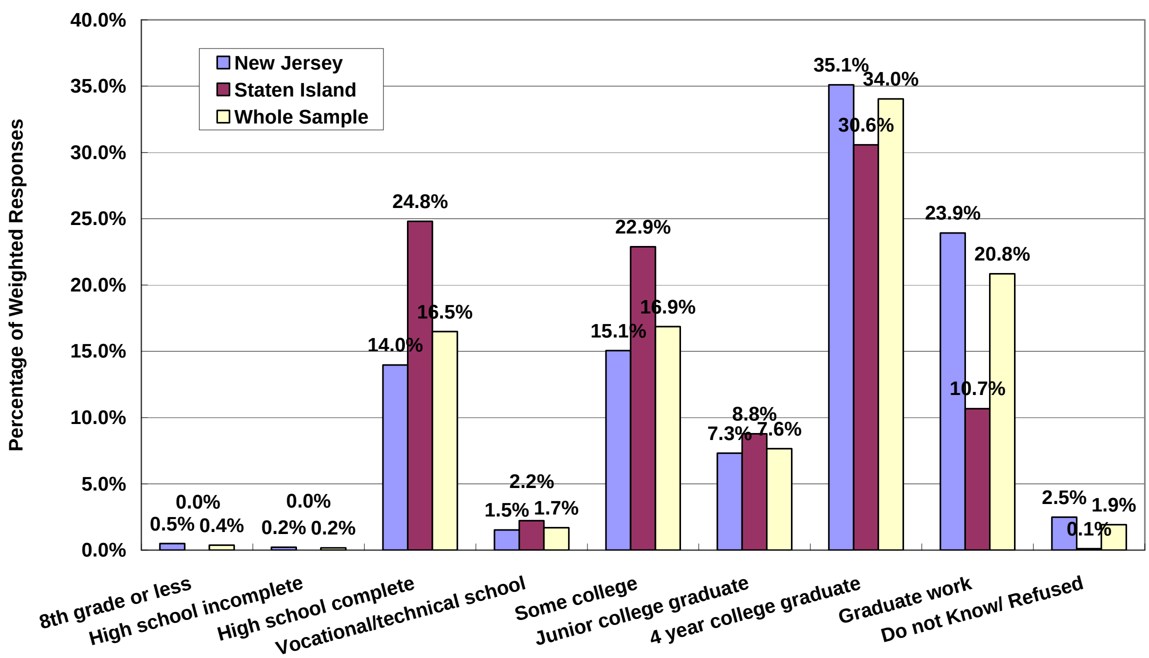

Figure 25. Education level distributions by areas in the weighted sample

The survey also asked about the respondent's employment status (Table 36). The survey data show that 87.8 percent of respondents work either full time (78.2 percent), or part time (9.6 percent). Indicating the importance of commuting, the survey results found that 69.9 percent of respondents cannot work at home (Table 37), indicating that work trips are important components of these respondents' travel schedules.

Table 36. Employment status in the weighted sample

Employment Status	New Jersey	Staten Island	Entire Weighted Sample
Employed full-time	79.4%	74.3%	78.2%
Employed part-time	8.9%	12.0%	9.6%
Retired	4.3%	4.7%	4.4%
Not working outside the home	3.3%	6.1%	4.0%
Student	1.2%	2.5%	1.5%
Don't Know/Refused	2.8%	0.4%	2.3%
Total	100.0%	100.0%	100.0%
Based on weighted responses of	**3297**	**997**	**4294**

Table 37. Could they work at home? (in the weighted sample)

Could they work at home?	New Jersey	Staten Island	Entire Weighted Sample
Yes	30.7%	22.6%	28.8%
No	68.7%	74.0%	69.9%
Don't Know/Refused	0.7%	3.4%	1.3%
Total	100.0%	100.0%	100.0%
Based on weighted responses of	**2913**	**860**	**3773**

Note: This question is only asked to those who reported being employed.

Households Characteristics

In addition to individual characteristics, the survey gathered data about the socio-economic attributes of respondents' households including: household structure, car ownership and household income, among others. The analysis suggests that most households are typically car-oriented with above average household income. The results are consistent with the individuals' characteristics, such as their education levels and employment status, analyzed in the previous subsection.

The households captured in the survey tended to be small (Table 38) with 2.5 adults and 1.1 children on average. In terms of the number of adults in household, the largest group of respondents includes those having two adults in their households (48.6 percent).

The average number of licensed drivers in household is 2.3, which is very close to the average number of adults in household. Meanwhile, the distribution of licensed drivers follows the same pattern as the distribution of adults in the household. Just over 50 percent of respondents reported the number of licensed drivers in household is two, 25.1 percent reported three and more, and 24.4 percent reported only one. The similarity between the number of adults and licensed drivers in household indicates that almost all adults in household could generate vehicle trips by themselves, adding to traffic congestion.

Households with no children are the dominant ones in the entire weighted sample. 53.7 percent of the respondents reported having no children in the household, followed by those that reported only one child (19.2 percent), two children (13.5 percent), and three and more children (10.4 percent). The average number of children in household is 1.1. Respondents from New Jersey and Staten Island have similar distributions of both household structure and licensed drivers.

Table 38. Household structure in the weighted sample

Adults in household (average)	2.6 adults	2.5 adults	2.5 adults
1	20.0%	19.5%	19.9%
2	49.8%	44.3%	48.6%
3+	26.0%	36.1%	28.4%
Do not know/Refused	4.1%	0.1%	3.2%
Total	100.0%	100.0%	100.0%
Licensed drivers in household (average)	**2.3 drivers**	**2.1 drivers**	**2.3 drivers**
1	22.4%	28.3%	23.8%
2	51.9%	40.2%	49.2%
3+	22.3%	31.5%	24.4%
Do not know/Refused	3.4%	0.0%	2.6%
Total	100.0%	100.0%	100.0%
Children in household (average)	**1.2 children**	**0.8 children**	**1.1 children**
0	53.1%	55.6%	53.7%
1	19.1%	19.4%	19.2%
2	12.6%	16.6%	13.5%
3+	11.1%	8.3%	10.4%
Do not know/Refused	4.1%	0.1%	3.2%
Total	100.0%	100.0%	100.0%
Based on weighted responses of	**3297**	**997**	**4294**

Table 39 summarizes the distribution of household car ownership in the sample. The average number of cars in household is 2.3. The largest group of respondents is the one that reported owning two cars (40.4 percent). One obvious result is that car ownership is highly correlated with the number of licensed drivers in the household, with 77.3 percent of the entire weighted sample households having at least as many cars as licensed drivers.

Table 39. Household car ownership in the weighted sample

Car Ownership	New Jersey	Staten Island	Entire Weighted Sample
Number of cars in household	**2.3**	**2.30%**	**2.30%**
0	3.7%	5.5%	4.1%
1	26.3%	24.8%	25.9%
2	42.3%	34.2%	40.4%
3+	23.7%	33.1%	25.9%
Do not know/Refused	4.0%	2.5%	3.7%
Total	100.0%	100.0%	100.0%
Based on weighted responses of	**3297**	**997**	**4294**
Among the respondents reporting car ownership:			
Fewer cars than licensed drivers	23.9%	18.9%	22.7%
Cars >= licensed drivers	76.1%	81.1%	77.3%
Total	100.0%	100.0%	100.0%
Based on weighted responses of	**3153**	**972**	**4125 (1)**

Note: not all respondents provide data.

The median household income of the respondents from the entire weighted sample, New Jersey, and Staten Island is approximately $92,223, $95,178 and $ $80,944 per year respectively. In contrast, the median household income in New Jersey and Staten Island in 2003 was only $55,932 and $58,667 respectively. [44, 45] As shown in Figure 26, 61.0 percent earned more than $55,000 per year and 35.6 percent earned more than $100,000 per year. Only 19.4 percent of these respondents earned less than $55,000 a year. The lower income level correlates with lower car ownership. Respondents from New Jersey and Staten Island stated a similar distribution of household income, although a relatively smaller proportion of Staten Island respondents made over $75,000 a year. These results indicate that off-peak discounts may not influence users' car trips and time of travel as they are likely to have relatively inelastic demand curves because of the relatively high income.

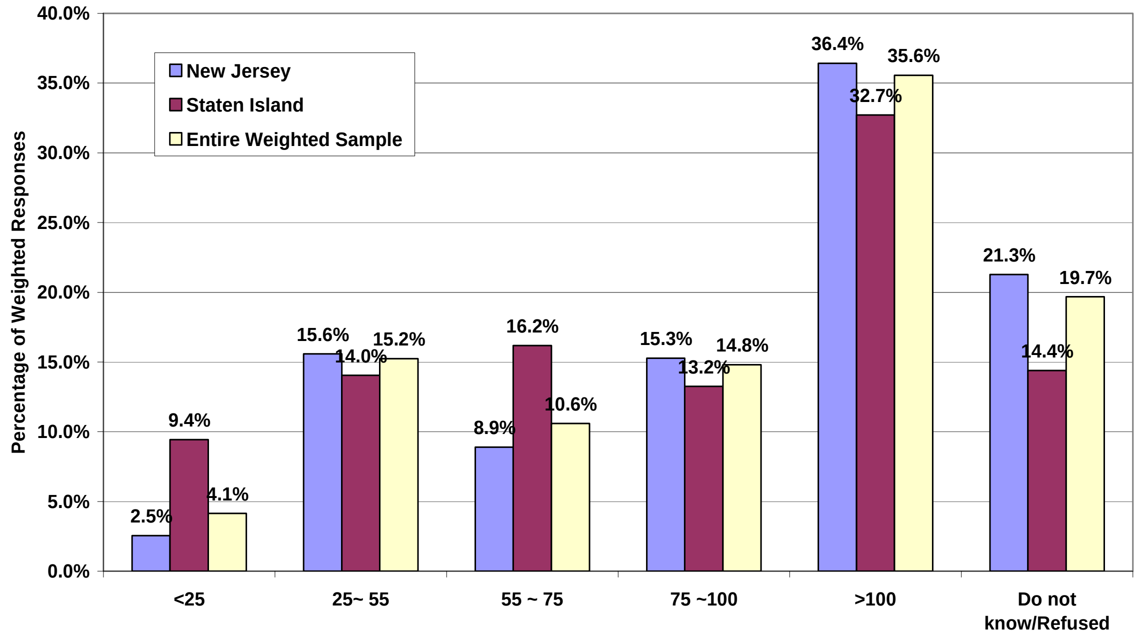

Figure 26. Distributions of annual household income by area ($1,000)

As shown in Figure 27, a little more than 70 percent of respondents reported that their household income for 2003 either increased (24.9 percent) or remained the same as in 2001 (46.6 percent). The New Jersey and Staten Island samples exhibit very similar patterns.

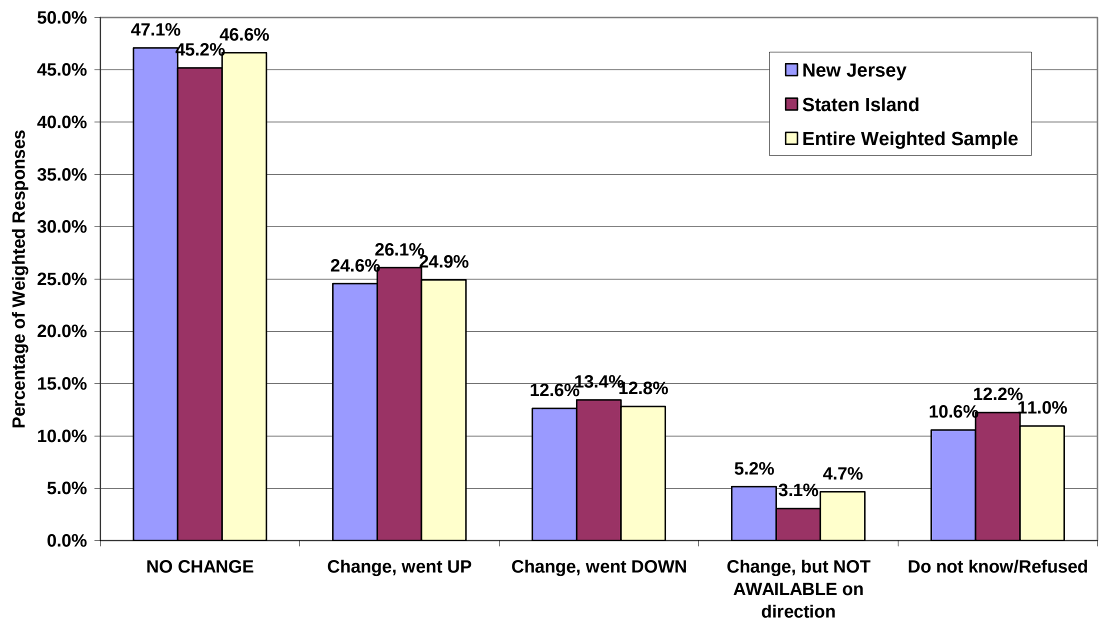

Figure 27. Change patterns in annual household income since 2001

Impacts of the Time of Day Pricing Initiative

This section analyzes the impacts of the 2001 PANYNJ time of day pricing on passenger travel behavior. Both current regular users and former regular users provided data to this section with 3297 and 997 trip-based weighted responses respectively. As typical of cases when small samples have to be used, it is important to keep in mind that the conclusions discussed in this section, that pertain to the users that changed behavior, are based upon a sample of 35 auto drivers in a region of 18 million people.

The data show that 35 passengers changed their travel behavior because of time of day pricing, which account for 316 weighted responses and 7.4 percent of the entire weighted sample. Table 40 shows the breakdown of these individuals in terms of their user type and geography. The majority of individuals (28 out of 35 individuals) who changed behavior still travel through the six PANYNJ toll facilities on regular basis (at least once per week) even though they adjusted their travel patterns because of time of day pricing. These current regular users account for 198 weighted responses and 4.6 percent of the entire weighted sample. The most significant changes are increasing the use of public transportation and decreasing car trips, rather than shifting time of travel. The other group of individuals reporting behavioral changes (7 out of 35 individuals) is the group of former regular users that account for 118 weighted responses and 2.7 percent of the entire weighted sample. Unfortunately this group reflects too small a sample upon which to base any meaningful conclusions about demographics or behavioral choices. The small sample size confirms that fact that the time of day pricing had little effect on travelers' choice of alternative modes or reduced trip-making as a result of the toll change.

Table 40. Breakdown of individuals who changed behavior

User Types	Geography	Raw Sample (505 observations)		Weighted Sample (4294 weighted responses)	
		Responses	% of entire sample	Responses	% of entire sample
Current regular users	New Jersey	22	4.4%	164	3.8%
	Staten Island	6	1.2%	34	0.8%
	Subtotal	**28**	**5.5%**	**198**	**4.6%**
Former regular users	New Jersey	5	1.0%	88	2.0%
	Staten Island	2	0.4%	30	0.7%
	Subtotal	**7**	**1.4%**	**118**	**2.7%**
All users	New Jersey	27	5.3%	252	5.9%
	Staten Island	8	1.6%	64	1.5%
	Total	**35**	**6.9%**	**316**	**7.4%**

As indicated in Table 40, the majority of respondents who changed behavior are from New Jersey. 27 out of these 35 respondents who changed behaviors are from New Jersey (5.9 percent of the entire weighted sample) while the remaining eight are from Staten Island (1.5 percent). When taking into account geography, it was found that, relatively speaking, a higher proportion of New Jersey users (7.7 percent) changed behavior compared to Staten Island users (6.4 percent), as shown in Table 41.

Table 41. Percentage of respondents who changed behavior by geography

Area	Raw Sample		Weighted Sample	
	Responses	% of subsample by area (1)	Responses	% of subsample by area (2)
New Jersey	27	6.9%	252	7.7%
Staten Island	8	7.1%	64	6.4%
Entire Sample	**35**	**6.9%**	**316**	**7.4%**

Note: (1) There are 392 New Jersey respondents, 113 Staten Island respondents and 505 respondents in total in the raw sample as shown earlier by Table 32;

(2) The weighted responses from New Jersey, Staten Island and the entire sample are 3297, 997 and 4294 respectively as shown earlier in Table 32.

Impacts on Current Regular Users

The data show that 28 respondents out of 467 current regular users changed their travel patterns because of time of day pricing, which accounts for 198 weighted responses and 4.6 percent of the sample once weighted by trip frequency (4294 weighted responses in the entire sample). Table 40 shows the geographic distribution of these respondents. The 22 current regular users who changed travel behavior are from New Jersey, representing 164 weighted responses and 3.8 percent of the entire weighted sample. Six Staten Island current users who changed behavior account for 34 weighted responses and 0.8 percent of the entire weighted sample.

Impacts on Former Regular Users

Only seven respondents out of 38 former regular users reported behavioral changes because of time of day pricing. They represent 118 weighted responses and 2.7 percent of the entire weighted sample. Among these former regular users, five respondents are from New Jersey (2.0 percent), and the remaining two are from Staten Island (0.7 percent). It is interesting to note that, when asked a follow up question about the main reason why they switched to transit, only two out of the seven individuals mentioned toll costs.

Reasons for Not Changing Behavior

As Table 42 shows, the respondents who did not change behavior did so because *they had no choice or no flexibility to change* (45.5 percent), or because they believe *they should travel whenever they want to* (32.4 percent). Other respondents felt that *the toll difference was not enough to justify a change*, or *it was paid by their employers*, and some said that *they did not use the facilities enough in order to change*.

Table 42. Reasons for not changing travel behavior

Reasons for not changing	New Jersey	Staten Island	Entire Weighted Sample
Have no choice, no flexibility	45.1%	47.0%	45.5%
My choice, I go when I want to go, convenient	30.9%	37.0%	32.4%
Price difference not that much\can afford it	11.3%	1.6%	8.8%
Toll is paid by employer	5.0%	6.3%	5.3%
Do not use it that much	2.6%	1.6%	2.4%
Do not Know / Refused	5.2%	6.5%	5.5%
Total	100.0%	100.0%	100.0%
Based on weighted responses of	**1609**	**536**	**2145**

Note: Only those who used the facilities more than three years and could also remember the implementation of time of day pricing and did not change behavior were asked this question.

Detailed findings of impacts of the time of day pricing initiative are shown in Appendix 6 and Appendix 7.

Awareness of Toll Discount Programs

This section discusses the respondents' level of awareness of key features of the available toll discounts: time of day, carpooling, general E-ZPass and the frequent use discount program (Staten Island only). The analyses place special emphasis on users' awareness of the toll discounts. This is important because time of day (and other) discounts are only available to E-ZPass users, and whether E-ZPass users are aware of the toll discounts available to them determines how they would react. For that reason, identifying the factors that encourage or discourage E-ZPass usage (and awareness of toll discounts) is a key component of policies to increase E-ZPass usage and, ultimately, increase the efficiency of the time of day pricing initiative. The questions in this section correspond to: usage of E-ZPass, awareness of the toll discount programs, reasons for using / not using E-ZPass, who paid for E-ZPass, advantages / disadvantages of E-ZPass, and suggestions for improving the E-ZPass system.

Most questions in this section were asked to all respondents participating in the survey, who account for 4294 trip-based weighted responses. As done before, the following analyses are based on weighted responses.

Usage of E-ZPass

The majority of respondents' trips (78.3 percent) were paid with an E-ZPass tag. The proportion of the E-ZPass users' trips from New Jersey (77.7 percent) is slightly lower than those from Staten Island (80.1 percent). As shown in Table 43, more than three-quarters of E-ZPass users' trips (79.2 percent) have been using it for three or more years, i.e., 2001 and before. The table also indicates that 61.6 percent of respondents' trips were made with tags obtained between two and five years ago (1999-2002).

Table 43. Number of years owning an E-ZPass tag

Answer	New Jersey	Staten Island	Entire Sample
Less than a year	2.1%	6.5%	3.1%
1 year	8.3%	3.6%	7.2%
2 years	13.7%	0.1%	10.4%
3 years	18.1%	8.6%	15.8%
4 years	13.4%	6.9%	11.9%
5 years	23.7%	22.9%	23.5%
6 years	6.1%	16.2%	8.5%
7 years	4.4%	6.3%	4.9%
8 years	4.0%	0.4%	3.2%
9 years	1.1%	0.0%	0.9%
10 years	3.0%	17.6%	6.4%
Do not Know/Refused	2.1%	10.8%	4.2%
Total	100.0%	100.0%	100.0%
Based on weighted responses of	**2562**	**798**	**3360** (1)

Note: (1) The weighted responses are from those who reported having E-ZPass tags.

About three-quarters of E-ZPass users' trips (75.8 percent) were paid by the individual traveler, while a relatively small group said that their trips were paid by their employer (10.6 percent) or a family member (12.4 percent). The latter groups may be less sensitive to toll changes through the day given that they do not pay.

Awareness of Toll Discount Programs

Both cash and E-ZPass users were asked if they were aware of any toll discounts. The data show that the majority of respondents' trips (62.7 percent) were made with awareness about the availability of some kind of discounts provided to E-ZPass users, though they were not sure about the details. Table 44 shows users' awareness of the available discounts for each trip they reported.

In general terms, 45.4 percent of respondents' trips where made with awareness of the three discount programs (time of day discount, frequent use discount of Staten Island bridges and carpooling discount). The respondents' trips in the second largest group (23.4 percent) were made with a vague idea about the discount programs; while 37.3 percent of the reported trips were made without being aware of any discount program. As shown, the most widely known discount program is the frequent use discount of the Staten Island bridges (21.6 percent) followed by the time of day pricing discounts (17.0 percent). It is also important to note that approximately 23.0 percent of respondents' trips were made with the basic knowledge of general toll discounts (10.2 percent) or heard of discounts but were not aware of any specific details (13.2 percent). Those respondents' trips made while *vaguely* or *not aware of any discount* are less likely to change their travel patterns due to time of day because of their poor awareness of the toll discounts.

Table 44. Awareness of toll discounts (all users)

Toll Discounts	New Jersey (1)	Staten Island	Entire Sample
Aware of discounts	**38.3%**	**69.1%**	**45.4%**
Frequent use of Staten Island bridges	11.5%	55.0%	21.6%
Time of day/off-peak use	20.3%	6.0%	17.0%
Carpool	6.4%	8.1%	6.8%
Vaguely aware of discounts	**25.2%**	**17.6%**	**23.4%**
EZ-Pass discount	9.4%	12.8%	10.2%
Heard of discounts, do not know specifics	15.8%	4.8%	13.2%
Not aware of any discount	**41.6%**	**22.9%**	**37.3%**
Based on weighted responses of	**3297**	**997**	**4294**

Note: Each respondent can select more than one option; therefore, the total percentage is greater than 100 percent.

There is a noticeable difference in the level of awareness of toll discounts between New Jersey and Staten Island users' trips. As shown, 69.1 percent of Staten Island users' trips were made with an understanding of the three discount programs offered to them, while only 38.3 percent of New Jersey users' trips were made with an awareness of their discount programs. Meanwhile, more than half of Staten Island users' trips were made with knowledge of the frequent use discounts in contrast to approximately ten percent of New Jersey users' trips. This could be explained in part by the fact that the time of day discounts are lower than the Staten Island frequent use discounts and therefore are less likely to be noticed in New Jersey users' trips. Another factor may be that Staten Island users' trips by virtue of their dependence on bridges and the relatively smaller geographic area are likely to be more aware of the toll structure at the bridges they depend on.

Participants were then asked explicitly if they were aware of the off-peak discounts available to E-ZPass users. The percentage of awareness increased from 17 percent mentioned earlier to 41.5 percent. This indicates that a significant group of users may have heard about the time of day pricing discounts but tend to ignore it.

As shown in Figure 28, E-ZPass users are much more likely to know about toll discounts than cash users, which is consistent with what one would expect. About three-quarters of E-ZPass users' trips among the sample were made with knowledge of the toll discounts, while only one-quarter of cash users' trips know about them. This pattern stands out especially for Staten Island users: almost all E-ZPass users' trips where made with some knowledge about toll discounts; while less than 15 percent of cash users' trips reported awareness of discounts. Table 45 explains this pattern more specifically. For any discount program, E-ZPass users are more aware than cash users, regardless of their place of residence. Furthermore, E-ZPass users from Staten Island are much more likely to know the frequent use discount of Staten Island bridges; and less aware of the time of day pricing program (which is the opposite of New Jersey E-ZPass users). A factor that may help explain the difference in levels of awareness among E-ZPass users may have to do with the significance of the toll discounts offered by a specific discount program. More specifically, E-ZPass users who join the Staten Island frequent use plan pay as little as $2.50 per trip no matter when they travel, whereas other E-ZPass users pay $5.00 and $4.00 to travel during the peak and off-peak hours respectively. In terms of magnitude, the frequent-user discount is more important than the time of day pricing discount. Users subscribing to the carpool program pay (only $1.00) even less than the users of the frequent use discount program. However, a very small proportion of people use it due to the inherent difficulty of meeting the required minimum number of passengers (three passengers in a car).

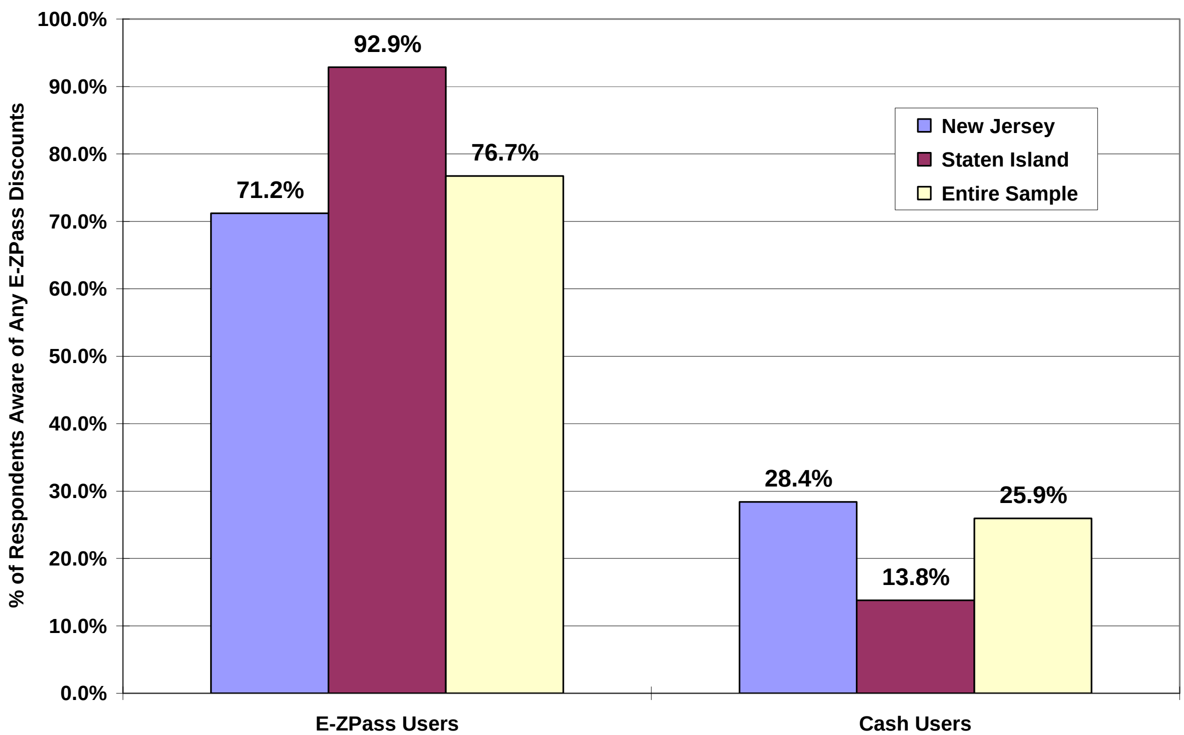

Figure 28. Awareness of toll discounts by type of users

Table 45. Awareness of various toll discounts by type of users

E-ZPass Discounts	New Jersey		Staten Island		Whole Sample	
	E-ZPass	Cash	E-ZPass	Cash	E-ZPass	Cash
Frequent use of Staten Island bridges	13.2%	5.9%	68.7%	0.0%	26.4%	4.6%
Time of day/off-peak use	25.1%	3.7%	6.8%	3.0%	20.8%	3.5%
Carpool	8.0%	0.7%	9.8%	1.0%	8.5%	0.7%
General EZ-Pass discount	9.2%	10.0%	14.3%	6.7%	10.4%	9.3%
Heard of discounts but do not know specifics	14.9%	18.7%	5.3%	3.0%	12.6%	15.4%
Not aware of any discount	35.8%	61.9%	7.1%	86.2%	29.0%	67.1%
Based on weighted responses of	**2562**	**735**	**798**	**199**	**3360**	**934**

Note: Each respondent can select more than one option; therefore, the total percentage is greater than 100 percent.

Reasons Offered for Not Using E-ZPass by Cash Users

The reasons why cash users do not use E-ZPass can be broadly classified in five major categories, as shown in Table 46. *Concerns about reliability and privacy* is the most important group, cited in 56.5 percent of the trip responses. The second group of reasons, *General lack of interest*, received 51.0 percent of trip responses. This group may correspond to users that, although may benefit from using E-ZPass do not have a compelling reason to do so. *Small perceived benefits* ranks third with 49.2 percent, followed by *Negative perceptions about the system* (39.4 percent) and *Dissatisfaction with the system* (31.9 percent).

One of the most significant reasons for not using E-ZPass is related to service reliability. A number of respondents said that they *were afraid of being overcharged or fined in the case that the tag did not work right* (33.9 percent). The data show that a fraction of current cash users are former E-ZPass users since 27.4 percent of them said that *they would not use it again*, and 4.5 percent cited *past problems with E-ZPass*. Approximately 25.0 percent of respondents said that *they do not subscribe to the E-ZPass system because they think it would be too much trouble to get one* (22.3 percent), or *it seems complicated to use* (2.2 percent). Further, 23.0 percent do not use E-ZPass because *they do not want to give out their personal information*. Some users (7.8 percent) said that *it would be too expensive to get a tag*. Some cash users do not have an E-ZPass tag because *they did not know where to get one* (12.9 percent), while other users *have never really thought about getting one* (25.1 percent), or *they have never gotten around to it* (13.1 percent).

Table 46. Reasons for not using E-ZPass (cash users)

Major Reasons	New Jersey	Staten Island	Entire Sample
Concerns about reliability and privacy	**57.1%**	**54.3%**	**56.5%**
Afraid of overcharges and fines if tag doesn't work	34.1%	33.2%	33.9%
I don't want to give out personal information	23.0%	21.1%	22.6%
General lack of interest	**46.3%**	**68.4%**	**51.0%**
I just never really thought about getting it	23.3%	31.7%	25.1%
Never got around to it	10.5%	22.6%	13.1%
I don't know where to get E-Zpass	12.5%	14.1%	12.9%
Small perceived benefits	**44.9%**	**64.9%**	**49.2%**
It really won't save me any time	12.1%	37.7%	17.6%
The discounts are not large enough	16.2%	21.6%	17.3%
It really won't save me any money	16.6%	5.5%	14.2%
Negative perceptions about the system	**39.0%**	**40.7%**	**39.4%**
It is too much trouble to get one	21.2%	26.2%	22.3%
It is too expensive to get one	6.0%	14.6%	7.8%
Anticipate errors or problems	3.9%	0.0%	3.1%
Puts people out of work	3.2%	0.0%	2.5%
Seems complicated to use	2.9%	0.0%	2.2%
Difficult to purchase	1.8%	0.0%	1.4%
Dissatisfaction with the system	**32.7%**	**29.2%**	**31.9%**
Wouldn't use it again	26.9%	29.2%	27.4%
Past problems with EZ Pass	5.8%	0.0%	4.5%
Based on weighted responses of	**735**	**199**	**934**

Note: This question accepted multiple answers; therefore, the totals are greater than 100 percent.

E-ZPass Users' Perceptions About the E-ZPass System

The survey included questions about what E-ZPass users like or dislike about E-ZPass (respondents were able to select more than one reason). Table 47 and Table 48 present the statistical breakdown of their responses.

The vast majority (78.4 percent) of E-ZPass users identified saving time as the key benefit of the E-ZPass system. It is worthwhile to note that *Not having to carry cash* with 12.2 percent of responses ranked slightly higher than *Saves money, cheaper than cash toll* (12 percent), which again suggests the small role played by tolls. The issues the respondents care the most about are making the system more efficient, quicker, and making transponders more reliable.

E-ZPass users identified a number of traffic-related, financial and procedural benefits associated with E-ZPass usage. More than three quarters of the E-ZPass users cited time savings as the primary benefit of E-ZPass usage. On the other hand, only 12 percent selected cost savings as a reason to like the system. E-ZPass users from Staten Island are more likely to cite cost savings as a key benefit (18.9 percent) than those from New Jersey (9.8 percent). This may be a reflection of the frequent use discount they receive. Procedural issues were also mentioned: some liked the fact that *they do not need to carry cash* (12.2 percent), *they do not need to interact with toll collector* (5.6 percent), or *simply that it is less stressful* (4.1 percent).

Table 47. Reasons for liking the E-ZPass system

Advantages of E-ZPass	New Jersey	Staten Island	Entire Sample
Traffic Related Benefits			
Saves time/quicker	77.5%	81.4%	78.4%
Financial Benefits			
Saves money, cheaper than cash toll	9.8%	18.9%	12.0%
Operational Benefits			
Do not need to carry cash	13.6%	7.5%	12.2%
Do not need to interact with toll collector	5.1%	7.0%	5.6%
Less stressful	4.4%	3.1%	4.1%
Just easier	2.7%	0.3%	2.1%
Like the itemized statement-no receipts	0.9%	3.1%	1.5%
Safer	1.2%	0.0%	0.9%
Can use it for parking	0.0%	0.0%	0.0%
Can use it for other toll roads	0.0%	0.0%	0.0%
Nothing in Particular	2.7%	1.8%	2.5%
Based on weighted responses of	**2562**	**798**	**3360**

Note: This question accepted multiple answers; therefore, the totals are greater than 100 percent.

E-ZPass users were also asked what they do not like about E-ZPass (see Table 48). The results show that about 44.0 percent of E-ZPass users are satisfied with the way the system works. The others offered different reasons for not liking it, varying from financial issues and concerns about potential problems of E-ZPass transponders, to procedural inconveniences. Financial concerns are associated with tying up their money, fear of being overcharged, and the perceived difficulty of tracking how much money they spend on tolls. A number of respondents (7.4 percent) cited *monthly fees* as the key reason for not using E-ZPass. Concerns about E-ZPass transponders focus on the potential failure of E-ZPass tags. It suggests that the reliability of E-ZPass tags is an important indicator of the service quality of E-ZPass. Several inconvenience factors were mentioned by the users, such as *I have to slow down to pay the to*ll, and it *is hard to find/get to E-ZPass booths*. A group of E-ZPass users (8.9 percent) said that using a tag does not make their trips any faster.

Table 48. Reasons for disliking the E-ZPass system

Disadvantage of E-ZPass	New Jersey	Staten Island	Entire Sample
NO, NOTHING IN PARTICULAR	40.9%	53.6%	43.9%
Financial Concerns	**17.5%**	**17.8%**	**17.6%**
Monthly fee	8.6%	3.5%	7.4%
Do not want to tie up money in my account	4.4%	6.9%	5.0%
Afraid of being overcharged	2.6%	4.3%	3.0%
Hard to keep track of how much spent on tolls	1.9%	3.1%	2.2%
Transponder Related Issues	**19.0%**	**9.8%**	**16.9%**
Tag does not always work	9.4%	8.5%	9.2%
You get fined if tag does not work	7.3%	1.3%	5.8%
Afraid it will not work, will not be read	2.1%	0.1%	1.6%
Battery life	0.3%	0.0%	0.2%
Procedural Inconveniences	**16.3%**	**10.3%**	**14.8%**
Have to slow down for toll	9.7%	4.2%	8.4%
Hard to find/get to EZ Pass booths	6.2%	6.0%	6.1%
Too complicated to use	0.4%	0.1%	0.3%
Small perceived benefits	**10.0%**	**5.3%**	**8.9%**
Paying toll not any faster, still traffic	10.0%	5.3%	8.9%
Privacy Concerns	**0.0%**	**3.8%**	**0.9%**
Afraid of giving credit card, personal information	0.0%	3.8%	0.9%
Based on weighted responses of	**2562**	**798**	**3360**

Note: Each respondent could select more than one option; therefore, the total percentages are greater than 100 percent.

Suggestions for Improving the E-ZPass System

Both E-ZPass and cash users offered diverse suggestions for improving the E-ZPass system (Table 49). A large group of respondents (29.6 percent) thought that the system works fine the way it is. The suggestions mainly focused on ways to improve performance in terms of time, cost, and service quality. A significant number of respondents want to make it faster to move through toll booths (29.5 percent combined). They suggested either high speed toll lanes or separate E-ZPass lanes, so that they do share road space with the cash users and therefore move quicker. Another group wants to receive either a discount for use or a bigger discount for using E-ZPass (17.1 percent). Some respondents (8.4 percent combined) want *better public relations / communications*, *the service expansion to other venues* or *better customer service*.

Table 49. Suggestions for improving the E-ZPass system

Major Reasons	**New Jersey**	**Staten Island**	**Entire Sample**
No, nothing in particular	**27.1%**	**38.7%**	**29.6%**
Time	**30.7%**	**24.8%**	**29.4%**
High speed toll lanes	20.8%	18.8%	20.4%
Make EZ Pass lanes separate, quicker	9.9%	6.0%	9.1%
Cost	**20.9%**	**26.0%**	**22.0%**
Give a bigger discount for use	8.3%	16.1%	10.0%
Give a discount for use	7.2%	6.6%	7.1%
Get rid of monthly fees	3.5%	3.2%	3.5%
No hold on credit card accounts/no prepayment	1.8%	0.0%	1.4%
Service Quality	**7.4%**	**12.0%**	**8.4%**
Better Public Relation, communication	5.7%	3.4%	5.2%
Expand use to other venues	1.0%	5.9%	2.1%
Better customer service	0.7%	2.7%	1.1%
System Accessibility	**4.1%**	**5.2%**	**4.4%**
Make it easier to get a tag	4.1%	5.2%	4.4%
Privacy Related:	**2.4%**	**1.8%**	**2.3%**
Make sure that information is not used to track people	2.4%	1.8%	2.3%
Don't know/refused	11.6%	3.8%	9.9%
Based on weighted responses of	**3360**	**934**	**4294**

Note: Each respondent can select more than one option; therefore, the total percentages are greater than 100 percent.

Conclusions

The analyses conducted are based on 505 complete passenger surveys collected during the period mid June - mid July, 2004. The following is a list of the key findings (percentages shown are with respect to the total number of trips made by the users):

- Users of the PANYNJ facilities tend to exhibit a relatively inelastic behavior with respect to tolls. The data indicates that 35 out of 505 individuals (7.4 percent of passenger trips) changed behavior after the time of day pricing initiative.
- The main reasons for not changing travel behavior include they have no choice, no flexibility to change (45.5 percent), and they should travel whenever they want to (32.4 percent).
- The time of travel flexibility data indicate that the majority (about 60 percent) of passengers have some flexibility, averaging 18.0 minutes (early departure), 14.4 minutes (late departure), 19.6 minutes (early arrival) and 12.2 minutes (late arrival). The relatively small time of travel flexibility indicates passengers' difficulties to shift their current time of travel.
- Although the majority of respondents are E-ZPass users (78.3 percent), this high level of E-ZPass usage did not translate into a high level of awareness of the toll discount programs, as one may expect. Although 62.7 percent are aware that there are toll discounts provided exclusively to E-ZPass users, only 17.0 percent were aware of the time of day discount program. Even among E-ZPass users, the percentage is only around 21 percent. Low awareness of the toll discounts available to E-ZPass users is bound to constrain the ability of time of day pricing in balancing traffic throughout the day. It suggests the need for expanded and perhaps improved outreach to disseminate public information.

CHAPTER VI

ATTITUDINAL FACTORS EXPLAINING THE USE OF E-ZPASS BY FREIGHT CARRIERS

Introduction

Since the Port Authority of New York and New Jersey (PANYNJ) introduced E-ZPass technology at their facilities in 1997, a series of improvements, such as the time of day pricing program, have been adopted to manage traffic demand and to increase mobility. Understanding the behavior of freight carriers towards E-ZPass technology is a necessary condition for defining and implementing policies to increase E-ZPass usage among freight carriers. This chapter attempts to help fill this void by conducting an econometric investigation on the freight carriers' E-ZPass choice behavior. This chapter provides a summary of research that was undertaken by the PANYNJ, in conjunction with Roper ASW, Inc., in November 2002 to assess the issues and concerns of truckers in adopting the E-ZPass toll technology. (1) While E-ZPass transactions by trucks had lagged those of autos by as much as 9 percent at the time, the situation in the first quarter of 2005 has seen this margin all but disappear. The current percentage of E-ZPass transactions by truckers now matches the percentage from autos.

The project team has used the 2002 data set from the PANYNJ study to employ a means of estimating discrete choice models. The intent was aimed at defining policies to increase E-ZPass usage by freight carriers. However, the age of the data and changes in the E-ZPass market at PANYNJ crossings makes this assessment somewhat out of date.

The data contain information about freight carriers' perceptions of the E-ZPass technology, as well as basic data about company characteristics. Among other things, the estimation of discrete choice models enables: (1) to conduct the analyses using techniques solidly grounded on behavioral theory; (2) the quantitative analysis of policies to improve E-ZPass usage; and (3) the estimation of the roles played by interactions among variables.

The remainder of the chapter is organized as follows: 1. Brief review about the related studies about freight carriers' attitudes towards new technologies. 2. Discussion about the trucking industry in general. 3. Introduction of the data set and the variables that are used for the analysis. 4. Descriptive analyses are made to qualitatively identify the potential reasons and factors that affect the E-ZPass choice behavior. 5. Presentation and discussion on the modeling results. 6. Discussion on policy implications and suggestions. Finally, this chapter ends with summarizing the major findings.

Previous Research

In the past fifteen years, several studies have been conducted to gain insights into the attitudes of trucking industry towards new technologies. A survey was conducted by Scapinakis and Garrison to gather data about carriers' perceptions about communications and positioning systems. [(46)] Kavalaris and Sinha surveyed freight carriers to investigate their attitudes towards ITS technologies. [(47)] They found that unawareness of ITS features had a negative impact on the level of penetration of ITS technologies. Regan, Mahmassani and Jaillet used a survey with about 300 interviewed companies to describe carriers' willingness to use new technologies. [(48)] Some business attributes, such as company size, were found to be highly correlated with freight carriers' acceptance of new technologies. Holguín-Veras found that, although the vast majority of container terminals had implemented information systems such as container status inquiry systems, freight carriers were still reluctant to use them. [(49)] Using random utility models, he found that the decision to use this information system was a function of company size and cost, among other variables. Golob and Regan analyzed the attitudes of common (for-hire) and private freight carriers about the impacts of congestion on their operations and the feasibility and effectiveness of potential congestion mitigation policies. [(50)] Golob and Regan used a multivariate discrete choice model to predict probabilities of adoptions of information technologies in trucking operations. [(51)] The common thread across the research reported here is that the attitude toward technology depends on operational characteristics such as basic carrier types, primary service, size of fleet, and load types. The bulk of the previous research focused on common (for-hire) carriers, i.e., those that sell transportation service in an open market. This neglects to study the behavior of private carriers, i.e., those that conduct transportation service for a parent company, which in fact represent the most important segment of the trucking industry transporting 51 percent of the 7.62 billion tons, and 23 percent of the ton-miles in 2002. [52] Among other contributions, the data used in this chapter enables a comparative study of the behavior of common and private carriers.

Description of the Data

The data used in the chapter was originally collected for the PANYNJ in 2002 to conduct a qualitative analysis explaining the attitudes of freight carriers towards E-ZPass. [1] Five hundred and seven companies located in New Jersey, New York, Pennsylvania and Connecticut, which had trucks using the six PANYNJ crossings, completed the survey. In the PANYNJ survey, separate questions for E-ZPass users and nonusers were included. These two datasets were consolidated into one for modeling purposes. These questions can be grouped into two categories: revealed preference questions and stated preference questions. The former included questions about the freight carriers' attributes and their awareness of E-ZPass. The latter was to evaluate the impact of some hypothetical E-ZPass programs.

The revealed preference questions, which account for a significant portion of the survey, can be clustered into three groups:

- Awareness of E-ZPass program features: this group includes three binary variables that represent freight carriers' awareness of E-ZPass features: whether they knew about the basic E-ZPass discounts, the time of day pricing initiative, and the off-peak discounts provided to E-ZPass users.
- Company attributes: the variables in this group characterize the companies in terms of the total number of trucks in the company, the type of trucks owned, the total number of interstate truck drivers employed by the company, and business types (i.e., common carriers, private carriers, owner operators, independent owner operators).

- Business patterns: this group contains information about the delivery characteristics and cargo attributes of freight carriers. The typical variables include: frequency of passing through the PANYNJ facilities during the past 90 days, the origins of the majority of deliveries (i.e., New York, New Jersey, Pennsylvania or Connecticut), the destinations of deliveries (i.e., New York State, or New Jersey) and the type of commodity they transport.

Although undoubtedly valuable, the data have some limitations. First and foremost, the data set is now old, and market conditions of E-ZPass use have changed substantially, suggesting a change in truckers perceptions of the electronic toll technology and it value. The 2002 data set gathered no information about the travel time saved by using E-ZPass. This prevented including time saved in the discrete choice models. However, it should be pointed out that since the time saved is relatively constant for all freight carriers, its contribution to the utility function would be captured (at least in part) by the constant term. Second, since the data was originally intended for qualitative analyses as opposed to discrete choice modeling, many quantitative variables, e.g., frequency of using the PANYNJ facilities, were gathered using fairly wide ranges which introduce estimation errors.

Descriptive Analyses

This section provides a summary of the descriptive analyses of the PANYNJ data. These analyses are intended to provide the reader with an idea about the composition of the sample, as well as the key factors explaining E-ZPass choices.

Sample Characteristics

In the strictest sense, the population of users of PANYNJ facilities should include all companies in the lower 48 States, and even Canada and Mexico, that use these facilities on a regular basis. However, because of the prohibitive costs of finding valid respondents from this huge universe of potential respondents, the target population for the survey was limited to users located in New Jersey, New York, Pennsylvania and Connecticut. This decision was supported by a 2000 Truck Survey conducted by the

PANYNJ that indicates that more than 80 percent of the trucks passing through the PANYNJ facilities originate from these four states, while 90 percent of such trucks deliver to locations within these four states.

The companies in the sample were evenly divided between common carriers (50 percent) and private carriers (49 percent). As shown in Table 50, almost half of the companies defined themselves as freight carriers, while only 3.47 percent said they were moving companies. Other types of company types include: manufacturing (10.87 percent), distributor (15.17 percent), construction (4.41 percent), service (7.12 percent) and others (11.51 percent). For analysis purposes, trucking and moving companies were classified as common carriers, since they provide transportation service to the open public; while all other company types were considered to be private carriers, because they provide service to a specific company.

The average fleet size for these companies is 11 trucks. E-ZPass nonusers tended to have small or medium sized fleets while the majority of users had medium or large fleet size. 39 percent of nonusers had only one truck and a little more than 36 percent had 2-5 trucks. 51 percent of E-ZPass users had 2-10 trucks and 18 percent had more than 11 trucks.

Table 50. Company types

Type of companies	Percentage
Common carriers:	
Trucking	46.00%
Moving	3.47%
Private carriers:	
Manufacturing	10.87%
Distributor	15.17%
Construction	4.41%
Service	7.12%
Others	11.51%
Missing data	1.45%
Total	100.00%

As shown in Table 51, the sample was dominantly composed of small or medium size companies. The fleet sizes of 82 percent of companies ranged from 1 truck to 10 trucks, while only 18 percent owned more than 10 trucks. The average fleet size for these companies was 11 trucks. For the types of trucks, the 2-axle trucks, 3-axle trucks and 5-axle trucks were the most popular types of trucks owned by companies as shown in Table 52. A very small percentage of companies owned trucks with more than six axles.

Table 51. Fleet size distribution

Fleet size (trucks)	Percent among the sample
1	27.30%
2~5	42.49%
6~10	12.09%
11~49	14.63%
>=50	3.49%
Total	100.00%
Average fleet size	11 trucks

Table 52. Breakdown of trucks by number of axles

Number of trucks	2 axles	3 axles	4 axles	5 axles	6 axles	More than 6 axles	Total
1	11.19%	4.76%	1.23%	10.70%	1.70%	0.39%	29.97%
2~5	27.44%	7.90%	2.28%	6.60%	1.58%	0.24%	46.04%
6~10	6.15%	1.15%	0.71%	2.32%	0.00%	0.10%	10.42%
11~49	3.47%	2.33%	0.75%	3.63%	0.42%	0.45%	11.05%
>=50	1.01%	0.49%	0.10%	0.91%	0.00%	0.00%	2.51%
Total	49.26%	16.63%	5.06%	24.16%	3.71%	1.18%	100.00%

Food, building materials, lumber, metal, cars, and general merchandise were the most common commodities that the target companies delivered, which accounted for 19.89 percent, 15.35 percent, 9.41 percent, 9.24 percent, 6.8 percent and 5.57 percent respectively. More than three quarters of all the companies had the majority of their deliveries originate in either New Jersey (40.76 percent) or New York (35.82 percent), while a quarter of all trucks originate in Pennsylvania (16.98 percent) or Connecticut (6.22 percent). The destinations of their deliveries were multiple, though most of them were located in New York City (62.52 percent), New York State (47.88 percent), New Jersey (45.26 percent) or other places.

The data indicated a number of differences between the common and private carriers. As shown in Table 53, among the companies that used the PANYNJ facilities, the common carriers tended to be larger and used the PANYNJ facilities more frequently than the private carriers, which is true for both nonusers and users of E-ZPass. Another general finding is that, for the same type of companies (common carriers or private carriers), E-ZPass users were larger and used the PANYNJ facilities more frequently than the nonusers. E-ZPass users passed through the PANYNJ facilities 42 times on average during the last 90 days while nonusers used the facilities only 25 times if both of them belonged to common carriers. Meanwhile, among the private carriers, the average frequency of E-ZPass users (40 times) was also much higher than the nonusers' (20 times).

Table 53. Comparison between common and private carriers

Key variables	Nonusers		Users	
	Common Carriers	Private Carriers	Common Carriers	Private Carriers
Frequency (1)	25	20	42	40
Number of trucks	7	6	16	11
Number of interstate drivers	6	5	17	7

Note: (1) Frequency of using the PANYNJ facilities during the last 90 days;

(2) The numbers in the table are the average values.

Common and private carriers exhibited different levels of awareness of the various E-ZPass features, as shown in Table 54. When both of them are E-ZPass nonusers, common carriers were slightly less aware of the E-ZPass features, such as the basic discount and the off-peak discount. However, if both of them were E-ZPass users, common carriers were more likely to know the E-ZPass discount programs than private carriers, especially the off-peak discount program. These differences in awareness may have been the result of differences in the frequency of use of the PANYNJ toll facilities, or frequent use of other regional toll facilities with other discount programs that make the larger system difficult to comprehend. It could have also reflected that their chances to contact sources of information may have been different.

Table 54. Awareness of the E-ZPass features

E-ZPass programs	Nonusers		Users	
	Common Carriers	Private Carriers	Common Carriers	Private Carriers
Basic discount	65.03% (1)	65.62%	84.41%	83.63%
Off-peak discount	28.50%	30.58%	58.86%	42.22%

Note: (1). The numbers represent the percentages that were aware of the corresponding E-ZPass program.

Reasons for Using / Not Using E-ZPass

The most frequent reasons for using / not using E-ZPass in 2002 are listed in Table 55. As shown, operational and cost considerations were cited as some of the most important factors: low frequency of using E-ZPass (31 percent), and cost of maintaining balance (14 percent). Administrative issues and concerns follow: billing is cumbersome (5 percent), makes record-keeping difficult (5 percent), driver reimbursement more difficult (4 percent). Time constraints and availability of program information were another group of reasons that are important: have not got around to it (17 percent), don't know how to sign it (8 percent) and not aware of the E-ZPass program at all (4 percent). Company concerns about E-ZPass also play an important role, which include driver issues, transponder issues and privacy concerns.

Table 55. Reasons for using / not using E-ZPass

Reasons for not using E-ZPass			
Reasons	%	**Reasons**	%
1. Does not travel through E-ZPass areas often	31%	11. Driver reimbursement more difficult/tracking driver expenses more difficult	4%
2. We haven't gotten around to it	17%	12. Respondent not aware of E-ZPass	4%
3. Cost of maintaining pre-paid toll balance for fleet is too high/cost of equipping fleet with e-ZPass too high	14%	13. E-ZPass does not limit waiting at tolls	3%
4. We don't know how to sign up	8%	14. Privacy concerns	3%
5. Past problems with E-ZPass	6%	15. Customer pays tolls	2%
6. Billing is too cumbersome	5%	16. Drivers complain	2%
7. Makes record-keeping difficult	5%	17. Drivers pay tolls	2%
8. No specific reason	4%	18. Discounts not high enough	1%
9. Fear of equipment being stolen	4%	19. Transponder not transferable	1%
10. System is not reliable or accurate	4%	20. Other reasons	6%
Reasons for using E-ZPass			
Benefits	%	**Benefits**	%
1. Avoid traffic congestion at toll plazas	79%	7. No cash to drivers	16%
2. Basic discount	50%	8. Convenient	7%
3. No need for driver reimbursement	34%	9. Off-peak discount	6%
4. Better accountability for drivers	22%	10. Shows truck time and location	5%
5. No lost receipts	21%	11. Saves money	2%
6. It is faster/save time	19%	12. Other	4%

Among the benefits indicated by E-ZPass users, avoiding traffic congestion at toll plazas was the most frequently cited one (79 percent). The E-ZPass discounts such as the basic discount (selected by 50 percent of users) and the off-peak discount (cited by 6 percent of users) were also significant to users although only 2 percent said that E-ZPass saved them money. Other operational benefits were identified, including: no need for driver reimbursement (34 percent), better accountability for drivers (22 percent), no lost receipts (21 percent) and so on.

These stated reasons revealed important information about the attractiveness of E-ZPass to truckers at the time. Firstly, although the discounts provided by the E-ZPass program are significant to the decisions of E-ZPass choice, the most attractive feature of E-ZPass is its ability to enable truckers to avoid congestion at toll plazas. In other words, saving time is more important that savings in toll costs.

Awareness of the E-ZPass Program

The data show that awareness of the E-ZPass program and its features is an important factor. When told of the different discount programs offered to the commercial vehicles, E-ZPass users were more likely to be aware of them than nonusers. The vast majority (84 percent) of users, but only 63 percent of nonusers, were aware of the exclusive discount offered only to E-ZPass users. For the time of day pricing program, about 63 percent of E-ZPass users noticed the toll rates vary by time of day whereas only 44 percent of nonusers knew about it. Furthermore, 48 percent of users were aware of the off-peak discount while only 27 percent of nonusers knew it.

Users learned about the E-ZPass program through a variety of sources such as the media, roadside signs, friends, other drivers, and trucking association pamphlets or newsletters. Among these sources, media / news / TV (33 percent), friends / colleagues / drivers (31 percent), roadside signs (29 percent) and the personal usage of E-ZPass (13 percent) were the most frequently cited sources. Interestingly enough, personal contacts account for almost as much as organized media.

Response to the Time of Day Pricing

The implementation of E-ZPass enabled putting in place a time of day pricing initiative with and off-peak discount to encourage increased use of E-ZPass (the discounts were available to E-ZPass users only) and a switch of commercial traffic from the peak-hours to the off-peak periods. This section discusses the corresponding results.

When nonusers were informed about the off-peak discounts and the time of day pricing program available to E-ZPass users, more than half (53 percent) stated that they would be “very likely” or “somewhat likely” to become E-ZPass users. However, a little more than 25 percent of nonusers exhibited strong reluctance towards the E-ZPass program saying that they were “not at all likely” to be E-ZPass subscribers. When nonusers were asked how likely they would be willing to shift their travel schedules if the off-peak toll rates were further reduced, about 57 percent of them said that they were “not very likely” or “not at all likely” to change their travel schedule; while only 34 percent of nonusers said they may be “very likely” or “somewhat likely” to change their travel schedules.

Users also showed strong resistance to shift their travel schedules to take advantage of the off-peak discount. Among users aware of the off-peak discount program, only 16 percent had changed their travel schedules to enjoy the off-peak discounts. Among users who were informed of the off-peak discount program through the survey process, about 23 percent said that they would be willing to change their travel schedules to take advantage of the E-ZPass off-peak discount. Even further, when users were asked how they would respond if further off-peak discounts were to be offered, strong reluctance to shift travel schedules still existed. Two-thirds of users said that they were “not very likely” or “not at all likely” to change their travel schedule while only 29 percent of all users said they may be “very likely” or “somewhat likely” to change their travel schedules. Even for these users that said they may change their travel schedules, most of them stated high preferred discounts which range from 10 percent to even above 50 percent.

The responses of both E-ZPass nonusers and users towards the off-peak discount and the time of day pricing indicated their strong resistance to shift their travel schedule to the off-peak hours even when relatively high discounts were offered. The main reason stated by the respondents was the time constraint. The vast majority (93 percent) of users who were “not very likely” or “not at all likely” to shift their travel schedules said their schedules were restricted by set pick-up or delivery times while 67 percent of nonusers reluctant to shift their schedules gave the same reason. This result confirms the all important role played by the cargo receivers who—by setting delivery times—impose hard constraints on freight carriers that limit their ability to travel during the off-peak hours.

Modeling Results

In the sample, which included 507 companies, 69 percent were E-ZPass users and 31 percent nonusers. These sample shares are slightly appear to match market conditions in 2005, but were somewhat higher than the actual transactions observed by the PANYNJ in 2002, which showed that out of 30,000 truckers that use the facilities daily, 64 percent were users and 36 percent were nonusers. In order to eliminate this difference, and avoid the need for correcting estimation weights, 92 observations of E-ZPass users and 15 observations of E-ZPass nonusers were randomly selected and taken out of the estimation data set. They were used as the validation data to measure the predicting performance of the estimated models.

As stated before, this chapter uses discrete choice models to study the E-ZPass choice process. Since there are only two alternatives (to use or not to use E-ZPass), this choice process corresponds to the family of binary choice problems, suggesting the use of binary models. More specifically, the chapter uses binary logit model, which have been widely used in economics, marketing, transportation, and other fields.

The main objective of discrete choice models, based on Random Utility Theory, is to represent the choice process as a function of the utility the alternatives provide to the decision maker. The utility is assumed to have two fundamental components: a systematic component, which is a function of the attributes of the alternative; and a random component, which is assumed to capture unobserved attributes, measurement and specification errors, among other sources of variability, as outlined by Ben-Akiva and Lerman. [53] In this context, the probability P_i that an individual selects alternative i equals the probability that the utility associated with alternative i, U_i, is greater than the utility associated with the competing alternative j. Different assumptions about the statistical distribution of the error terms lead to alternative models.

The purpose of this section is to discuss the findings from the discrete choice modeling process. Once the models were estimated, their predictive ability was assessed by means of a validation sample and classification tables. To illustrate the relative roles of key explanatory variables, a set of sensitivity analyses were conducted to show how the probability of using E-ZPass in a company would respond to changes in the explanatory variables.

Final Model

A number of models were estimated and screened out on the basis of conceptual validity and statistical significance. The best model includes company attributes as well as the binary variables that represent the awareness about E-ZPass features as shown in Table 56. The coefficients of explanatory variables in the final model provide a lot of insights into the overall attitude of the trucking industry towards the use of E-ZPass and other forms of electronic toll collection systems.

The positive signs of both the binary variables representing their awareness of the basic E-ZPass discounts (EZPDISC) and of the E-ZPass off-peak discounts (OFFPKDISC) denote that improving the E-ZPass awareness will increase the likelihood of using E-ZPass. Since the coefficient of EZPDISC (1.12) is greater than the coefficient of OFFPKDISC (0.685), it indicates that the basic E-ZPass discount plays a more important role in affecting the E-ZPass choices of freight carriers than the off-peak discount. This is, undoubtedly, a reflection of the inherent difficulty of switching to off-peak hours.

The company size also plays a significant role in determining the E-ZPass choice behavior, as mentioned before. As shown, the total number of interstate drivers—an indicator of the company size—employed by the freight carriers has a positive coefficient (0.012). It tells that large companies would be more likely to subscribe to the E-ZPass program.

It is interesting, though not entirely unexpected, to find out that independent owner operators (independent truckers who own the vehicle and drive them themselves) tend to shy away from using E-ZPass. The coefficient of the corresponding binary variable

(IOP) is (-0.71) which tells that under equal conditions, independent owner operators are less likely than others to use E-ZPass. This result is consistent with the findings of previous research. As explained in Holguín-Veras, most independent owner operators have relatively small operations and are fairly traditional in their practices, which make it difficult, and probably not worthwhile, to embrace new technologies. [49]

The frequency (FREQ) of using the facilities has a positive relationship with E-ZPass usage, which indicates frequent users of PANYNJ facilities are more likely to be E-ZPass users. From the conceptual point of view, it makes sense that acceptance of new technologies would increase with the scale of the operation and usage of technology.

The binary variables of origins (ORIGINNY and ORIGINNJ) and destinations (DNY and DNJ) of deliveries have positive impacts on the E-ZPass usage. It tells if the freight carriers have most of their deliveries departing from or arriving at New York or New Jersey, then they would be more likely to participate in the E-ZPass program than the companies with the majority of deliveries from Connecticut or Pennsylvania.

The types of cargoes delivered by freight carriers were found to influence the decision to use E-ZPass. Freight carriers transporting general merchandise (MERCHAND), cars (CARS), and building materials (BUILDING) are less likely to use E-ZPass. Of these commodity types, general merchandise is the one that is associated with the strongest reluctance to use E-ZPass (-2.118), followed by cars (-1.625) and building materials (-0.692). As shown, the absolute value of the coefficients of CARS and MERCHAND (-1.625 and -2.118) are even greater than the coefficients of the variables representing awareness of E-ZPass features, which means that companies in these groups—even if they are aware of the E-ZPass features—would be less likely use the system. In general terms, these results are consistent with previous research that found the type of commodity transported plays a role on the type of trucks used by freight carriers. [54]

The modeling process also found several important interaction terms linking the commodity types, frequency of using the PANYNJ facilities, business type and the total number of interstate drivers. It is important to make a distinction between two sets of interaction variables. The first two interaction terms link binary variables and the frequency of usage of PANYNJ facilities. The net effect of the coefficients of these interaction variables is to increase or decrease the coefficient of frequency of usage (FREQ) depending on the sign of the coefficient of the interaction variable (a positive sign increases it, while a negative one decreases it). The coefficient (0.032) of the interaction between the frequency (FREQ) and the variable indicating whether the company delivered food (FOOD) shows that for companies delivering food the net coefficient of FREQ (0.029 + 0.032) is more than double than for other companies, which indicates the increased importance of this variable. On the contrary, freight carriers delivering household goods (HOUSEHOLD), exhibit the completely opposite behavior. The net coefficient is almost equal to zero (0.029-0.026) which indicates that, for this industry segment, the frequency of usage ceases to be a factor.

Interestingly enough, the binary variable that indicates if the carrier is transporting food (FOOD) also has a negative impact on the probability of using E-ZPass in the case of common carriers. As shown, the coefficient of the interaction term between the variable representing whether the company was a common carrier and the variable showing whether they delivered food to New York City (CCNYFOOD) is negative (-0.901) indicating that if a company is a common carrier delivering food to New York City, they would be less likely to use E-ZPass. This suggests the interesting proposition that the variable FOOD has both positive (by increasing the net coefficient of FREQ) and negative impacts (by adding a negative intercept to common carriers).

The last interaction (TRCONS) captures the net impact of number of interstate drivers for those cases in which the trucking company is delivering construction materials. As in the case involving frequency of usage, the net effect of this interaction term is to modify the coefficient of the number of interstate drivers (DRIVERS). The net coefficient (0.012-0.151) indicates that company size has a negative relationship with E-ZPass usage for those freight carriers transporting construction materials (CONSTRUCTION), which is the complete opposite of the rest of the trucking industry.

Table 56. Final binary model of E-ZPass choice

Variable	Name	Coefficient	t-value
Utility of users:			
Awareness of E-ZPass program features			
If aware of the basic E-Zpass discounts, =1, 0 otherwise	EZPDISC	1.120	3.252
If aware of the E-Zpass discounts in off-peak hours,=1, 0 otherwise	OFFPKDIS	0.685	2.312
Company Attributes:			
Total number of interstate drivers	DRIVERS	0.012	1.511
If independent owner operators, =1, 0 otherwise	IOP	-0.710	-1.572
Business Patterns:			
Frequency of using PANYNJ facilities in the past 90 days	FREQ	0.029	4.137
If majority of deliveries origin in New York state, =1, 0 otherwise	ORIGINNY	1.583	4.287
If majority of deliveries origin in New Jersey, =1, 0 otherwise	ORIGINNJ	1.286	3.751
If destination includes New York state, =1, 0 otherwise	DNY	0.554	1.964
If destination includes New Jersey, =1, 0 otherwise	DNJ	0.537	1.885
If deliver cars, =1, 0 otherwise	CARS	-1.625	-3.137
If deliver mechandise, =1, 0 otherwise	MERCHAND	-2.118	-3.185
If deliver building materials, =1, 0 otherwise	BUILDING	-0.692	-1.907
Interaction terms:			
Interaction between FREQ and FOOD	FQFOOD	0.032	2.242
Interaction between FREQ and HOUSEHOLD	FQHOUSE	-0.026	-2.125
Interaction between COMMON CARRIER and FOOD in New York City	CCNYFOOD	-0.901	-1.546
Interaction between DRIVERS and CONSTRUCTION	TRCONS	-0.151	-1.799
Utility of nonsers:			
Alternative specific constant (nonusers)	CONSTANT	2.603	5.343
Adjusted Likelihood Ratio	0.2622		
Likelihood Ratio	0.2960		

Validation Results

Classification tables were used to evaluate the predictive performance of the final model using a holdout sample. The model was able to correctly estimate 75 percent of E-ZPass users and 54 percent of non-users. The potential reasons accounting for the high percentage of misclassifying observed nonusers as users involved:

- The data was collected for qualitative analysis instead of discrete choice modeling. As mentioned before, most of the explanatory variables available were business specific variables, while some important variables such as travel time saved and the cost purchasing and administering E-ZPass tags were not available.
- Quality of the available variables. A number of quantitative variables, e.g., frequency of using PANYNJ facilities (FREQ), were collected in the form of ranges (that in

some cases were fairly wide) instead of actual numbers. This, as expected, introduces error in the estimation process.

Sensitivity Analysis of Explanatory Variables

In order to illustrate the relative importance of the key explanatory variables, the probabilities of using E-ZPass were computed for various combinations of values. This was accomplished by examining how the probability of using E-ZPass changes as a response to a change in an explanatory variable, for a sample of companies. The corresponding results are shown in Table 57. The level of awareness of E-ZPass program features has a significant impact on the probabilities of using E-ZPass. As indicated by the results, the probability of using E-ZPass for an individual company increases by 16.96-24.67 percent if freight carriers are aware of the basic E-ZPass discounts. Furthermore, for companies that know the basic E-ZPass discount awareness of the off-peak discount increases their probabilities of using E-ZPass by an additional 3.63-16.87 percent.

Among the variables representing the company attributes, the indicator of the company size, the total number of interstate drivers (DRIVERS), impact the E-ZPass choice behavior significantly. The probability of using E-ZPass increases by 0.21-14.08 percent if the number of interstate drivers owned by the companies increases to 50. Independent owner operators (IOP) are less likely to participate in the E-ZPass program. If a trucking company belongs to this group, the probabilities of using E-ZPass are 0.6-17.49 percent lower than for comparable companies.

The final model includes eight explanatory variables that represent business patterns. Their impacts on the probabilities of using E-ZPass can be summarized as follows:

1. The probability of using E-ZPass increases with the increase of the frequency of passing through the PANYNJ facilities. The values of the increased probabilities range from 3.31 percent to 37.38 percent if the companies pass through the PANYNJ facilities more than 50 times during the past 90 days.

2. The origins and the destinations of deliveries have a significant impact on probabilities of using E-ZPass facilities. In general, the companies with the majority of deliveries originating in New York or New Jersey have 0.42-35.84 percent higher probabilities of using E-ZPass than companies with deliveries departing from other regions. Furthermore, the companies with the majority of trucks originating in New York are more likely to use E-ZPass than the companies with trucks departing from New Jersey. The destinations of deliveries have the same pattern of impacts. This may be a reflection of the fact that, at the time of the survey, E-ZPass was used by more toll facilities in New York than in New Jersey.

3. General merchandise (MERCHAND) is the commodity type that has the most significant impact on the probability of using E-ZPass. The model shows that if the freight carriers deliver general merchandise, their probabilities of being E-ZPass users decrease by 4.1- 48.33 percent.

Table 57. Sensitivity analysis of the key explanatory variables

Name	Variable	Value	Change in probability of being E-ZPass user	
			Lower bound	Upper bound
Awareness of E-ZPass program features:				
If aware of the basic E-Zpass discounts, =1, 0 otherwise	EZPDISC	1	16.96%	24.67%
If aware of the E-Zpass discounts in off-peak hours,=1, 0 otherwise	OFFPKDISC	1	3.63%	16.87%
Company attributes:				
Total number of interstate drivers	DRIVERS	50	0.21%	14.08%
If independent owner operators, =1, 0 otherwise	IOP	1	-17.49%	-0.60%
Business patterns:				
Frequency of using PANYNJ facilities in the past 90 days	FREQ	60	3.31%	37.38%
If majority of deliveries origin in New York state, =1, 0 otherwise	ORIGINNY	1	16.89%	35.84%
If majority of deliveries origin in New Jersey, =1, 0 otherwise	ORIGINNJ	1	0.42%	30.93%
If destination includes New York state, =1, 0 otherwise	DNY	1	7.33%	13.67%
If destination includes New Jersey, =1, 0 otherwise	DNJ	1	3.02%	13.25%
If deliver cars, =1, 0 otherwise	CARS	1	-38.48%	-2.33%
If deliver merchandise, =1, 0 otherwise	MERCHAND	1	-48.33%	-4.10%
If deliver building materials, =1, 0 otherwise	BUILDING	1	-17.04%	-6.52%

Note: The numbers represent the difference between the probabilities before and after changing the value of the variable.

Potential Changes in Market Shares

An important use of the discrete choice model is to estimate the impacts of the policies to increase E-ZPass usage on its market share. Given the significant importance of awareness of E-ZPass program features, this section examines how E-ZPass market share would change with respect to increasing levels of awareness.

Figure 29 shows a simplified depiction of the response surface of the E-ZPass market share as a function of awareness of both the basic E-ZPass discount and the off-peak discount. The four different lines correspond to different levels of awareness of the basic discount offered to E-ZPass users, from the current level (77.16 percent) to 100 percent. The horizontal axis shows various levels of awareness of the off-peak discount available as part of the Time of day pricing initiative. The vertical axis shows the resulting E-ZPass market share. The market shares were estimated by simulating the different levels of E-ZPass awareness and computing the corresponding market shares.

As shown, programs to increase the awareness of the E-ZPass program are likely to have a fairly significant impact on market penetration of E-ZPass. Figure 29 also shows the relative importance of those segments of the commercial sector that inherently dislike E-ZPass, e.g., independent owner operators. As illustrated in Figure 29, even in the remote case in which everybody knows about E-ZPass' features, the maximum level of penetration would be slightly less than 76 percent, which is less than the current market penetration for passenger cars.

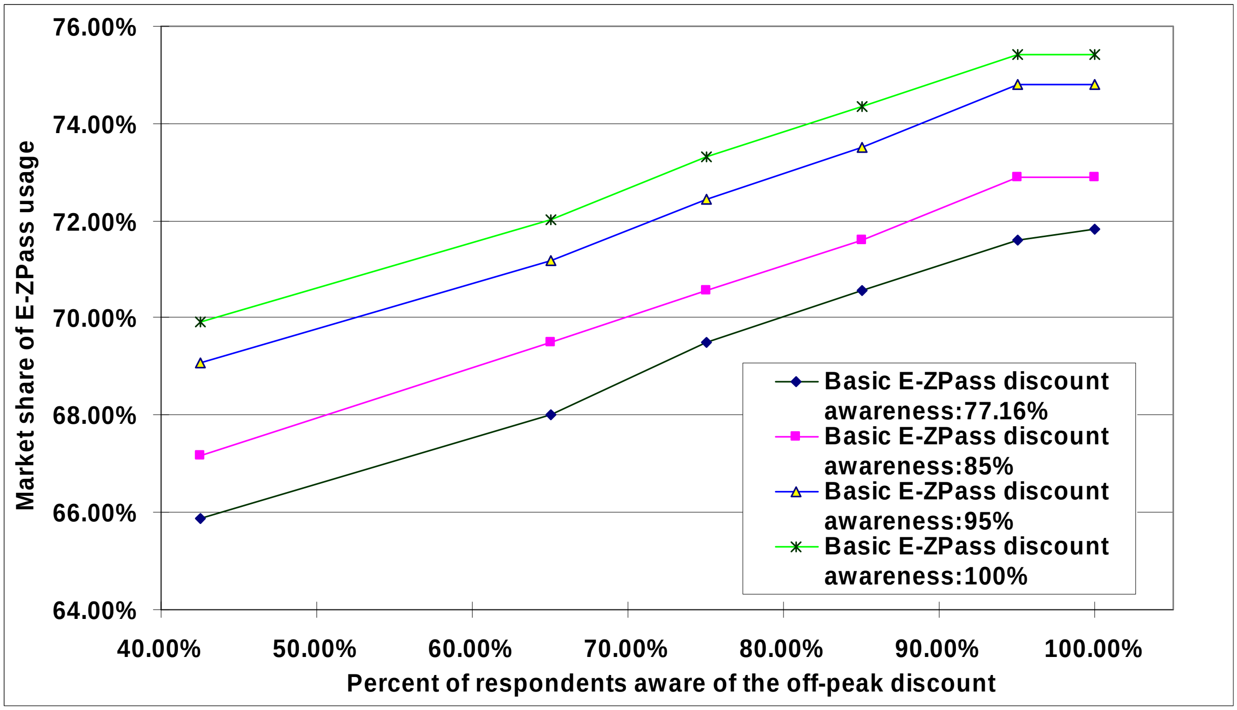

Figure 29. Impact of the awareness of E-ZPass features on market share

Policy Implications

As a specific group of users and significant contributors of traffic at PANYNJ facilities, freight carriers are a highly heterogeneous group, which translate into a wide range of attitudes toward E-ZPass. Understanding these differences and the underlying factors that account for their particular reactions towards the E-ZPass technology are a prerequisite to increase E-ZPass usage among freight carriers. The modeling results—by explaining the role of the key attributes in affecting E-ZPass choice decisions—provide insights that support the process of policy design:

- Lack of awareness of E-ZPass features is a major factor in explaining nonusers' decisions, which in turn weakens the performance of E-ZPass incentives such as the time of day pricing. Therefore, programs designed to promote awareness of E-ZPass may have a significant impact in increasing E-ZPass usage. However, as illustrated by Figure 29, such advertising campaigns are likely to be constrained by a ceiling because—even when all potential users know about E-ZPass there will be some that will not use it.

- In order to overcome the concerns of those segments of the carrier industry opposed to use E-ZPass—that translate into a ceiling for its market share—specific outreach activities must be undertaken targeting those segments of the private sector that exhibit strong reluctance to use E-ZPass. The main objective of this outreach must be to address the concerns of these groups. The list includes: independent owner operators, companies (both common and private carriers) transporting cars, general merchandise, building materials, food and household goods. To this effect, working closely with trade associations may be a very effective way to approach these groups.

Conclusions

Freight carriers are an important stakeholder of the transportation system. They account for significant amounts of usage of transportation facilities whereas they share different perceptions and attitudes towards new technologies. Furthermore, their decisions are of great import not only for their own operational efficiency, but also for the efficiency of the transportation system as a whole. In this context, understanding the attitude of Freight carriers towards E-ZPass is a necessary condition for successful policy making.

The chapter reports the first analyses conducted on the impacts of time of day pricing on the behavior of freight carriers at major facilities in the U.S. In doing so, it has established that time factors, instead of cost factors, are the most important determinant affecting freight carriers' attitudes towards the E-ZPass system and its various discount programs. The analyses showed that 16 percent of the carriers reported shifting to the off-peak hours as a response to the combined effect of time savings and off peak discounts. Among those carriers that indicated they could not change their travel schedules, the reason most frequently cited (67 percent) was the inflexibility of receivers. This strongly suggests that, in order to move truck traffic to the off peak hours in significant numbers, comprehensive policies targeting receivers and carriers must be implemented.

This chapter systematically explored the roles of business specific attributes in determining the E-ZPass choice behavior of freight carriers. As illustrated by the econometric models, the private sector's decision of using E-ZPass depends on the frequency of using the PANYNJ facilities, the awareness of E-ZPass features, the origins of deliveries, and the cargo types they deliver. It was also identified that independent owner operators were more reluctant to use the E-ZPass facilities than other types of companies.

By analyzing the potential changes of market shares with respect to key explanatory variables, this chapter suggests that outreach programs and targeted campaigns to increase awareness are an efficient way to increase E-ZPass usage among freight carriers. However, the analyses indicated that advertising alone will not enable E-ZPass to increase its market share beyond 76 percent. Increasing market share beyond 76 percent will require outreach campaigns aimed at overcoming the strong reluctance of some segments of the private sector, e.g., independent owner operators.

It was found that the cargo type plays a significant role in determining E-ZPass adoption. Some cargo types (i.e., household goods, construction and building materials, general merchandise and cars) have a negative effect on E-ZPass adoption. In contrast, carriers transporting food exhibit mixed effects which is a consequence of the fact that, at the same time, the binary variable representing food (FOOD) increases the positive coefficient of the frequency of use of the PANYNJ facilities (FREQ); and decreases the negative intercept of the utility function for common carriers.

An interesting finding is related to the market orientation of the trucking activity. Although, the descriptive analyses suggested that common and private carriers exhibit different behaviors towards E-ZPass, the discrete choice modeling process indicated—once the role of company size and frequency of use of the PANYNJ facilities is accounted for—that their behaviors are more similar than originally thought. As shown, the binary variable representing common carrier was statistically significant as part of an interaction term with the binary variable representing food.

This chapter is a further step toward a full understanding the attitudes of the trucking industry towards new technologies. Its findings suggest to policymakers and researchers that understanding the distinct perceptions and requirements of the potential users is a crucial requirement to achieve wider use of new technologies in the entire transportation system.

CHAPTER VII

DESCRIPTIVE ANALYSES OF THE IMPACTS OF THE TIME OF DAY PRICING INITIATIVE ON CARRIER BEHAVIOR

Introduction

This chapter discusses the descriptive analyses of the impacts of the 2001 time of day pricing initiative on carriers' travel behavior. The main objective of the analysis is to gain insight into how carriers adjusted their behavior in response to time of day pricing.

The emphasis on carriers necessitates some discussion. Commercial freight related traffic is the result of complex interactions involving various players in the logistic chain: shippers, distribution centers, warehouses, carriers and receivers (consignees). Given the large consumer markets in the New York-New Jersey region, a large proportion of commercial traffic within the region is transporting goods for final consumption. As such, some the most important players for the purposes of this project are the carriers transporting the goods, and the receivers. The importance of carriers is evident, since they are a direct target of the time of day pricing initiative. The importance of receivers is frequently overlooked, though they, to a great extent, are the ones that set the delivery time constraints the carriers must meet. [55, 56]

During the early stages of the data collection planning process, the project team considered collecting data about the impacts on receivers (consignees) because of the role they play in setting the delivery time constraints. At the end, unfortunately, the project team and the agency partners decided against a receiver survey because, given funding and schedule constraints, it would have forced a significant reduction in the carrier survey's sample size. It is clear however that future research should specifically target the role played by receivers in shaping the behavior of carriers as a response to road pricing strategies.

The data used in the analyses were collected by means of a survey instrument that included questions pertaining to company characteristics, current operations and time of travel flexibility, E-ZPass usage and awareness, the impacts of the time of day pricing initiative on operations, and a set of hypothetical toll scenarios (stated preference). The survey instrument was designed by the project team in close consultation with the project partners (i.e., Federal Highway Administration, The Port Authority of New York and New Jersey (PANYNJ), and New Jersey Department of Transportation), who provided invaluable comments and suggestions. Rutgers University's Eagleton Institute was in charge of conducting the computer aided telephone interviews (CATI) and submitting a clean data set to the project team. The CATI were conducted from the middle of November to the middle of December 2004.

Target Population

The target population for the survey was defined as all carriers who have used any of the PANYNJ toll facilities on a regular basis (at least once per week) since the time of day pricing implementation in March 2001 (current regular users); and those individuals that regularly used toll facilities before March 2001 and stopped doing so about that time (former regular users). The population of interest includes former regular users because they may have stopped using the PANYNJ facilities because of the time of day pricing initiative. According to the definition of the target population, the sample should cover all areas where potential users locate. Ideally, this would include an adequate mix of carriers operating in the various market segments of the trucking industry. This would include those that do thru trips through the PANYNJ facilities, as well as those that undertake relatively local operations. Unfortunately, collecting data using random telephone calls from companies doing thru trips through the PANYNJ facilities was found to be prohibitively expensive because of the very low probability to find qualified respondents (i.e., that use the PANYNJ facilities in a regular basis) from the overall universe of companies (which includes, in essence, all carriers operating in the United States). As a result, the project team after consultations with the partner agencies decided to collect the sample from those areas that concentrate the majority of users. For that reason, the sampling process focused on carriers located in New Jersey and New York. More specifically, the target counties included six counties in New Jersey (i.e., Bergen, Essex, Hudson, Middlesex, Passaic and Union) and two boroughs in New York City (i.e., Kings and Queens). These counties were selected because previous studies determined they are significant generators, or transshipment locations, of cargoes destined to New York City. [(57)] The survey made a distinction between: (a) current regular users that currently dispatch trucks between New York City and New Jersey on regular basis (at least once per week); and (b) former regular users that dispatched between New York City and New Jersey on regular basis at any time in the past three years and are not regular users any longer. Former regular users were included because it was believed that some of them could stop being regular users of the toll facilities because of time of day pricing.

The target companies were selected from two groups: for-hire carriers (those that provide services to the open market) and private carriers (those that provide transportation service to a parent or a related company). Considering the small likelihood to get suitable private carriers from small companies, the sampling process focused on those private carriers with at least 25 employees. Private and for-hire carriers were assumed to have different responses towards the changes in the toll structure because of their inherent differences in company attributes.

Once valid respondents were identified during the screening process, the survey branched out to either the current regular users' sections or the former regular users' sections depending on whether or not they continue using the six PANYNJ toll facilities at least once per week. Current regular users were asked to respond to all questions in the survey. Former regular users were asked about their company attributes and general opinions towards toll policies.

The data collected contain 200 complete observations. Among them, 182 companies (91.0 percent) are current regular users of the toll facilities, and 18 companies (9.0 percent) are former regular users. From the view point of carrier type, there are 103 private carriers (51.5 percent) and 97 for-hire carriers (48.5 percent), which is consistent with national statistics. Of those surveyed, 165 companies (82.5 percent) are located in New Jersey; while 35 companies are from New York (17.5 percent). This geographic breakdown was, to a great extent, the result of the inherent difficulties in finding valid respondents from the New York area, which forced the project team to increase the relative proportion of New Jersey users.

This chapter describes the data collection process, and then discusses key findings from the analyses. Following the summary, detailed descriptions of the results are presented.

Overview of the Data Collection Process

This section discusses the survey instrument, the sampling procedure, and the sample expansion process used. The last sub-section focuses on the process of adjusting the data to represent respondents' actual usage of the PANYNJ toll facilities.

Survey Instrument

The survey had seven major sections as shown in Figure 30. The questionnaire is shown in Appendix 12.

(1) Screening Section: This section gathered general information about the respondents and determined if the respondent: (1) is indeed a member of the target survey population as defined in this study; and (2) should be classified as a current or former regular user. Information about facilities usage and former regular users' reasons for not now using the facilities were also collected.

(2) Current Operations and Time of Travel Flexibility: This section collected information on current regular users' operations and time of travel flexibility, including types of commodities carried, frequency and number of stops made on a typical roundtrip for deliveries between New York City and New Jersey, the breakdown of truck trips made during peak, off-peak and overnight, time of travel flexibility, duration of a typical round-trip tour, typical shipment size, and load factor.

(3) Toll Payment and E-ZPass Use: This section discusses the respondents' level of awareness of E-ZPass features and the available toll discounts. The questions in this section were categorized into six groups: E-ZPass use, reasons for not using E-ZPass, advantages of E-ZPass, awareness of the toll discount programs, impact of time of day pricing on E-ZPass use, and suggestions for improving the E-ZPass system.

(4) Changes Due to Time of Day Pricing: This section focuses on the impacts of the 2001 PANYNJ time of day pricing on carriers, and it includes questions about changes

in operations, trip frequency, number of stops, time of travel, duration of tour, shipment size, shipment charge, load factor, type of vehicles used, fleet size, and routes for deliveries.

(5) Toll Scenarios Tests: This section was intended to assess the impact of different hypothetical combinations of toll rates and travel time savings on respondents' decisions about E-ZPass usage and travel schedules.

(6) Public Opinion: This section gathered respondents' input regarding the fairness of tolls, and other related issues. The analysis of this section is discussed in Chapter X.

(7) Company Attributes: This section captured the socio-economic profile of the interviewed carriers in terms of company type, business type, fleet size and composition, the number of interstate drivers employed, and origins and destinations of deliveries.

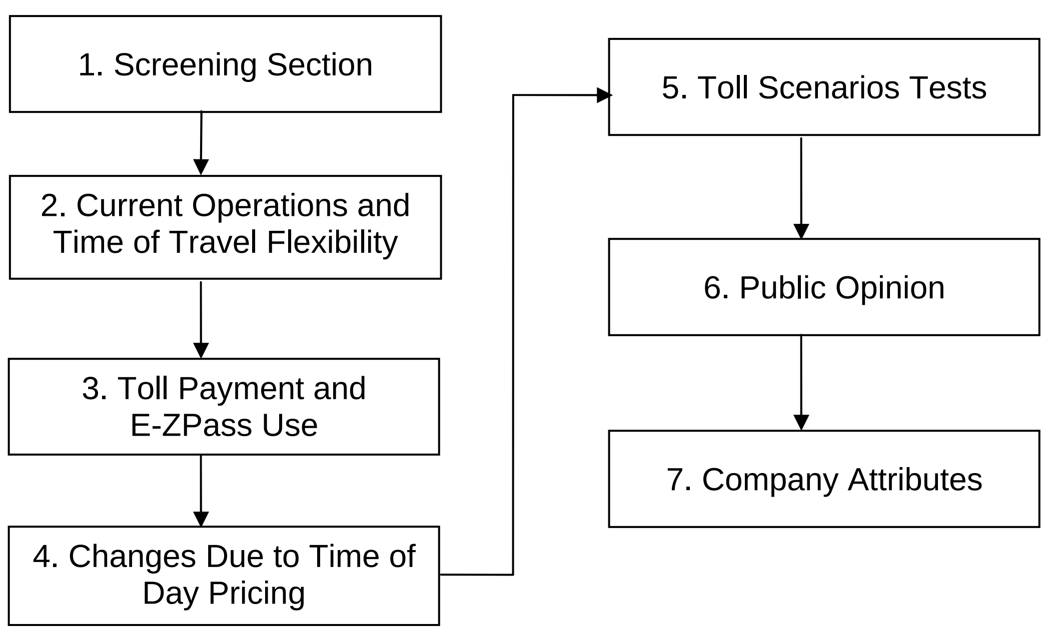

Figure 30. Outline of survey instrument

Sampling Procedures and Data Collection

Having decided to focus on both private and for-hire carriers, the project team considered the definition of the sampling frame, i.e., the master list from which the sample would be drawn. Cost considerations suggested collecting the sample from those areas that concentrate the majority of users. For that reason, the sampling process focused on carriers located in New Jersey and New York; more specifically, from the New Jersey counties of Bergen, Essex, Hudson, Middlesex, Passaic and Union in, and from Kings (Brooklyn) and Queens in New York.

The sampling frame used was the Dun and Bradstreet (DNB) database from which a sample was drawn. Table 58 shows the breakdown of the sample (see the detailed breakdown in Appendix 10). Letters were sent to the companies in the sample asking them to participate in the survey (see a sample letter as Appendix 11). Companies willing to participate in the survey were contacted again to set up a time for the telephone interview.

Table 58. Sampling frame

Carriers	New Jersey (1)		New York (2)	
	Potential Private Carriers (6)	Potential For-Hire Carriers	Potential Private Carriers (6)	Potential For-Hire Carriers
Available Records (5)	3800	1676 (3)	1682	1145(3)+890(4)
Downloaded records for the PANYNJ Survey (5)	1800	900 (3)	N/A	800

Note: (1) New Jersey counties: Bergen, Essex, Hudson, Middlesex, Passaic and Union;

(2) New York boroughs: Kings and Queens;

(3) Standard Industrial Classification (SIC) codes of for-hire carriers in New Jersey include 4213 (Trucking, except local), 4215 (Courier services, except by air), and 4731 (Freight transportation arrangement);

(4) SIC codes of for-hire carriers include 4212 (Local trucking without storage), 4214 (Local trucking with storage);

(5) For private carriers, the available records and the downloaded records only includes those that have more than (or equal to) 25 employees in their companies;

(6) Potential private carriers include agriculture, manufacturing, wholesale, and petroleum retail based on SIC codes.

Data were collected from 200 carriers (165 from New Jersey State and 35 from New York State), among which 182 companies (91.0 percent) are current regular users, and 18 companies (9.0 percent) are former regular users. Among these 200 carriers, 103 (51.5 percent) were private carriers, and 97 (48.5 percent) were for-hire carriers (common carriers and contract carriers).

Sample Expansion

Ideally, a sample such as the one collected in this project should be expanded so that it represents the collective behavior of the universe of users. This is usually accomplished by means of an expansion procedure using a set of control totals (classified by one or more socio-economic attribute) and the number of observations for each stratum. For instance, if the number of users for each income level is known, the corresponding expansion factors could be estimated as the ratio between these control totals and the number of observations in each income level. Unfortunately, the project team did not have data that could be used as control totals (an estimate of the statistical universe) for the expansion procedure.

After considering different alternatives, the project team decided to expand the sample using the trip frequencies for each user as the expansion factor. In this way, the expanded sample is weighted based on the number of trips made by the respondents rather than the number of individual users. As a result, the expanded sample provides an indication of the attributes of a larger collection of trips across the bridges and tunnel (in which the same individual or company uses the facility numerous times during a given time period). However, as discussed before, the survey sample is not likely to be representative of the universe of commercial traffic that use the PANYNJ crossings. This is because of the over-sampling in New Jersey, the inability to survey out-of-state carriers doing thru trips through the region. The trip-based expansion methodology—because of the lack of suitable control totals—makes no provision to address response biases that stem from the sampling plan employed.

It is important to remember this later in the paper because it implies that the metric used in the analyses are based on user-trips; as opposed to one based on individual users. The response rate was 54 percent (all cooperative contacts divided by all good telephone numbers) and. However, after eliminating non-contacts and “dead" contacts from the denominator, the response rate became 58 percent. Since the survey did not collect data about trip frequency for former regular users, the average trip frequency (6.4 truck trips/day) by current regular users was used as expansion factors. After sample expansion, the original 200 observations were found to represent 1272 trips/day, as shown in Table 59. The readers should keep in mind that, most of the analyses are based on weighted responses; and that the number of valid observations is specified at the beginning of each section.

Table 59. Raw and expanded sample breakdown

Carriers	Raw Sample (200 observations)				Expanded Sample (1271 weighted responses)			
	Current Regular Users		Former Regular Users		Current Regular Users		Former Regular Users	
	Responses	%	Responses	%	Weighted Responses	%	Weighted Responses	%
Private Carriers	**92**	**50.5%**	**11**	**61.1%**	**382**	**33.0%**	**70**	**61.1%**
New Jersey	75	41.2%	10	55.6%	295	25.5%	64	55.6%
New York	17	9.3%	1	5.6%	87	7.5%	6	5.6%
For-Hire Carriers	**90**	**49.5%**	**7**	**38.9%**	**774**	**67.0%**	**45**	**38.9%**
New Jersey	75	41.2%	5	27.8%	724	62.7%	32	27.8%
New York	15	8.2%	2	11.1%	50	4.3%	13	11.1%
Total	**182**	100.0%	**18**	100.0%	**1156**	100.0%	**115**	100.0%

Note: Since the survey did not gather former regular users’ trip frequency; the average trip frequency of current regular users (6.4 truck trips per day) was used as the expansion factor for former regular users.

Key Conclusions

The analyses conducted are based on 200 complete carrier surveys collected during the period from mid November to mid December, 2004. The analyses conducted are based on the total number of truck trips made by the users, rather than the users themselves. These are the key findings:

- The data indicate that the trips made by 36 carriers (20.2 percent) were changed because of the time of day pricing initiative. This number includes the trips reported by 17 carriers (9.0 percent) that reacted by increasing shipping charges to receivers.
- Carriers that changed behavior are more likely to begin or end their trip outside the New York-New Jersey region. This finding suggests that carriers doing through trips are fairly sensitive to the time of day pricing initiative. The fact that the survey could not reach a larger population of these users, by limiting the CATI to mostly New Jersey-based firms, suggests that the sample used in this report may be biased towards those that are less sensitive to pricing efforts and have less flexibility in routing and time of travel.
- The main reasons why trucks travel at the time they do were: *customer requirements dictate schedule (*61.6 percent), *to avoid congestion (*26.0 percent), and *to deliver during a normal business / daytime hours (*20.8 percent). Only 3.5 percent mentioned *toll is cheaper* as a reason.
- The time of travel flexibility data indicate that only 25.6 percent of respondents' trips have flexibility, averaging 37.3 minutes (early arrival) and 48.8 minutes (late arrival).
- Though 85.5 percent of respondents use E-ZPass for their reported trips, they are not fully aware of the toll discounts: 67.4 percent of trips either *do not know of any discounts* (35.9 percent) or *heard of discount,* or *do not know specifics* (31.5 percent); only 27.4 percent of the trips were made by carriers that could identify a specific discount program.
- When specifically asked about if and how the time of day pricing initiative impacted their E-ZPass usage, 88.3 percent of respondents' trips were reported as *no change*, 8.2 percent trips *switched to E-ZPass*, and 2.2 percent of the trips *increased use of E-ZPass*.
- Carrier trips that were changed because of the time of day pricing tend to: a) focus on full truck load service; b) own smaller fleets; c) employ fewer interstate truck drivers on average but the same interstate truck drivers per truck; d) venture to areas outside New Jersey and New York; and e) use multiple combinations of strategies to deal with the time of day pricing.

- The key combinations of changed trip patterns include: *passing the additional costs generated by the toll changes to their customers* + *decreasing the truck trips through the toll booths* + other changes (6.1 percent); *changing routes* + *increasing charges* + other changes (5.5 percent); and *decreasing truck trips* + *changing routes* + other changes (4.1 percent).

Summary of Findings

This section provides a brief summary of the key findings from the descriptive analyses. More detailed information can be found in the specific sections discussing the data.

Company Characteristics

The interviewed carriers are classified into current regular users and former regular users depending on whether they currently dispatch trucks between New York City and New Jersey using the PANYNJ toll facilities on a regular basis, i.e., at least once a week. These two groups of carriers represent 1156 and 115 weighted responses respectively which account for 91.0 percent and 9.0 percent of the entire weighted sample.

Findings pertaining to current regular users

There are 182 current regular users that account for 1156 weighted responses. About two-thirds of current regular users (67.0 percent) are for-hire carriers while the remaining are private carriers (33.0 percent). In terms of the geographical distribution, 88.2 percent of current regular users are from New Jersey and the remaining (11.8 percent) are from New York (Figure 31). This geographical breakdown is due to the difficulties of finding the valid respondents from New York.

The average current regular user tends to:

- Provide less than truckload (LTL) or full truckload (FTL) service. The vast majority of current regular users do LTL services (54.1 percent) or FTL (34.6 percent). Other services mentioned include intermodal carriers (11.1 percent), drayage companies (4.2 percent), or marine containers (1.0 percent) (Figure 32);

- Operate medium to large fleets. The average fleets owned by current regular users are 53.9 trucks (Table 60). The largest group of current regular users (34.9 percent) owns more than 50 trucks (Figure 33);
- Own more large-size trucks (trailers / semi-trailers) than small-size trucks (two, three / four-axle trucks). In terms of fleet composition, trailers / semi-trailers are the equipment types more frequently owned by current regular users, followed by two-axle trucks and then three / four-axle trucks. 77.0 percent of current regular users own trailers / semi-trailers while those that have two-axle trucks and three / four-axle trucks account for 50.2 percent and 46.8 percent respectively (Figure 34 through Figure 36). Moreover, the average number of trailers / semi-trailers owned by current regular users is 38.0 trucks while the average numbers of two-axle trucks and three / four-axle trucks owned are 10.3 trucks and 4.6 trucks respectively (Table 60);
- Employ 38.3 interstate truck drivers and 0.7 interstate truck drivers per truck on average. The distributions of interstate licensed truck drivers employed by current regular users resemble the distributions of fleet size. The largest group is the one employing more than 50 interstate truck drivers (32.7 percent) (Figure 37). The distributions of interstate truck drivers with respect to fleet size indicate that 51.4 percent of current regular users have at least 0.75 interstate drivers per truck;
- Work on New Jersey and New York, not venturing far from the Mid-Atlantic region. The majority of shipments for current regular users originate in New Jersey (71.1 percent) or in New York (8.5 percent) (Table 63). The majority of shipments tend to be originated at the states where the companies are located. 79.3 percent of the carriers from New Jersey and 61.3 percent of the carriers from New York did so (Table 64). Meanwhile, current regular users were found not to venture far from the Mid-Atlantic areas. Therefore, the four large states of the Mid-Atlantic region, New York State (74.3 percent), New Jersey (29.0 percent), Pennsylvania (13.3 percent) and Connecticut (10.2 percent), represent the destinations of most shipments for current regular users (Table 65). Current regular users, regardless of their locations,

usually send the majority of their shipments to New York State, presumably New York City (Table 66).

Among current regular users, for-hire carriers and private carriers present different company characteristics, which impact their responses towards time of day pricing inherently. In contrast to private carriers, for-hire carriers tend to:

- Be larger in fleet size. The average number of trucks owned by for-hire carriers (67.3 trucks) is more than twice the average number for private carriers (31.0 trucks) (Table 60);
- Have less time of travel flexibility than private carriers. On average, for-hire carriers could arrive about 26 minutes later, and about 24 minutes earlier; while private carriers could arrive about 80 minutes later, and about 55 minutes earlier (Table 69).
- Own larger truck combinations, e.g., trailers / semi-trailers. The average numbers of two-axle trucks and three / four-axle trucks owned by private carriers (12.7 two-axle trucks and 4.7 three / four-axle trucks) are higher than the ones owned by for-hire carriers (9.1 two-axle trucks and 4.6 three / four-axle trucks). On the contrary, the average number of trailers / semi-trailers owned by for-hire carriers (50.7 trailers / semi-trailers) is above three times higher than the one owned by private carriers (13.4 trailers / semi-trailers) (Table 60);
- Employ more interstate truck drivers and more interstate truck drivers per truck than private carriers, which reflect their predominantly interstate roles. The average number of interstate drivers employed by for-hire carriers (51.1 drivers) is almost four times higher than the one for private carriers (13.0 drivers) (Figure 37 and Table 61). Meanwhile, it was found that for-hire carriers tend to have more interstate truck drivers per truck (0.8 vs. 0.6 interstate truck trips per truck), and then, as a result, are the main generators of interstate truck trips (Figure 38 and Table 62).

Appendix 13 contains preliminary findings pertaining to former regular users. This discussion was placed in an appendix because the small sample prevented statistically conclusive analyses.

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Facilities Used

The survey gathered information about the PANYNJ facilities used by respondents, allowing them to indicate all facilities that they use. Among current regular users, 93.5 percent reported trips across the George Washington Bridge, followed by Lincoln Tunnel (48.5 percent), Goethals Bridge (33.3 percent), Outerbridge Crossing (29.7 percent), Holland Tunnel (25.2 percent), and Bayonne Bridge (14.8 percent) (Figure 39). The survey also gathered information on usage of other regional toll facilities. The six most cited facilities are the Verrazano Narrows Bridge (56.3 percent), followed by the Tappan Zee Bridge (27.1 percent), Triboro Bridge (21.4 percent), Whitestone Bridge (20.6 percent), ThrogsNeck Bridge (11.6 percent), and the New Jersey Turnpike (11.4 percent).

On average, current regular users have been using these facilities for about 22 years, regardless of type of carrier. New York carriers have been using these facilities about 30 years (Table 67).

On average, current regular users have been using these facilities for about 22 years, and similarly among all types of carriers except that New York carriers have been using these facilities about 30 years (Table 67).

Current Operations

On average, current regular users make 6.4 truck trips per day and 13.0 stops per tour for deliveries between New York City and New Jersey. However, readers should keep in mind that more than 80 percent of current regular users are New Jersey regular users that make 50 percent more trips and twice as many stops as New York regular users. For-hire carriers make twice as many trips and stops (8.6 truck trips per day and 15.7 stops per tour) as private carriers (4.2 truck trips per day and 7.1 stops per tour).

Current regular users carry various types of commodities: household goods / various (25.0 percent), textiles / clothing (22.4 percent), food (20.0 percent), machinery (14.6

percent), other (6.9 percent), paper (6.4 percent), metal (5.4 percent), electronics (5.4 percent), furniture (4.7 percent), stone, concrete (4.3 percent), beverage (4.0 percent), chemical (3.7 percent), plastics / rubber (3.0 percent), wood / lumber (2.4 percent), agriculture, forestry, fishing products (1.8 percent), alcohol (0.9 percent), tobacco (0.3 percent), and petroleum / coal (0.2 percent) (Figure 41).

The breakdown of trips according to time of day indicates that 68.4 percent of trips are made during peak hours (6-9 AM and 4-7 PM during weekdays, and 12 Noon-8 PM on weekends), 19.6 percent during day time off-peak hours (9 AM-4 PM and 7 PM-Midnight during weekdays, and before 12 Noon and after 8 PM on weekends), and 10.2 percent during overnight hours (Midnight-6 AM during weekdays). In general terms, for-hire carriers make 74.1 percent of trips during the peak hours. Private carriers have a higher percentage of trips during daytime off-peak and overnight hours. In terms of geography, New Jersey carriers have a higher percentage of trips during peak hours, while New York carriers have higher percentage of trips during day time off-peak and overnight hours (Figure 43).

On average, a typical tour takes about 337 minutes for private carriers, 448 minutes for for-hire carriers, 418 minutes for New Jersey regular users, 341 minutes for New York regular users, and 409 minutes for all current regular users. The average typical shipment size is 15,902 pounds for private carriers, 29,337 pounds for for-hire carriers, 26,725 pounds for New Jersey regular users, 11,579 pounds for New York regular users, and 25,028 pounds for all current regular users. The average load factor for current regular users is 85.2 percent, 83.2 percent for private carriers, 86.2 percent for for-hire carriers, 85.8 percent for New Jersey carriers, while 80.3 percent for New York carriers. The relatively high values of the load factor suggest the reported values correspond to the values for trucks leaving the home base.

Time of Travel Flexibility

When asked about reasons why trucks travel on their current schedule as opposed to other times of day, 61.6 percent of current regular users said customer requirements dictate schedule, followed by to avoid congestion (26.0 percent), have to deliver during a normal business / daytime hours (20.8 percent), and only 3.5 percent cited the toll is cheaper. The low number of carriers that mentioned tolls indicates that tolls play a relative minor role in affecting overall behavior. Private carriers seem to be more concerned about tolls and congestion than for-hire carriers, and New York carriers are more concerned about tolls than New Jersey carriers (Figure 44).

The survey also collected data on the carriers' time of travel flexibility, that is, how much later/earlier than the agreed delivery time trucks would be able to arrive at the destination and still meet customer needs. The analyses are based on 221 trip-based weighted responses (19.1 percent of entire sample) of late arrival flexibility and 216 trip-based weighted responses (18.7 percent of entire sample) of early arrival flexibility.

The data show that only 25.6 percent of current regular users' trips have any time of travel flexibility; while the majority indicated they do not have any flexibility. Among those that have flexibility, on average, current regular users' trips could arrive about 49 minutes later and 37 minutes earlier. Private carriers could arrive about 80 minutes later, and about 55 minutes earlier; while for-hire carriers could arrive about 26 minutes later, and about 24 minutes earlier (Table 69). The data clearly show that for-hire carriers are more constrained by the schedule and have much less flexibility than private carriers.

In terms of late arrival flexibility, 8.5 percent of all current regular users' trips (8.7 percent of private carriers and 8.4 percent for-hire carriers) could arrive up to 10 minutes later; 8.2 percent of all current regular users' trips (15.3 percent of private carriers and 4.7 percent for-hire carriers) could arrive more than half an hour later. In terms of early arrival flexibility, 6.6 percent of all current regular users (3.4 percent of private carriers and 8.3 percent of for-hire carriers) could arrive up to 10 minutes earlier; 11.8 percent of all current regular users (20.3 percent of private carriers and 7.3 percent of for-hire carriers) could arrive more than half an hour earlier. Interestingly enough, about 10 percent of trips have flexibility of more than half an hour, which could be the target of time of day pricing initiative (Figure 50 and Figure 51).

E-ZPass Use and Awareness of Toll Discounts

In general, 85.5 percent of current regular users' trips currently use E-ZPass. A higher percentage of New York carriers' trips (92.0 percent) than New Jersey trips (84.6 percent) are E-ZPass transactions. Percentages of E-ZPass transactions for private carrier trips (83.5 percent) and for-hire carrier trips (86.4 percent) are very similar (Table 70). The average length of using E-ZPass is 5.4 years for all E-ZPass trips, 6.1 years for private carriers' trips, 5.1 years for for-hire carriers' trips, 5.2 years for New Jersey carriers' trips, and 6.9 years for New York carriers' trips.

The analysis of the data indicates that 88 percent of all trucks have E-ZPass tags; as 73 percent of private carriers' trucks, 89 percent of for-hire carriers' trucks; almost all New Jersey carriers' trucks (91 percent), and about half (48 percent) of New York carriers' trucks (Table 71).

Cash users provided the main reasons for not using E-ZPass: 16.6 percent of all cash users cited driver abuse / need receipts for use, 15.0 percent cited seems complicated to use; 12.2 percent cited would not use it enough, 4.8 percent cited afraid of being overcharged or fined if tag does not work. Interestingly, 4.7 percent of cash users cited monthly fee as a reason. Compared by carrier type, for-hire carriers seem to be more concerned about issues like driver abuse, being overcharged, and giving out company information (Figure 54).

E-ZPass users provided various reasons why they like E-ZPass for the trips they make: 64.9 percent cited saves time / quicker, 33.7 percent cited do not need to carry cash, 8.5 percent cited saves money, cheaper than the cash toll, 7.4 percent cited like the itemized statement / do not need to keep receipts, and 7.0 percent cited simplifies accounting. Compared by carrier type, a higher percentage of private carriers cited saves time / quicker, and a higher percentage of for-hire carriers cited do not need to carry cash. Compared by geography, a higher percentage of New Jersey carriers cited do not need to carry cash (14.1 percent higher) (Figure 55 and Figure 56).

It seems clear that current regular users' trips are not made with a full awareness of available toll discounts: 35.9 percent of them do not know of any discounts, 31.5 percent of current regular users heard of discount, do not know specifics, 25.4 percent knew about off-peak or non-rush hour use discounts, 3.7 percent knew about general E-ZPass discount, and only 2.0 percent knew about overnight use discounts. The comparison between E-ZPass and cash users indicates that E-ZPass users seem to have poorer awareness of toll discounts even though they are using E-ZPass (Figure 57). 37.9 percent of cash users knew about off-peak or non-rush hour use discounts, while only about 25.7 percent for E-ZPass users; 13.2 percent of cash users knew about general E-ZPass discount, while only 2.9 percent for E-ZPass users.

When asked about if they remembered March 2001 toll increase, 83.7 percent of all current regular users, 78.5 percent of private carriers, 86.3 percent for for-hire carriers, 81.4 percent of E-ZPass users, 83.8 percent of New Jersey carriers, and 83.2 percent of New York carriers indicated they remembered the toll increase. Almost all cash users (96.9 percent) remembered the toll increase.

In terms of changes of E-ZPass usage due to time of day pricing, most (88.3 percent) current regular users reported no change, 8.2 percent reported switching to E-ZPass, 2.2 percent reported increasing use of E-ZPass, and only 1.0 percent did both. Compared by carrier type, a higher percentage of private carriers (9.7 percent) than for-hire carriers (7.5 percent) switched to E-ZPass, and a higher percentage of for-hire carriers (2.9 percent) than private carriers (0.8 percent) increased use of E-ZPass (Figure 60).

Respondents provided various suggestions for improving the E-ZPass system: 18.8 percent of all current regular users mentioned give a bigger discount for use, 9.7 percent cited high speed toll lanes, 7.0 percent of current regular users cited give a discount for use,6.5 percent suggested make the E-ZPass toll lanes separate from other traffic, move quicker, 6.0 percent cited simplified / accurate billing with receipts, 5.6 percent cited better public relation, communications, 4.6 percent cited lower deposit requirement, among others(Table 72 and Table 73).

Impacts of the Time of Day Pricing Initiative

The data indicate that 36 carriers changed behavior because of the time of day pricing initiative. They represent 257 trips (i.e., weighted responses) and 20.2 percent of the entire trip-based weighted sample. These carriers includes 31 current regular users that changed behavior in different ways though still remained using the PANYNJ facilities (17.7 percent) and five former regular users that cited tolls as the key reason to stop using the facilities (2.5 percent) (Table 74). Only two out these five former users (1.0 percent) reported tolls as the key reason for stopping using the facilities; while the remaining three (1.5 percent) cited toll costs as a contributing factor to the high costs that forced them to change business patterns. Since former regular users were not asked questions about behavioral changes, the analyses focus only on current regular users.

In contrast to those that did not change, the small group of carriers that changed behavior because of time of day pricing tends to:

- Focus on full truck load (FT) service. The vast majority of those carriers that changed behavior (73.6 percent) are Full-Truck-Load (FTL) operators. (Figure 61).
- Own smaller fleets, averaging 51.6 trucks. (Table 76).
- Employ fewer interstate truck drivers on average but the same interstate truck drivers per truck on average. Carriers that changed behavior hire 34.2 interstate drivers on average (Table 77). The average interstate truck drivers per truck owned by these that changed behavior (0.7 drivers per truck) are the same as the one for those that did not change (Table 78).
- Venture in the areas out of New Jersey and New York. The distributions of origins and destinations of shipments indicate that the carriers that changed behavior are

more likely to transport shipments originating in areas other than New Jersey and New York that are delivered to areas outside the Mid-Atlantic region. A significant proportion of these carriers have shipments originating in Pennsylvania (14.2 percent) or Maryland (12.0 percent), which is much higher than the ones among those that did not change (0.4 percent and 0.0 percent). About 47.9 percent of these carriers send their cargoes to the areas outside the Mid-Atlantic region such as Massachusetts and Maryland, while only 26.6 percent of those that did not change their behavior did so (Table 79 thru Table 82). This finding suggests that carriers doing through trips are fairly sensitive to the time of day pricing initiative. The fact that the survey could not reach a larger population of carriers doing thru trips suggests that the sample used in this report may be biased towards those that are less sensitive to pricing efforts and have less flexibility in routing and time of travel.

- Use various strategies and multiple combinations of strategies to deal with time of day pricing. The main strategies used by these carriers in response to the time of day pricing initiative include *switching to or increasing use of E-ZPass* (10.4 percent), *increasing shipment charges* (9.0 percent), *reducing truck trips* (6.2 percent), and *changing their routes to avoid toll facilities* (6.2 percent). *Changing the time of travel to the off peak hours* was found to be a really minor strategy. Only 0.5 percent of current regular users shifted to off-peak periods because of time of day pricing (Table 83 and Table 84).

For the most part, they involve combinations of the actions mentioned before (i.e., *switching to or increase use of E-ZPass*, *increasing shipment charges*, *decreasing truck trips*, *changing routes*, and *switching business to other areas*) (Table 85). The key combinations of change patterns include: *passing the additional costs generated by the toll changes to their customers* + *decreasing the truck trips through the toll booths* + others (6.1 percent), *changing routes* + *increasing charges* + others (5.5 percent), *decreasing truck trips* + *changing routes* + others (4.1 percent), combinations between *switching business to other areas* and *increasing shipment charges* (2.4 percent), *decreasing their truck trips through the toll facilities* (2.4 percent), or *changing their* *delivery routes* (2.4 percent); and *switching to E-ZPass* and simultaneously either *decreasing truck trips* (2.2 percent) or *increasing shipment charges* (2.1 percent).

Detailed Findings: Company Characteristics

Carriers that responded to the survey are classified into current regular users (182 firms) and former regular users (18 firms), depending on whether they currently use the PANYNJ facilities on a regular basis. These two types of users account for 1156 trips by current regular users and 115 trips by former regular users. The number of trips is used to weight the firms' responses respectively, after expanding the sample using truck trip frequency as the expansion factor. The following percentages and the corresponding analysis are based on trip-based weighted responses instead of the (raw) individual observations. The descriptive analyses of former regular users' company characteristics are shown in Appendix 14. It is important to highlight that the results in Appendix 14 must be interpreted with caution due to the small sample size of former regular users.

A set of questions captured current regular users' characteristics in terms of company type, business type, fleet size and composition, the number of interstate drivers employed, and origins and destinations of deliveries. It was also assumed that for-hire carriers and private carriers have different company characteristics that may determine their behavioral attitudes towards time of day pricing. For that reason, comparisons are made between them.

Current regular users account for 1156 weighted responses. Figure 31 shows the breakdown of current regular users by carrier type and geography. 88.2 percent of current regular users are from New Jersey (1019 weighted responses) while 11.8 percent are from New York (137 weighted responses). This geographical breakdown reflects the difficulties of finding valid respondents from New York as explained earlier in the introduction section. In terms of carrier type, about two-thirds of current regular users (67.0 percent) are for-hire carriers (774 weighted responses) while 33.0 percent are private carriers (382 weighted responses). As will be analyzed later, for-hire carriers reported a higher trip frequency than private carriers, on average. Therefore, for-hire carriers account for a higher proportion of the weighted responses although the two types of carriers contribute a very similar number of individual observations to the raw sample (97 for-hire carriers vs. 103 private carriers).

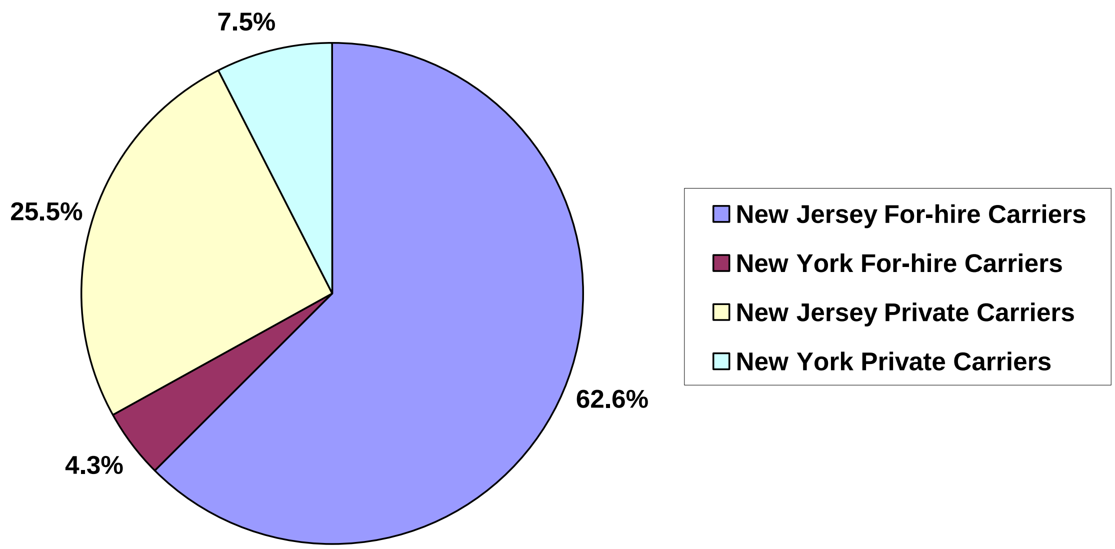


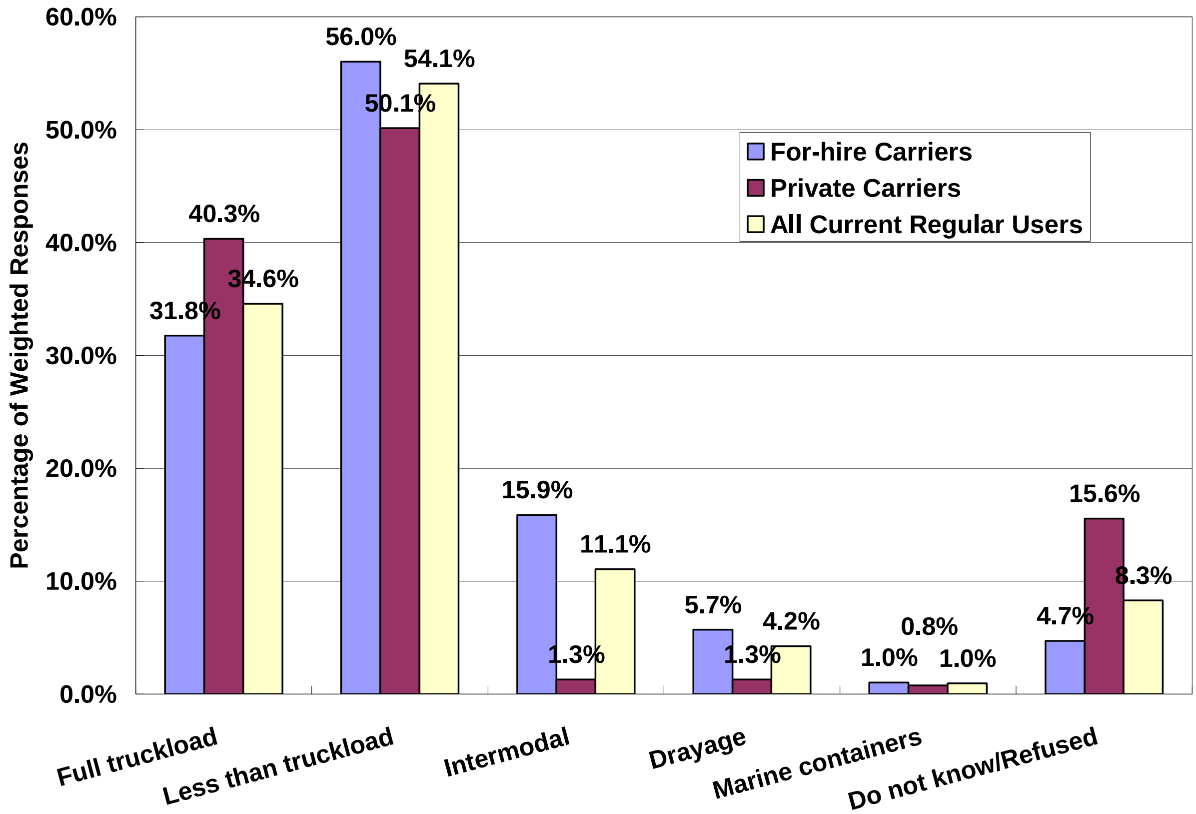
Figure 31. Breakdown of current regular users by carrier type and area

The companies are characterized in terms of business type, fleet size and composition, number of interstate truck drivers, number of interstate truck drivers per truck, and origins and destinations of most of deliveries. In summary, less than truckload and full truckload are the two main groups of services provided by current regular users. Current regular users own more large size trucks (trailers / semi-trailers) than small size trucks (two, three / four-axle trucks). In terms of origins and destinations of most shipments, they are more likely to identify New Jersey as the origin and New York State as the destination. These findings are discussed next.

(1) Business type

As shown in Figure 32, among current regular users' trips, the vast majority of carriers do LTL (54.1 percent) or FTL services (34.6 percent) while the remaining carriers focus on intermodal, drayage, or marine containers. A larger share of for-hire carriers' trips

(21.6 percent) focus on intermodal or drayage services than private carriers' trips (2.6 percent).



Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

Figure 32. Distributions of business type (current regular users)

(2) Fleet size and composition

The company size is measured by the total number of two-axle trucks, three / four-axle trucks, and trailers / semi-trailers. The sample is dominated by medium and large size carriers, as shown in Figure 33. More than half of current regular users (56.1 percent) own 21 to 49 trucks (21.2 percent) or more than 50 trucks (34.9 percent). The high proportion of medium and large size carriers could be due to the difficulties of reaching small size carriers that are usually less willing to participate in surveys. It needs to be noted that 3.5 percent of current regular users said they do not own any truck, which maybe because these carriers rent trucks from other companies.

Another feature revealed by Figure 33 is that for-hire carriers tend to be larger than private carriers. The average fleet size of for-hire carriers (Table 60) is 67.3 trucks, which is about twice more than the average fleet size of private carriers (31.0 trucks).

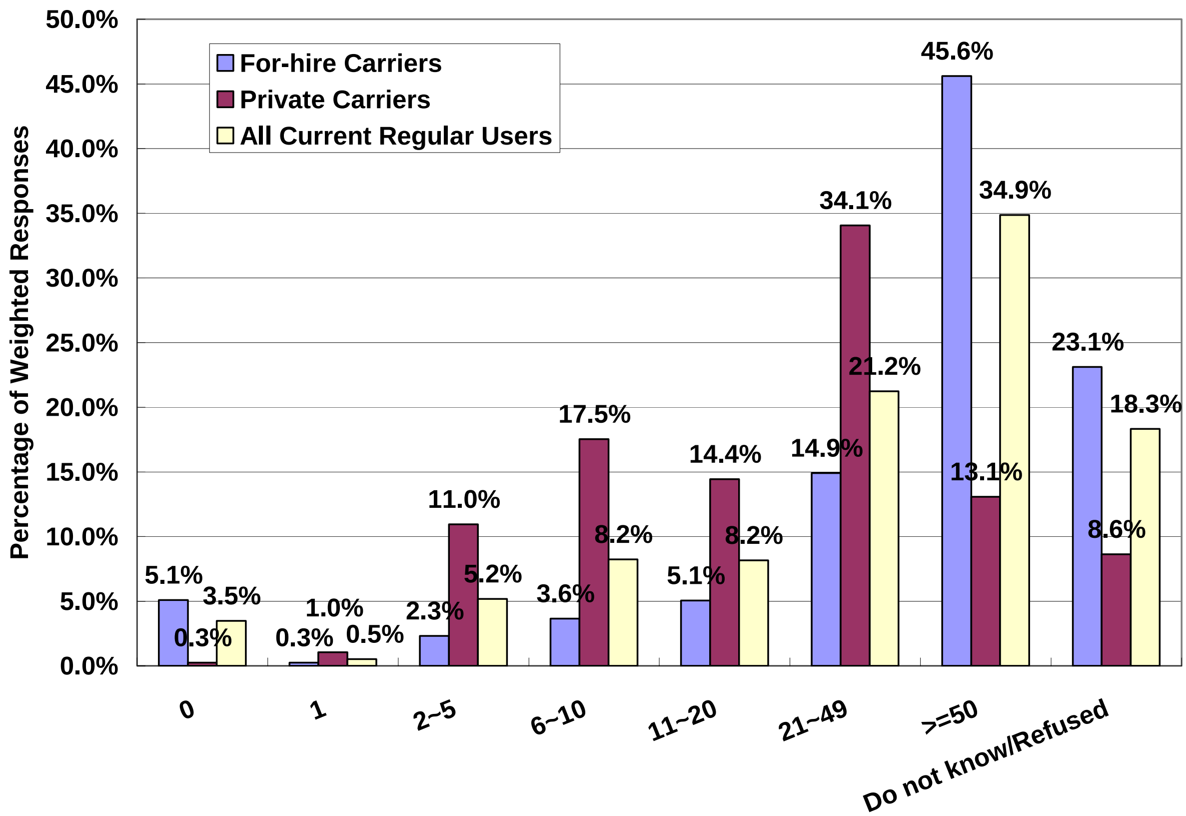


Figure 33. Distributions of fleet size (current regular users)

Table 60. Average number of trucks owned (current regular users)

Average number of trucks	For-hire Carriers	Private Carriers	All Current Regular Users
Two axle trucks	9.1	12.7	10.3
Three / four axle trucks	4.6	4.7	4.6
Trailers / semi-trailers	50.7	13.4	38.0
Fleet size	**67.3**	**31.0**	**53.9**

The survey classified the trucks owned by current regular users in three types: two-axle trucks, three / four-axle trucks, and trailers / semi-trailers. Figure 34 thru Figure 36 and Table 60 suggest the following conclusions:

1) In general, the average current regular user tends to own large size trucks, e.g., trailers / semi-trailers. The vast majority of current regular users (88.0 percent) said they own trailers / semi-trailers while 58.7 percent and 55.3 percent reported having two-axle trucks, or three / four-axle trucks respectively. Moreover, as shown in Table 60, the average number of trailers / semi-trailers owned by current regular users is much higher than the numbers of two, and three / four-axle trucks (38.0 trailers / semi-trailers vs. 10.3 two-axle trucks and 4.6 three / four-axle trucks). What is more, among small-size trucks, current regular users are more likely to own two-axle trucks as high as for three / four-axle trucks. The average number of two-axle trucks owned (10.3 two-axle trucks) is about twice higher than the one of three / four-axle trucks (4.6 three / four-axle trucks).

2) Among carriers that own two-axle trucks, the group owning 11 to 20 trucks is the most significant one accounting for 16.0 percent of the entire current regular users; among carriers that own three / four-axle trucks, the carriers owning two to five, or six to ten trucks are the dominant ones representing 16.0 percent and 14.8 percent of current regular users respectively; the most important segment of those that reported owning trailers / semi-trailers are large fleet carriers with more than 50 trailers / semi-trailers in their companies (31.0 percent).

3) The fleet compositions vary by carrier type. Private carriers are more likely to own small-size trucks such as two-axle trucks or three / four-axle trucks; while for-hire carriers tend to own larger truck combinations. As can be seen in Table 60, the average numbers of two-axle trucks and three / four-axle trucks owned by private carriers (12.7 two-axle trucks and 4.7 three / four-axle trucks) are higher than the ones of for-hire carriers (9.1 two-axle trucks and 4.6 three / four-axle trucks). On the contrary, the average number of trailers / semi-trailers owned by for-hire carriers (50.7 trailers / semi-trailers) is above three times higher than the one owned by private carriers (13.4 trailers / semi-trailers). Another interesting finding is that for-hire carriers dominate the high ranges of truck ownership for each truck type while private carriers tend to dominate the low ranges. As shown in Figure 34, the percentages of private carriers are always higher than for-hire carriers when the range of two-axle trucks is below 49 trucks. However, this pattern reverses when the range is more than 50 trucks. The distributions of three / four-axle trucks and trailers/ semi-trailers follow the similar pattern although

the cut-off points are different, e.g., 11 three (or four) axle trucks and 11 trailers (or semi-trailers) respectively.

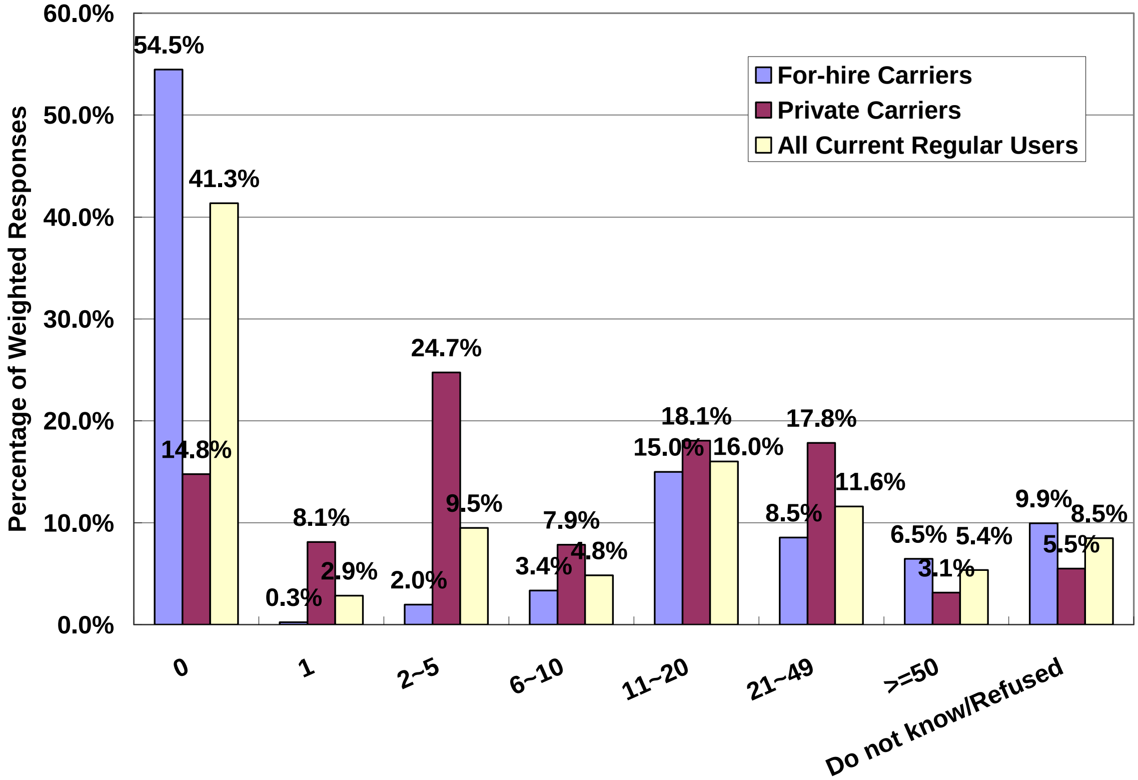


Figure 34. Distributions of two-axle trucks (current regular users)

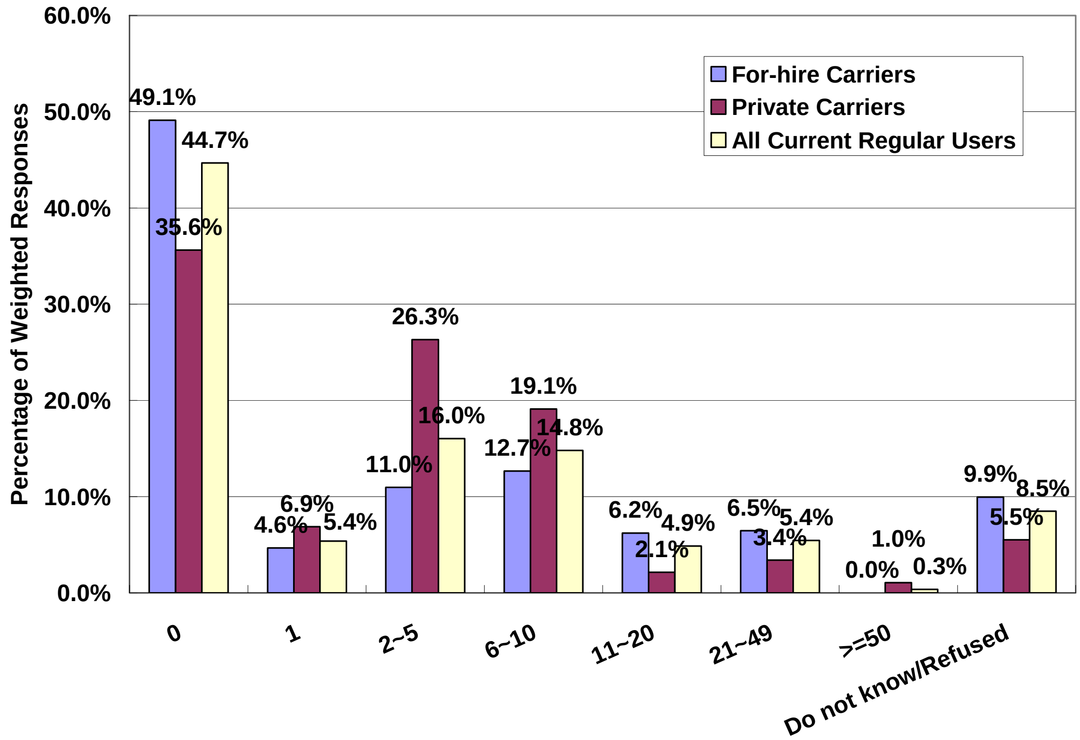


Figure 35. Distributions of three / four-axle trucks (current regular users)

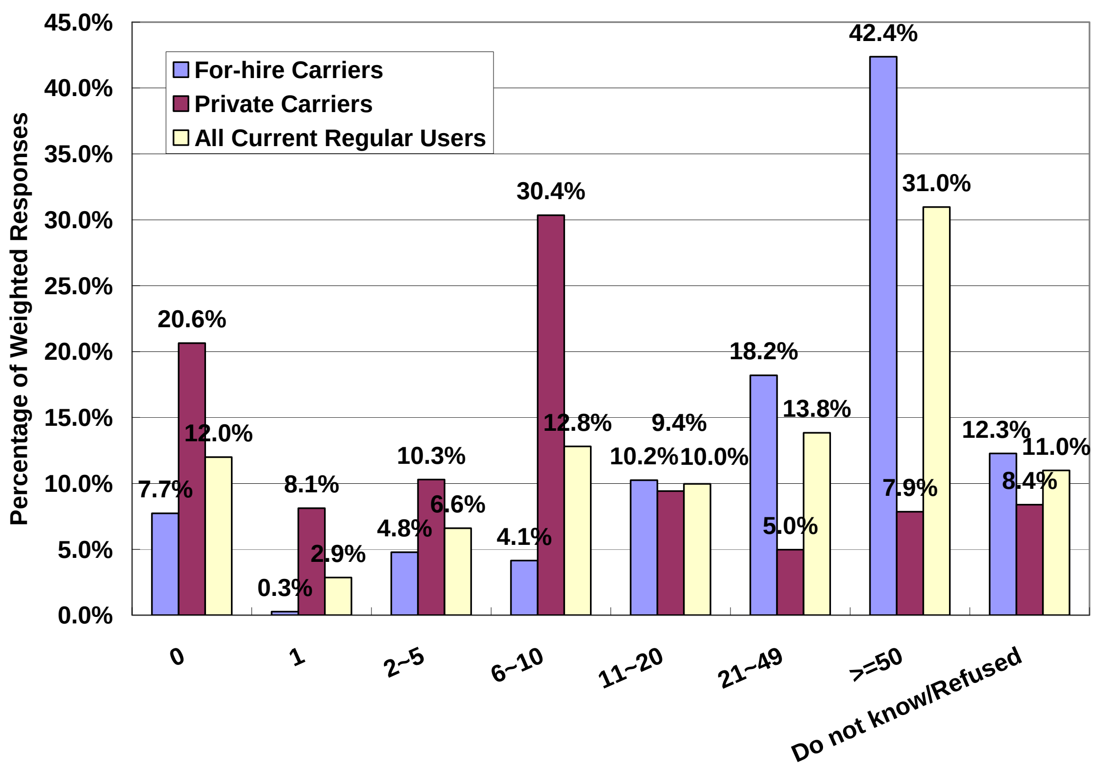


Figure 36. Distributions of trailers and semi-trailers (current regular users)

(3) Number of interstate truck drivers

The number of interstate truck drivers is an important indicator because it shows how significant interstate operations are for a particular carrier. The analyses discussed in this section are based on both the numbers of interstate truck drivers and the ratio of interstate drivers to trucks.

The distributions of interstate licensed truck drivers employed by current regular users resemble the distributions of fleet size. The largest group is the one employing more than 50 interstate truck drivers (32.7 percent). Consistent with the fleet size, for-hire carriers employ more interstate truck drivers than private carriers. A little more than half of private carriers (55.1 percent) hire two to five (32.1 percent) or six to ten interstate drivers (23.0 percent) while almost half of for-hire carriers (48.3 percent) hire more than 50 interstate drivers. The average numbers of interstate licensed truck drivers in Table 61 confirms this. The average number of interstate drivers employed by for-hire carriers (51.1 drivers) is almost four times higher than the one for private carriers (13.0 drivers).

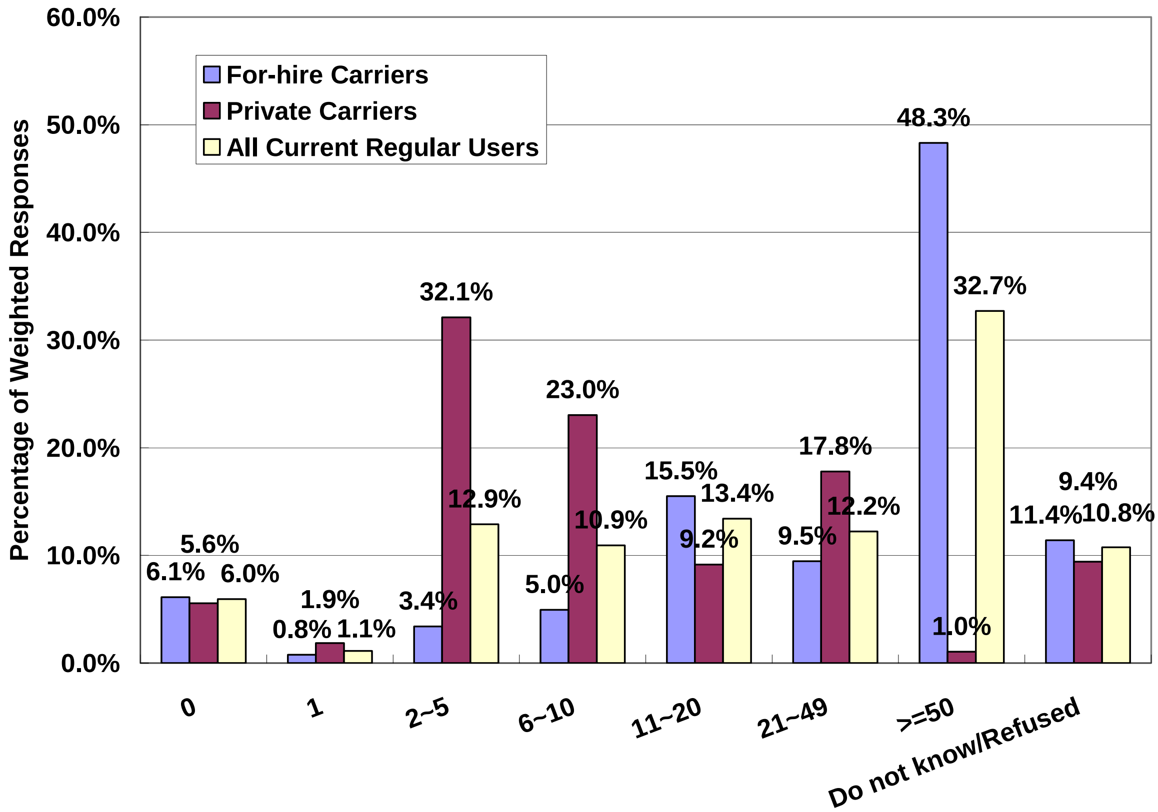


Figure 37. Distributions of interstate truck drivers (current regular users)

Table 61. The average number of interstate truck drivers (current regular users)

	Average number of interstate truck drivers
For-hire Carriers	51.1
Private Carriers	13.0
All Current Regular Users	38.3

Figure 38 and Table 62 show the distributions, and the average values of the interstate truck drivers per truck owned by current regular users. In general, the average interstate drivers per truck for current regular users is 0.7 interstate drivers per truck; among them, the group of carriers with 0.75 to 1.0 interstate truck drivers per truck is the dominant one that is responsible for 41.9 percent of cases. As shown, for-hire carriers tend to hire more interstate licensed drivers per truck than private carriers. The interstate drivers per truck owned by for-hire carriers are always greater than the ones owned by private carriers when the range is more than 0.25 drivers per truck. Moreover, the average number of interstate drivers per truck owned by for-hire carriers is 0.8 drivers per truck, which is higher than the one owned by private carriers (0.6 drivers per truck).

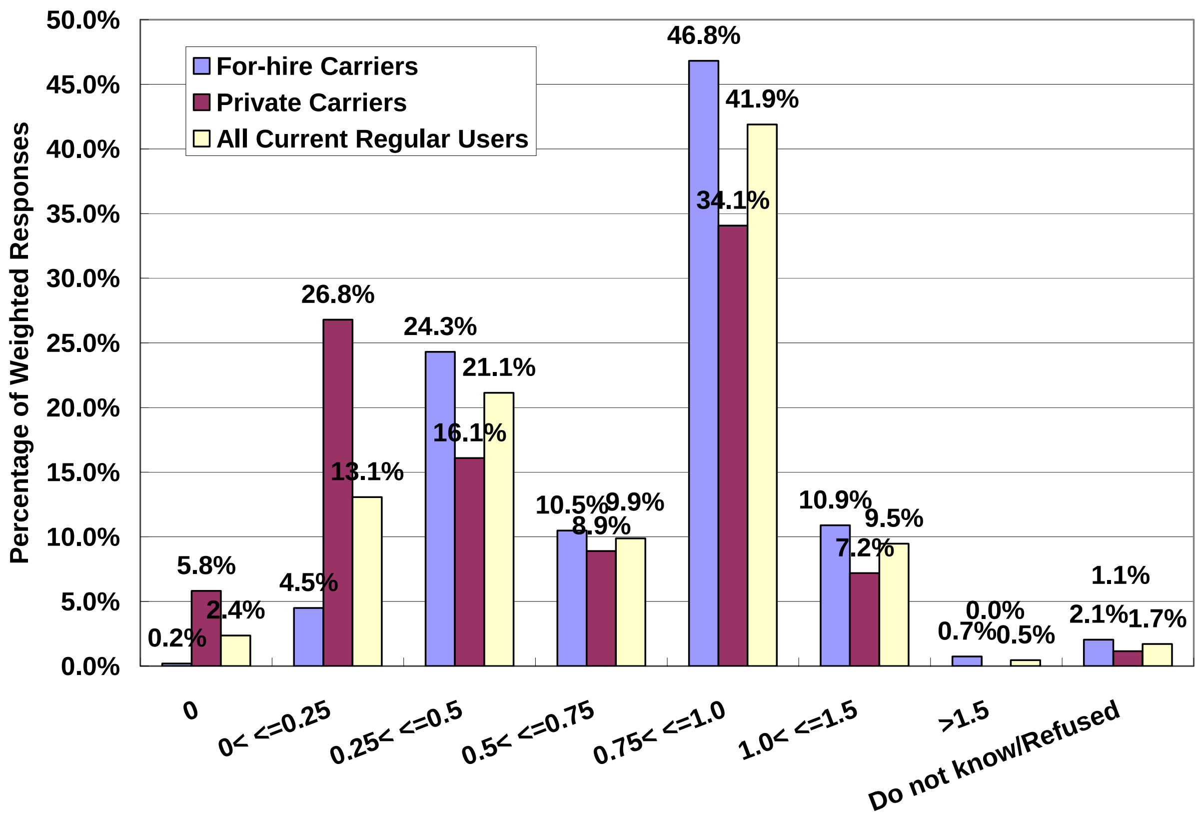


Figure 38. Distributions of interstate drivers per truck (current regular users)

Table 62. The average interstate truck drivers per truck (current regular users)

	Average interstate truck drivers per truck
For-hire Carriers	0.8
Private Carriers	0.6
All Current Regular Users	0.7

(4) Origins and destinations of majority of shipments

The majority of current regular users' shipments (71.1 percent) originate in New Jersey and 8.5 percent in New York (Table 63). Other minor origins include: California (5.8 percent), Pennsylvania (3.1 percent), Maryland (2.3 percent), Ohio (0.3 percent), and

Georgia (0.1 percent). Some carriers reported that their origins of shipments are regional (1.6 percent) or overseas (0.3 percent). For-hire carriers and private carriers reported similar origins of deliveries.

Table 63. Origins of majority of shipments by carrier type (current regular users)

Origin	**For-hire carriers**	**Private carriers**	**All Current regular users**
New Jersey	70.0%	73.2%	71.1%
New York	4.3%	17.1%	8.5%
California	8.7%	0.0%	5.8%
Pennsylvania	0.0%	9.4%	3.1%
Maryland	3.5%	0.0%	2.3%
Regional	2.3%	0.0%	1.6%
Ohio	0.4%	0.0%	0.3%
Overseas	0.4%	0.0%	0.3%
Georgia	0.0%	0.3%	0.1%
Do not know/Refused	10.5%	0.0%	7.0%
Total	100.0%	100.0%	100.0%
Based on weighted responses of	**774**	**382**	**1156**

The origins of most of shipments are correlated with the locations of the current regular users. As shown in Table 64, the shipments for most of the current regular users from New Jersey (79.3 percent) have New Jersey as their origin while a little more than 60 percent of New York current regular users' shipments originate in New York. Some carriers reported other origins. Pennsylvania is cited as an origin by a significant proportion of New York carriers (21.9 percent) while California is the second most cited origin by New Jersey carriers (6.5 percent) besides New York.

Table 64. Origins of majority of shipments by carrier's location (current users)

Origin	New Jersey Carriers	New York Carriers	All current regular users
New Jersey	79.3%	9.5%	71.1%
New York	1.4%	61.3%	8.5%
California	6.5%	0.7%	5.8%
Pennsylvania	0.6%	21.9%	3.1%
Maryland	2.6%	0.0%	2.3%
Regional	1.2%	4.4%	1.6%
Ohio	0.0%	2.2%	0.3%
Overseas	0.3%	0.0%	0.3%
Georgia	0.1%	0.0%	0.1%
Do not know/Refused	7.9%	0.0%	7.0%
Total	100.0%	100.0%	100.0%
Based on weighted responses of	**1019**	**137**	**1156**

Current regular users reported multiple destinations for most of their deliveries. In general, they do not generally venture far from the Mid-Atlantic region, and the four large states of the Mid-Atlantic region represent the destinations of most shipments for current regular users. New York State is the most cited destination (74.3 percent) followed by New Jersey (29.0 percent), Pennsylvania (13.3 percent) and Connecticut (10.2 percent). This pattern coincides with the geographical distributions and market orientations of current regular users. Current regular users either come from New Jersey (88.2 percent) or New York (11.8 percent). Since New York State, especially New York City, has an enormous demands for various cargoes, carriers are more likely to orientate their business in New York State. Not surprisingly, New York State represents the destination of most shipments.

Table 65. Destinations of majority of shipments by carrier type (current users)

Destination	For-hire carriers	Private carriers	All current regular users
New York	73.1%	76.7%	74.3%
New Jersey	28.7%	29.6%	29.0%
Pennsylvania	14.8%	10.2%	13.3%
Connecticut	10.5%	9.8%	10.2%
California	11.5%	1.6%	8.2%
Massachusetts	6.3%	6.0%	6.2%
Maryland	4.1%	5.5%	4.6%
Texas	3.2%	4.4%	3.6%
Florida	0.4%	9.4%	3.4%
Illinois	0.0%	4.4%	1.5%
Rhode Island/Vermont/Maine	1.5%	0.5%	1.2%
North Carolina /Virginia/Georgia	0.0%	2.6%	0.9%
Delaware	0.3%	1.3%	0.6%
Michigan/Ohio	0.4%	0.0%	0.3%
Minnesota	0.4%	0.0%	0.3%
Do not know/Refused	7.9%	0.0%	5.3%
Based on weighted responses of	**774**	**382**	**1156**

Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

Table 66 explains the patterns in the distribution of destinations from the viewpoint of carriers' locations. Current regular users, no matter where they are from, usually send most of their shipments to New York State, presumably New York City. The majority of New Jersey carriers send most of their shipments to New York State (73.7 percent) followed by New Jersey (25.6 percent). Carriers from New York State also tend to send their shipments to somewhere in New York State (78.8 percent) although more than half of these New York carriers cited New Jersey (54.3 percent) as a destination.

Table 66. Destinations of majority of shipments by carriers' location (current users)

Destination	New Jersey carriers	New York carriers	All current regular users
New York	73.7%	78.8%	74.3%
New Jersey	25.6%	54.3%	29.0%
Pennsylvania	14.0%	8.0%	13.3%
Connecticut	8.7%	21.9%	10.2%
California	9.3%	0.0%	8.2%
Massachusetts	5.6%	11.0%	6.2%
Maryland	3.2%	14.6%	4.6%
Texas	4.1%	0.0%	3.6%
Florida	1.8%	15.3%	3.4%
Illinois	1.7%	0.0%	1.5%
Rhode Island/Vermont/Maine	1.4%	0.0%	1.2%
North Carolina /Virginia/Georgia	1.0%	0.0%	0.9%
Delaware	0.7%	0.0%	0.6%
Michigan/Ohio	0.0%	2.2%	0.3%
Minnesota	0.0%	2.2%	0.3%
Do not know/Refused	6.0%	0.0%	5.3%
Based on weighted responses of	**1019**	**137**	**1156**

Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

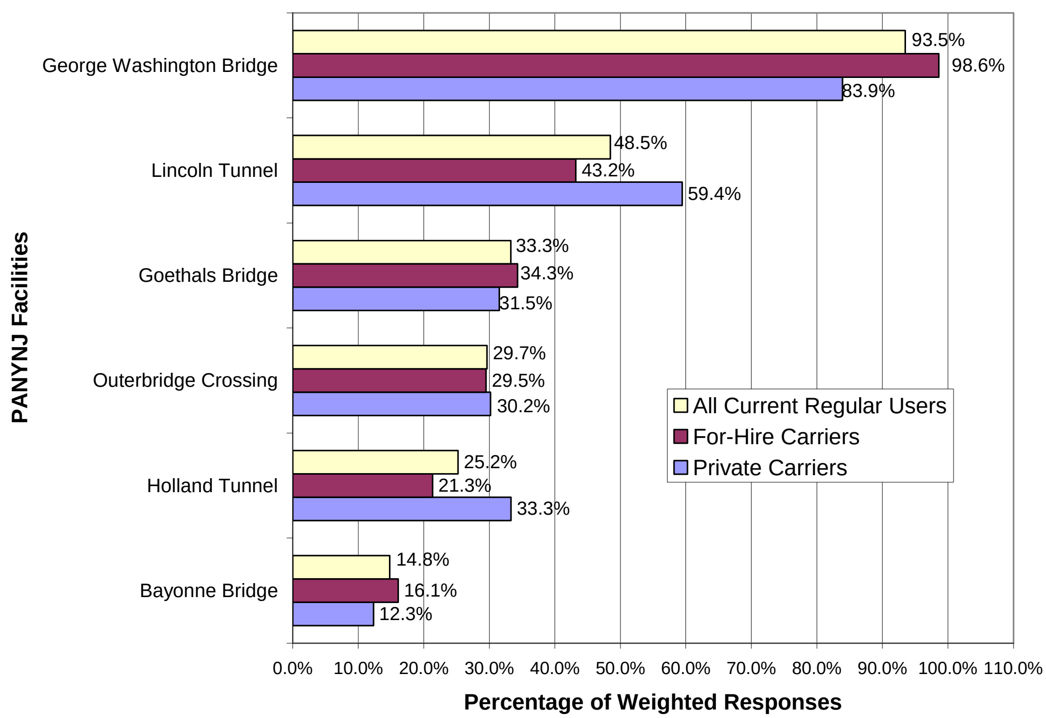
Detailed Findings: Facilities Used

All current regular users provided information about toll facilities used for deliveries in the New York / New Jersey metropolitan area. The following percentages and the corresponding analyses are based on 1156 weighted responses (774 weighted responses of for-hire carriers, 382 weighted responses of private carriers, 1019 weighted responses of New Jersey regular users, and 137 weighted responses of New York regular users). Figure 39 and Figure 40 show the comparisons of usage of PANYNJ facilities among current regular users by carrier type and geography. Note that since respondents could have multiple answers, the percentages do not add up to 100 percent. As shown in Figure 39, 93.5 percent of current regular users use the George Washington Bridge, 48.5 percent use the Lincoln Tunnel, 33.3 percent use the Goethals Bridge, 29.7 percent use the Outerbridge Crossing, 25.2 percent use the Holland

Tunnel, and 14.8 percent use the Bayonne Bridge. Comparison between for-hire and private carriers indicates that, although the top three most cited facilities are exactly the same, the percentages are very different. Compared with for-hire carriers, the percentage of using George Washington Bridge among private carriers is 14.7 percent less and 16.2 percent more for Lincoln Tunnel.

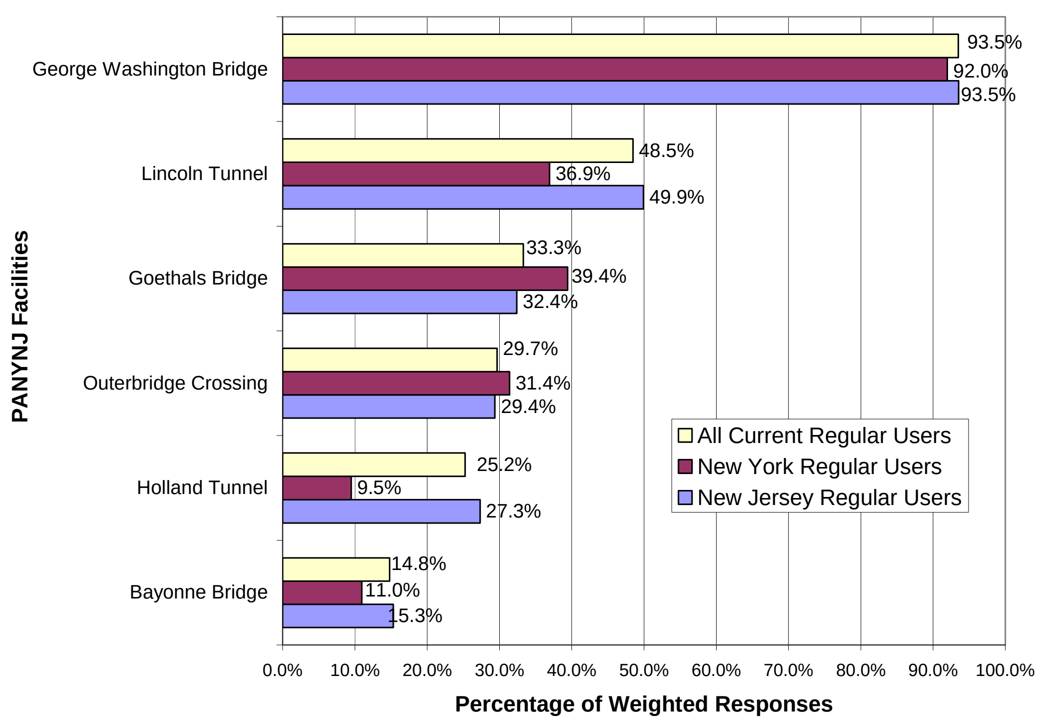
As shown in Figure 40, users in New Jersey and New York have different patterns. The top three most cited facilities for New Jersey users are the George Washington Bridge (93.5 percent), followed by the Lincoln Tunnel (49.9 percent), and the Goethals Bridge (32.4 percent). The top three most cited facilities for New York users are the George Washington Bridge (92.0 percent), followed by the Goethals Bridge (39.4 percent), and the Lincoln Tunnel (36.9 percent).

The survey also gathered information on the usage of other facilities. The six most cited facilities are the Verrazano Narrows Bridge (56.3 percent), followed by the Tappan Zee Bridge (27.1 percent), the Triboro Bridge (21.4 percent), the Whitestone Bridge (20.6 percent), the ThrogsNeck Bridge (11.6 percent), and the New Jersey Turnpike (11.4 percent).



Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

Figure 39. Comparison of PANYNJ facilities used by carrier type



Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

Figure 40. Comparison of PANYNJ facilities used by geography

The survey also gathered information about how long current regular users have been using the facilities on a regular basis. Table 67 shows the average length of using the facilities by carrier type and geography. On average, current regular users have been using these facilities for about 22 years, and similarly among all types of carriers except that New York carriers have been using these facilities about 30 years.

Table 67. Average length of using the facilities regularly

Carriers	Years
By Carrier Type	
Private Carriers	23.5
For-Hire Carriers	21.7
By Geography	
New Jersey Regular Users	21.3
New York Regular Users	29.7
All Current Regular Users	22.3

Former regular users also provided information about the facilities used before. Since the expansion factor was identical among the former users, the percentages before and after expansion are the same. Among the eighteen respondents, fourteen (77.8 percent) cited the George Washington Bridge, nine (50.0 percent) cited the Lincoln Tunnel, seven (38.9 percent) cited the Holland Tunnel and the Verrazano Narrows Bridge, three (16.7 percent) cited the Goethals Bridge and the Outerbridge Crossing, and one (5.6 percent) cited the Midtown Tunnel and the Triboro Bridge.

Among the sixteen former regular users that provided reasons why they stopped using the facilities, five (31.3 percent) cited demand changed, four (25.0 percent) cited congestion delay, three (18.8 percent) cited company downsized, two (12.5 percent) cited toll increased, one (6.3 percent) cited other costs-gas went up, and one (6.3 percent) cited travel route changed.

Fourteen respondents provided reasons other than toll increased for no longer using the facilities. Among them, three (21.4 percent) cited *toll costs* as a contributing factor to the high costs that forced them to change their business patterns; three (21.4 percent) said that *not enough demand* is the reason; two (14.3 percent) said that *customers pay for* *the tolls*; one (7.1 percent) said *tolls are part of the overall cost*; and one (7.1 percent) said they have E-ZPass and do not pay attention to tolls.

Detailed Findings: Current Operations

The questionnaire collected information on current regular users' operations, including types of commodities carried, frequency and number of stops on a typical roundtrip for deliveries between New York City and New Jersey, the breakdown of truck trips made during peak, off-peak and overnight, duration of a typical round-trip tour, typical shipment size, and load factor. (The reader should keep in mind that over 80 percent of current regular users, for-hire carriers, and private carriers captured in this survey are from New Jersey.) Nevertheless, the difference between for-hire and private carriers is not affected since New Jersey regular users are evenly distributed in these two groups. The percentages and corresponding analyses in this section are based on 1156 trip-based weighted responses of current regular users (774 weighted responses of for-hire carriers, 382 weighted responses of private carriers, 1019 weighted responses of New Jersey regular users, and 137 weighted responses of New York regular users) unless otherwise specified.

Trip Frequency and Number of Stops

Table 68 shows the average number of inbound trips and the average number of stops on a typical roundtrip that trucks make between New York City and New Jersey by carrier type and geography. On average, current regular users make 6.4 truck trips per day and 13.0 stops per tour. However, this result should be interpreted with caution, since more than 80 percent of current regular users are New Jersey regular users, which make 50 percent more trips and twice as many stops as New York regular users. For-hire carriers make twice as many trips and stops as private carriers.

Table 68. Average trip frequency and number of stops

Carriers	Number of Trips per Day between NYC and NJ	Number of Stops on a Typical Roundtrip between NYC and NJ
By Carrier Type		
Private Carriers	4.2	7.1
For-Hire Carriers	8.6	15.7
By Geography		
New Jersey Regular Users	6.8	13.7
New York Regular Users	4.3	6.0
All Current Regular Users	6.4	13.0

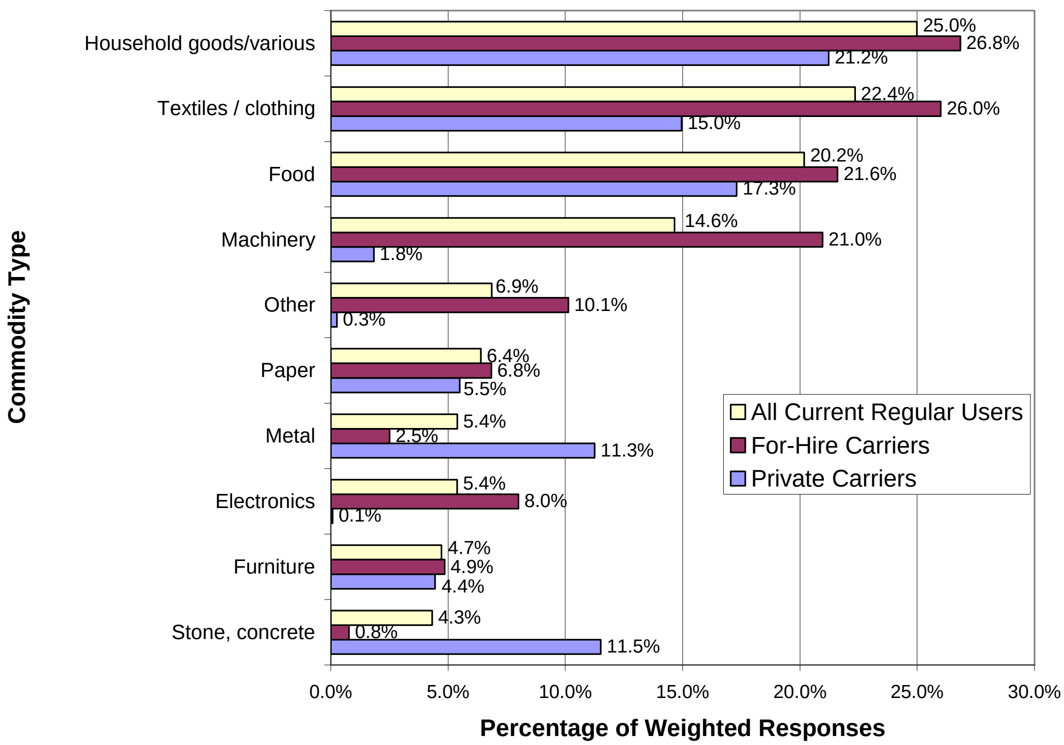
Commodities Carried

Figure 41 and Figure 42 show the types of commodities or products that current regular users carry the most by carrier type and geography. All current regular users provided information about commodity types in the survey. There are seventeen categories in total, and only the ten most cited ones by current regular users are shown. Note that the percentages do not add up to 100 percent since respondents could have multiple answers. As shown in Figure 41, current regular users carry a variety of commodities. The most cited commodities include: household goods / various, textiles / clothing, food, and machinery.

As shown in Figure 42, the top four commodities that New Jersey regular users carry are household goods/various (23.7 percent), followed by textiles / clothing (22.9 percent), food (22.4 percent), and machinery (16.2 percent), consistent with the pattern of all current regular users, which is not surprising since most of them are from New Jersey. On the other hand, New York regular users carry household goods / various (34.3 percent), followed by stone, concrete (21.9 percent), textiles / clothing (18.5 percent), and electronics (6.6 percent). This breakdown is consistent with the nature of New York City as a consumer market.

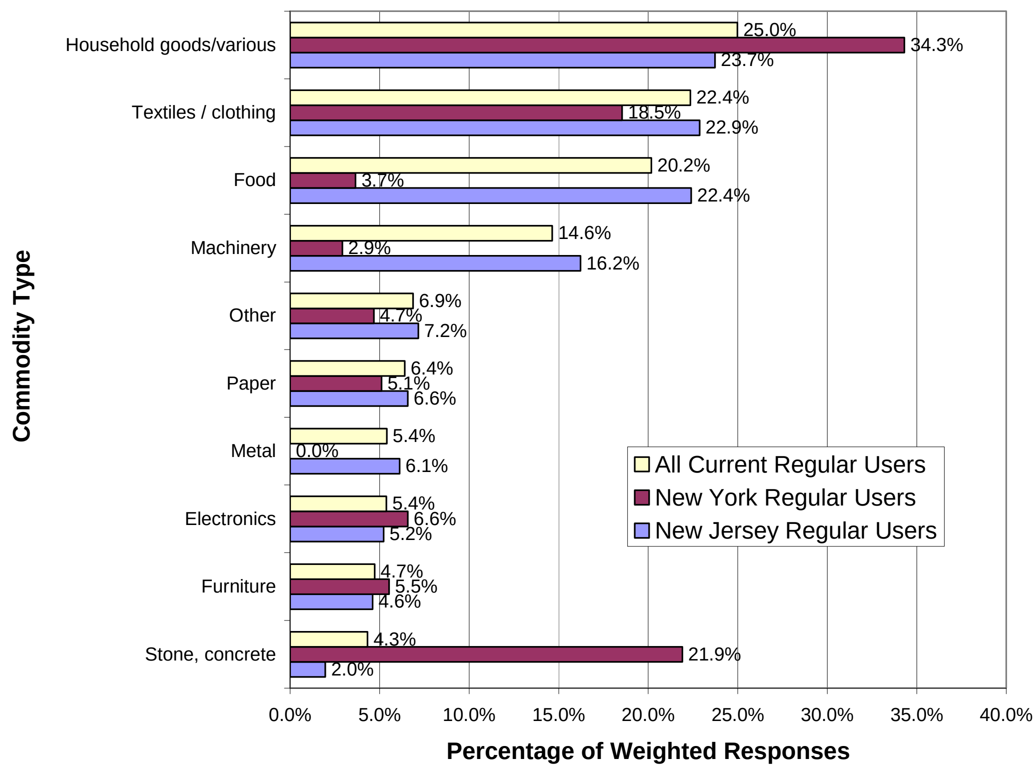
Current regular users also carry other types of commodities, such as beverages (4.0 percent), chemicals (3.7 percent), plastics / rubber (3.0 percent), wood / lumber (2.4 percent), agriculture, forestry, fishing (1.8 percent), alcohol (0.9 percent), tobacco (0.3 percent), and petroleum / coal (0.2 percent).

The structure of commodity types captured in this survey is similar to a previous PANYNJ survey in terms of the percentages of food, beverage, alcohol, tobacco, wood / lumber, paper, petroleum / coal chemicals, plastics / rubber, metal, electronics, and stone, concrete. (58) These results should be interpreted with caution because in this survey there could be multiple answers for commodity types, while in the previous one each respondent (truck driver) reported only one.



Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

Figure 41. Commodity types by carrier type



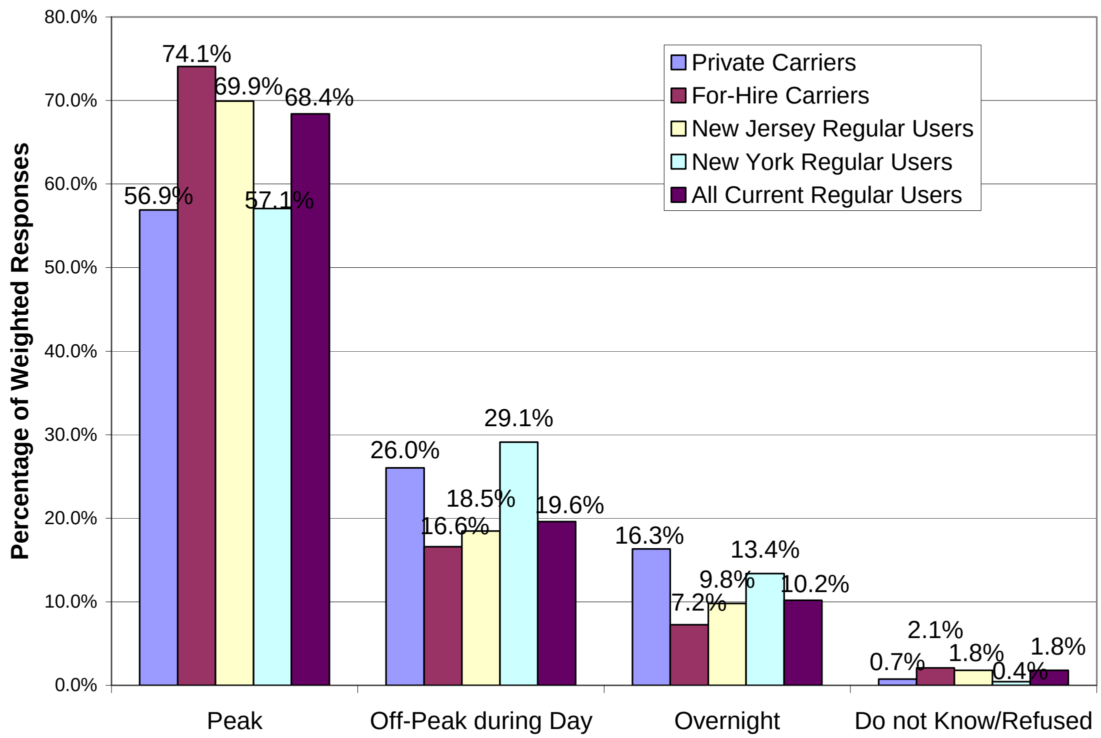
Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

Figure 42. Commodity types by geography

Breakdown of Trips During Time of Day Travel

Current regular users provided information about the percentages of eastbound truck trips through the toll booths during peak, off-peak and overnight hours. Figure 43 shows the breakdown of truck trips by time of day by carrier type and geography. Following PANYNJ's definitions of peak, off-peak and overnight, it was found that, on average, 68.4 percent of total truck trips made by a current user are made during peak hours (6-9 AM and 4-7 PM during weekdays, and 12 Noon-8 PM on weekends), 19.6 percent during day time off-peak hours (9 AM-4 PM and 7 PM-Midnight during weekdays, and before 12 Noon and after 8 PM on weekends), and 10.2 percent during overnight hours (Midnight-6 AM during weekdays). [12]

On average, private carriers make more trips during off-peak and overnight hours (a total of 42.3 percent) than for-hire carriers (a total of 23.8 percent), which indicates the higher likelihood for a private carrier to benefit from the time of day pricing program. If compared by geography, New Jersey carriers make a higher percentage of trips during peak hours, while New York carriers have higher percentage of trips during off-peak and overnight hours.



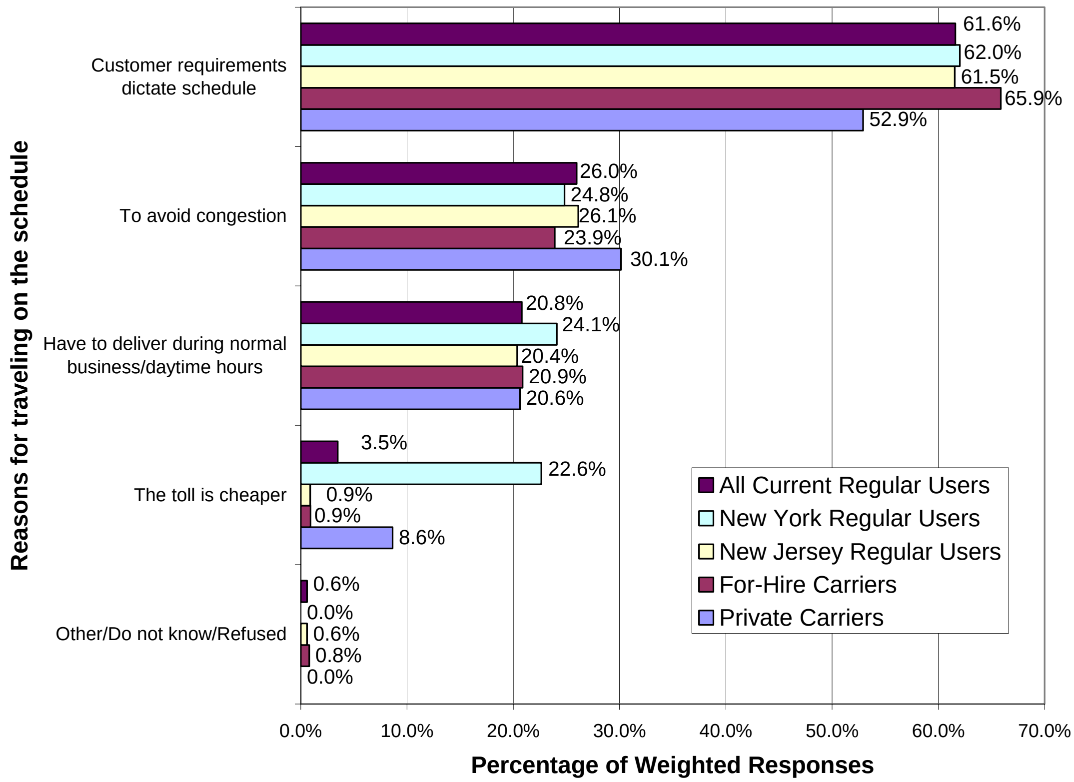
Note: (1) Peak hours are 6-9 AM and 4-7 PM during weekdays, and 12 Noon-8 PM on weekends.

(2) Day time off-peak hours are 9 AM-4 PM and 7 PM-Midnight during weekdays, and before 12 Noon and after 8 PM on weekends.

(3) Overnight hours are Midnight-6 AM during weekdays.

Figure 43. Breakdown of truck trips by time of day

Current regular users gave the reasons why trucks travel during the stated time. Figure 44 shows the breakdown of reasons by carrier type and geography. Note that percentages do not add up to 100 percent since respondents could have multiple answers. The most important reason is customer requirements dictate schedule *(*61.6 percent), followed by to avoid congestion *(*26.0 percent), have to deliver during a normal business / daytime hours *(*20.8 percent), and only 3.5 percent cited the toll is cheaper. Private carriers seem to be more concerned about tolls and congestion than for-hire carriers, and New York users are more concerned about tolls than New Jersey users. Also, it is important to note that for-hire carriers are more likely to cite customer requirements as the key reason than private carriers.



Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

Figure 44. Reasons for dispatching trucks on the schedule

Duration of Tour, Shipment Size, and Load Factor

Current regular users were asked about the duration of a typical round-trip tour when delivering between New York and New Jersey. On average, a typical tour takes about 409 minutes for all current regular users, 337 minutes for private carriers, 448 minutes for for-hire carriers, 418 minutes for New Jersey regular users, and 341 minutes for New York regular users. Figure 45 shows the distribution of duration of tour by carrier type. In general terms, 30.2 percent of all current regular users reported the typical tour takes about four to six hours, and 8.4 percent reported no typical time. More than half (53.4 percent) of private carriers' typical tour is less than six hours. For-hire carriers seem to have longer tours, 18.6 percent reported a typical tour takes more than 12 hours. Figure

46 shows the distribution of duration of tour by geography. 48.9 percent of New York regular users reported a typical tour takes between four to six hours, while only 27.7 percent of New Jersey regular users did so. 14.0 percent of New Jersey regular users reported a typical tour takes at least 12 hours while only 2.9 percent of New York regular users did so.

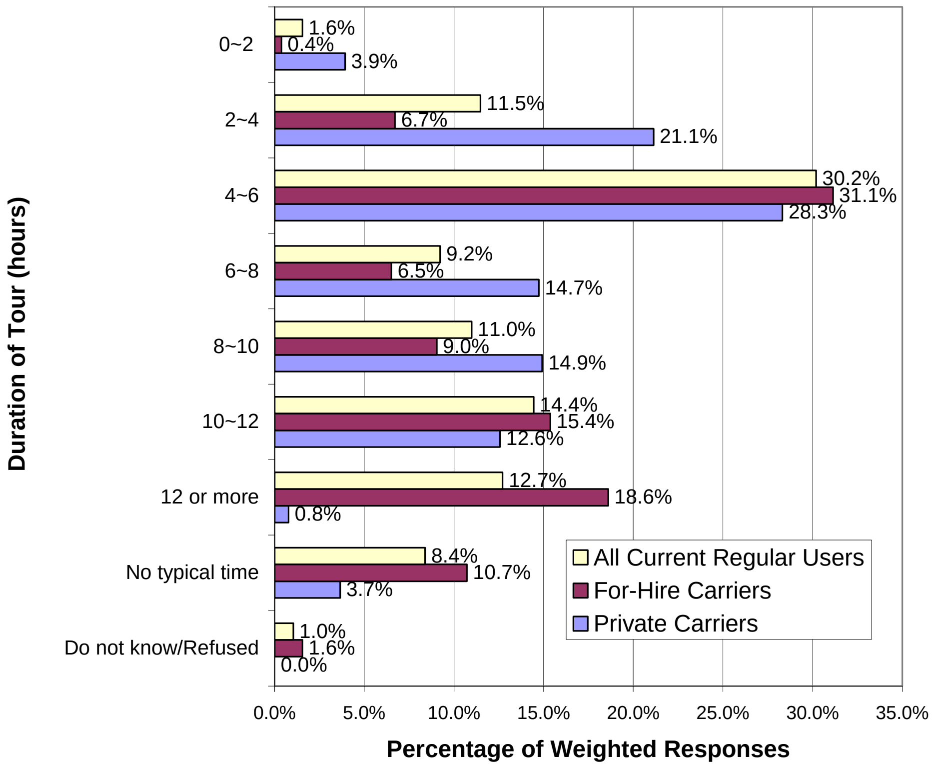


Figure 45. Distribution of duration of a typical tour by carrier type

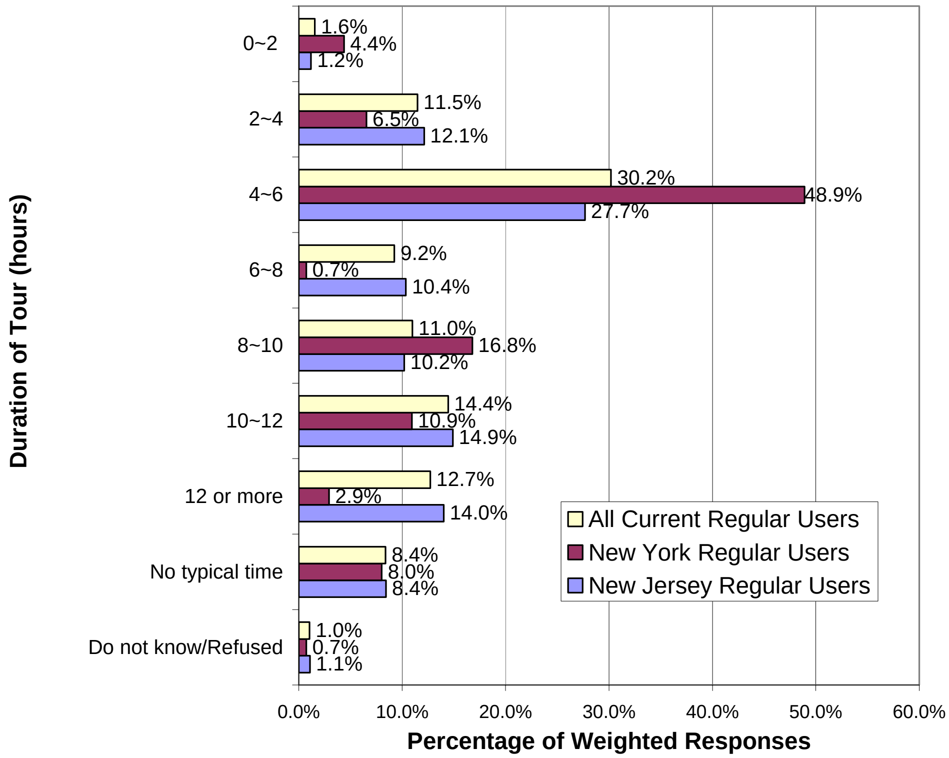


Figure 46. Distribution of duration of a typical tour by geography

The survey also gathered information about the typical shipment size. On average, the typical shipment size is 25,028 pounds for all current regular users, 15,902 pounds for private carriers, 29,337 pounds for for-hire carriers, 26,725 pounds for New Jersey regular users, and 11,579 pounds for New York regular users. Figure 47 and Figure 48 show the distributions of typical shipment size by carrier type and geography. For private carriers, 25.5 percent reported that the typical shipment size is less than 1,000 pounds, 11.3 percent reported more than a truckload (40,000 pounds). For for-hire carriers, 32.0 percent reported the typical shipment size is more than a truckload. As shown in Figure 48, various shipment sizes were observed among New Jersey regular users, 28.4 percent is more than a truckload; while most (79.9 percent) New York users reported shipment size is less than a truckload. The analysis of typical shipment size indicates that for-hire carriers carry shipments almost twice as large as private carriers, and that New Jersey companies carry shipments more than twice the size than New York carriers'.

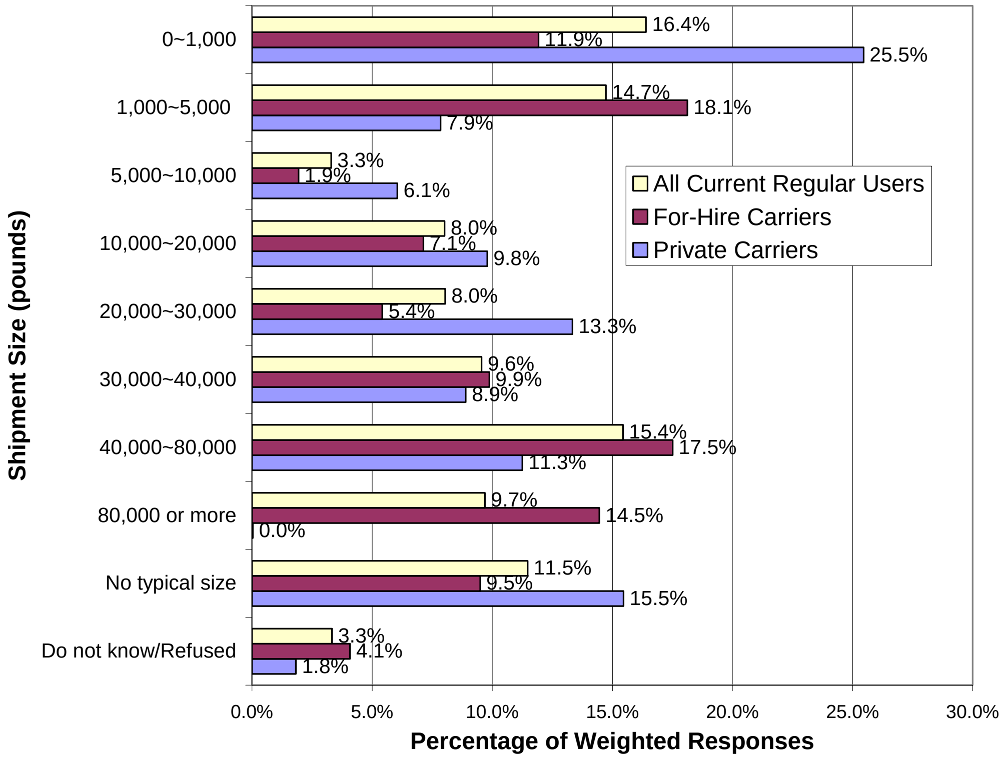


Figure 47. Distribution of typical shipment size by carrier type

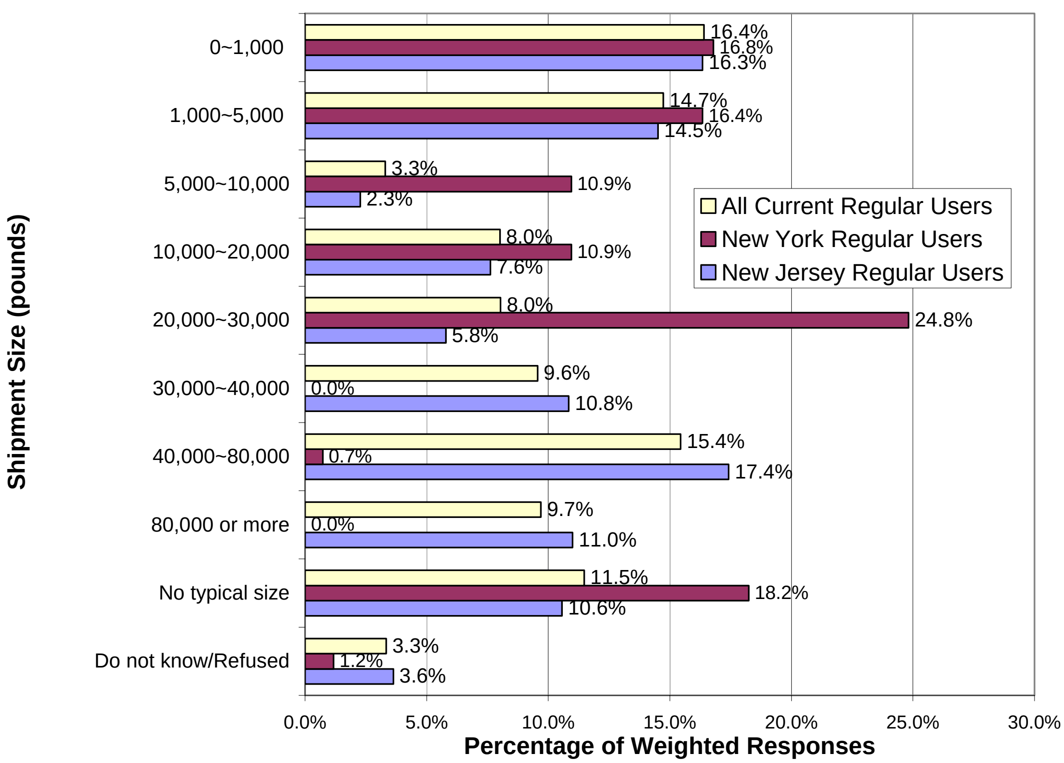


Figure 48. Distribution of typical shipment size by geography

The survey collected data about load factor, i.e., percentage of the truck capacity being utilized. On average, the load factor for current regular users is 85.2 percent, 83.2 percent for private carriers, 86.2 percent for for-hire carriers, 85.8 percent for New Jersey users, while 80.3 percent for New York regular users. Figure 49 shows the distribution of load factor by carrier type and geography. 42.4 percent of all current regular users reported that the trucks are fully loaded, similarly for for-hire carriers, private carriers and New Jersey users, while only 25.5 percent for New York users.

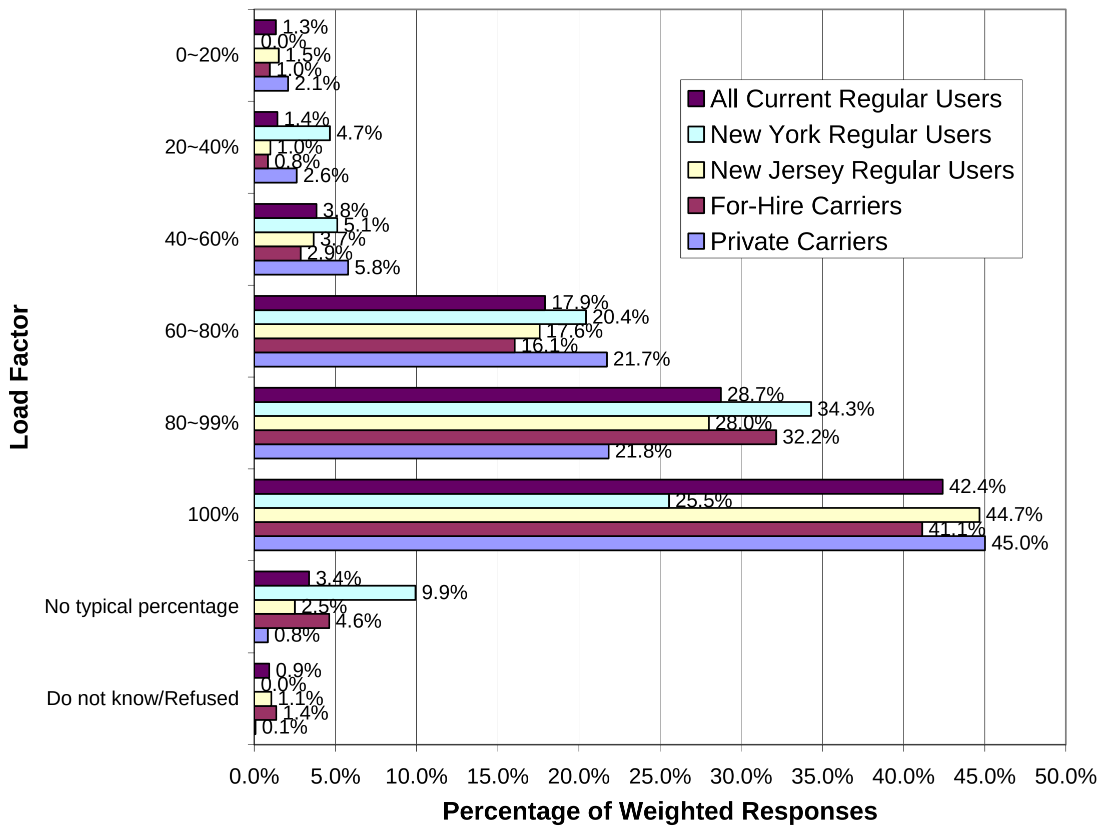


Figure 49. Distribution of load factor by carrier type and geography

Time of Travel Flexibility

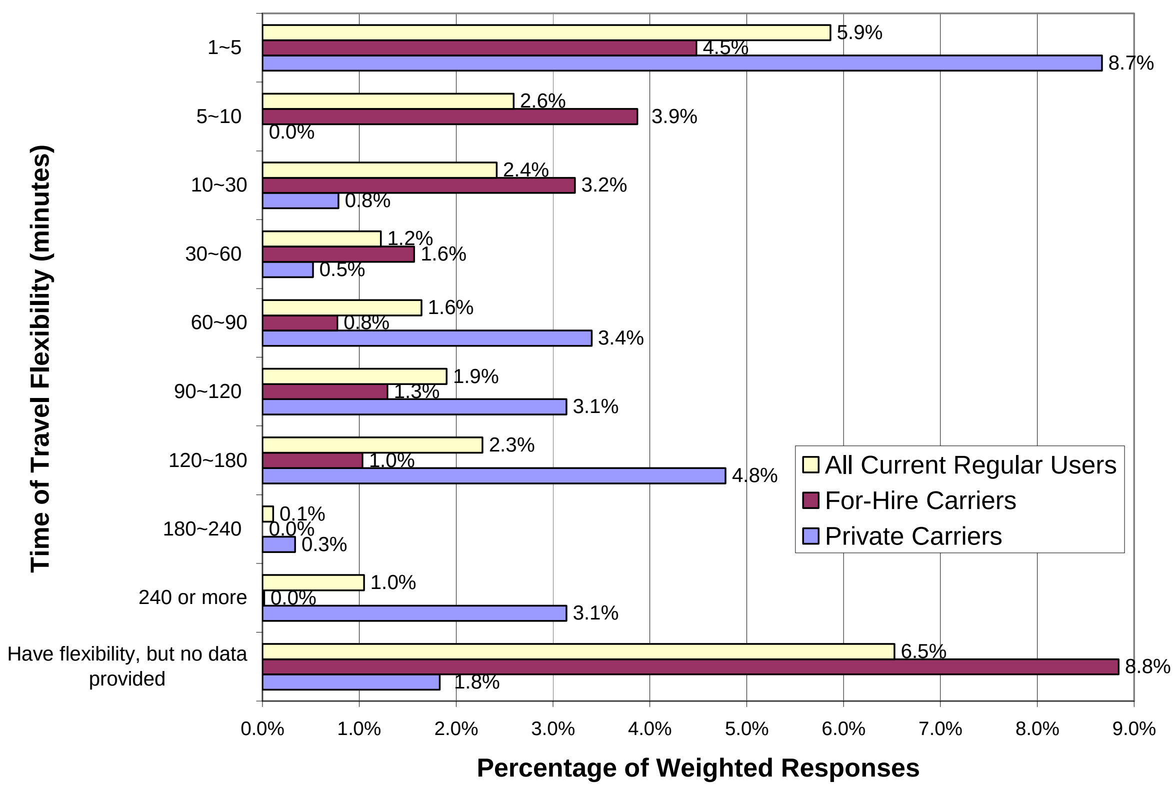
The survey also collected information on time of travel flexibility, i.e., how much later/earlier than the typical delivery time trucks would be able to arrive at the destinations and still meet customer needs. Table 69 shows the average time of travel flexibility by carrier type. Among all current regular users, only 25.6 percent reported that they have some time of travel flexibility, while 73.8 percent reported that they do not have any time of travel flexibility; and 0.6 percent did not know or refused to answer. For-hire and private carriers exhibit similar percentages. Based on 221 weighted responses (19.1 percent) of late arrival flexibility and 216 weighted responses (18.7 percent) of early arrival flexibility, as shown in Table 69, private carriers could arrive about 80 minutes later, and about 55 minutes earlier. It was found that for-hire carriers seem to be more constrained by schedule. Flexibility for for-hire carriers is within the range of half an hour: about 26 minutes later, and about 24 minutes earlier, which makes it difficult for them to switch to off-peak or overnight.

Figure 50 and Figure 51 show the distributions of late/early arrival flexibility by carrier type for those carriers that have some flexibility. The percentages are based on 1156 weighted responses. In terms of late arrival flexibility, as shown in Figure 50, 8.5 percent of all current regular users (8.7 percent among private carriers and 8.4 percent among for-hire carriers) could arrive up to 10 minutes later; 8.2 percent of all current regular users (15.3 percent among private carriers and 4.7 percent among for-hire carriers) could arrive more than half an hour later. In terms of early arrival flexibility, as shown in Figure 51, 6.6 percent of all current regular users (3.4 percent among private carriers and 8.3 percent among for-hire carriers) could arrive up to 10 minutes earlier; 11.8 percent of all current regular users (20.3 percent among private carriers and 7.3 percent among for-hire carriers) could arrive more than half an hour earlier. Interestingly enough, about 10 percent of all current regular users have flexibility of more than half an hour, which could be the target of time of day pricing initiative.

The analysis of flexibility indicates that for-hire carriers are more constrained by the schedule and, as a result, have much less flexibility than private carriers, which is consistent with the results discussed early. As a result, for-hire carriers are less sensitive to tolls because they have to arrive at the destinations on time.

Table 69. Time of travel flexibility by carrier type (minutes)

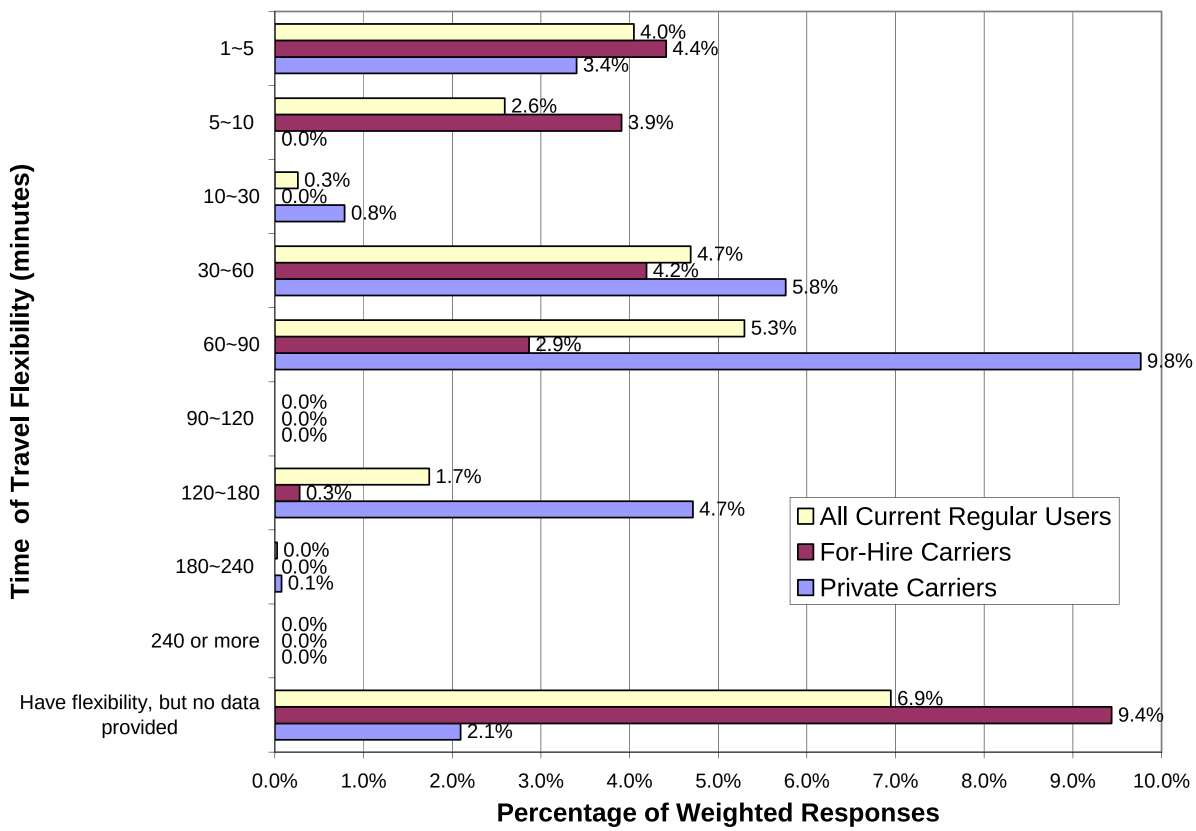
Carriers	Late Arrival Flexibility	Early Arrival Flexibility
Private Carriers	79.0	55.1
For-Hire Carriers	26.1	23.7
All Current Regular Users	48.8	37.3



Note: (1) This figure only shows the percentages for those that reported having any time of travel flexibility, therefore the percentages add up to 25.6 percent for all current regular users, 26.6 percent for private carriers, and 25.1 percent for for-hire carriers;

(2) The majority reported that they do no have any time flexibility: 73.8 percent of all current regular users, 71.6 percent of private carriers and 74.9 percent of for-hire carriers;

Figure 50. Late arrival flexibility by carrier type



Note: (1) This figure only shows the percentages for those that reported having any time of travel flexibility, therefore the percentages add up to 25.6 percent for all current regular users, 26.6 percent of private carriers, and 25.1 percent of for-hire carriers;

(2) The majority reported that they do no have any time flexibility: 73.8 percent of all current regular users, 71.6 percent of private carriers and 74.9 percent of for-hire carriers;

Figure 51. Early arrival flexibility by carrier type

Detailed Findings: E-ZPass Use and Awareness of Toll Discounts

This section discusses the respondents' level of awareness of E-ZPass features and the available toll discounts. This is important because the discounts are only available to E-ZPass users, and as a result, users' awareness of E-ZPass features directly determines how they would react. For these reasons, identifying the factors that encourage or discourage E-ZPass usage is a crucial step to define policies to increase E-ZPass usage and, ultimately, increase the efficiency of the time of day pricing initiative. The questions in this section were categorized into six groups: E-ZPass use, reasons for not using E-ZPass, perceived advantages and disadvantages of E-ZPass, awareness of the toll discount programs, impact of time of day pricing on E-ZPass use, and suggestions for improving the E-ZPass system. The percentages and corresponding analyses in this section are based on 1156 weighted responses of current regular users (774 weighted responses of for-hire carriers, 382 weighted responses of private carriers, 1019 weighted responses of New Jersey regular users, and 137 weighted responses of New York regular users) unless otherwise specified.

E-ZPass Use

Table 70 shows the breakdown of current regular users' trips by payment type. As shown, 85.5 percent of current regular users' trips currently use E-ZPass. A higher percentage of New York carriers' trips (92.0 percent) than New Jersey carriers (84.6 percent) use E-ZPass to pay their tolls. Percentages of E-ZPass trips among private carriers and for-hire carriers are very similar.

Table 70. Breakdown of current regular users by usage of E-ZPass

User Type	Percentage of Weighted Responses				
	Private Carriers	For-Hire Carriers	New Jersey Regular Users	New York Regular Users	All Current Regular Users
E-ZPass Users	83.5%	86.4%	84.5%	92.3%	85.4%
Cash Users	16.5%	5.6%	9.4%	7.7%	9.2%
Total	100.0%	92.0%	93.9%	100.0%	94.6%
Based on Weighted Responses of	382	774	1019	137	1156

Note: 50 trip-based weighted responses from New Jersey for-hire carriers were not applicable since individual drivers pay tolls, and another 12 trip-based weighted response from New Jersey for-hire carriers did not know or refused to answer this question, hence the total percentages of for-hire carriers, New Jersey regular users, and all current regular users do not add up to 100 percent.

The average length of using E-ZPass is 5.4 years for all E-ZPass users' trips, 6.1 years for private carriers, 5.1 years for for-hire carriers, 5.2 years for New Jersey carriers, and 6.9 years for New York carriers. Figure 52 and Figure 53 show the distributions of length of using E-ZPass by carrier type and geography. As indicated in Figure 52, 64.4 percent of private carriers have used E-ZPass for at least five years, and 20.7 percent have used it for at least ten years. Half of for-hire carriers have used E-ZPass for at least five years, and only 3.4 percent have used it for ten years or more. As indicated in Figure 53, 52.4 percent of New Jersey carriers have used E-ZPass for at least five years, and 6.6 percent have used it for ten years or more. For New York carriers, 69.9 percent have used E-ZPass for at least five years, and 25.3 percent have used it for at least ten years. These analyses indicate that private carriers have used E-ZPass longer than for-hire carriers (about one year longer on average), and that New York carriers have used E-ZPass longer than New Jersey carriers (about two years longer on average).

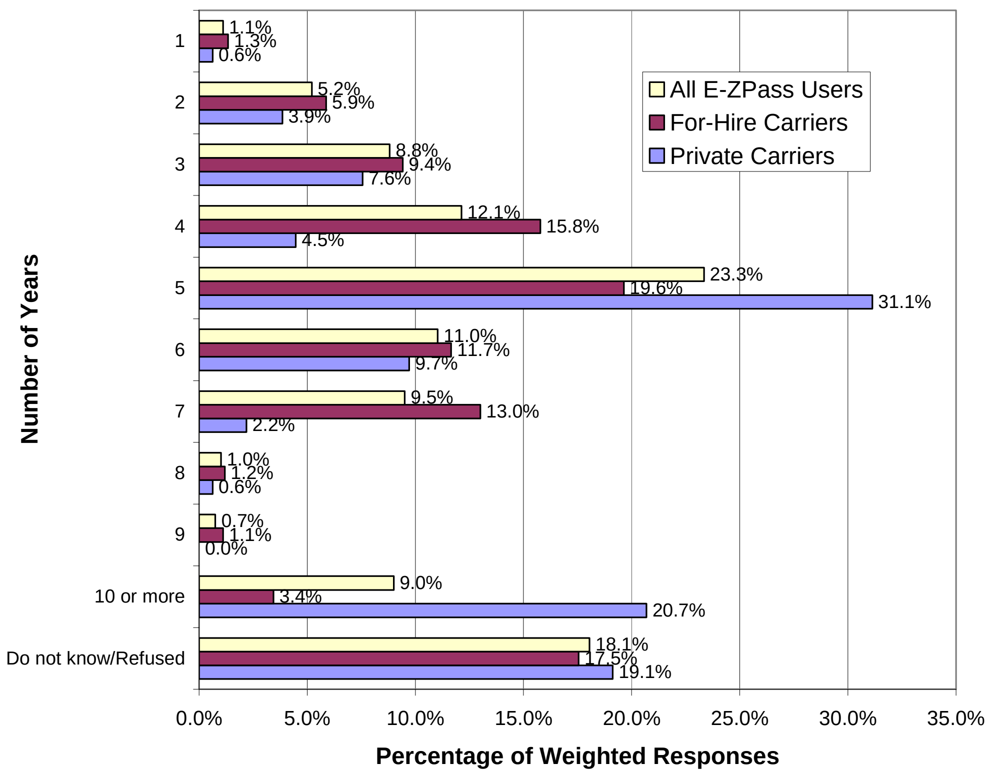


Figure 52. Distribution of length of using E-ZPass by carrier type

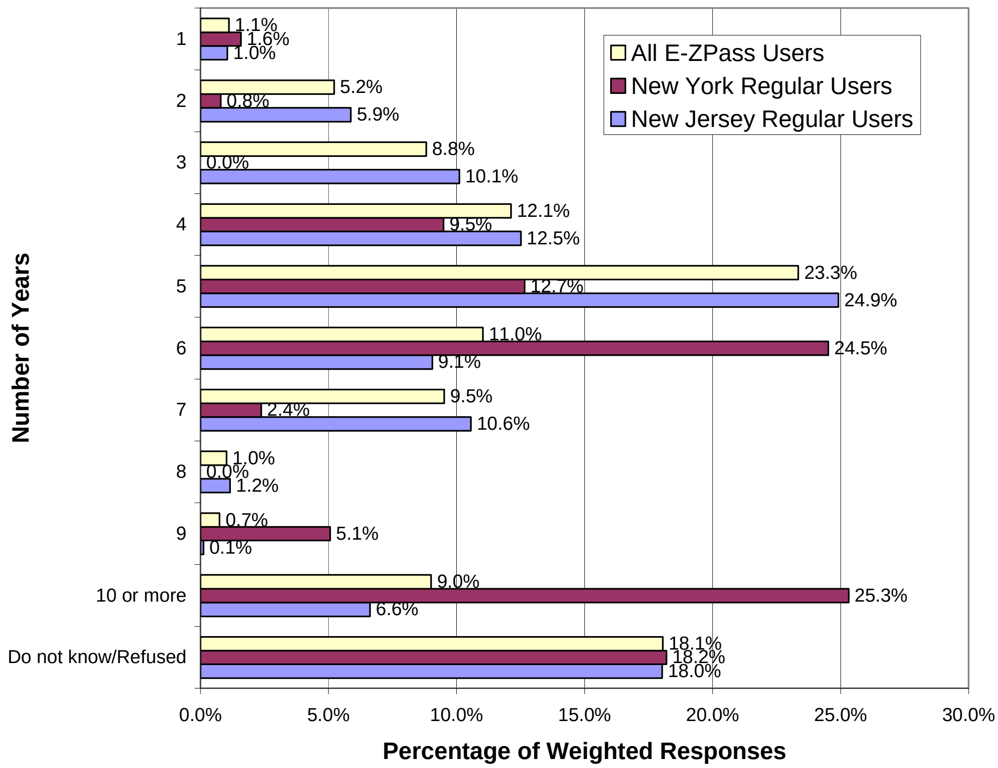


Figure 53. Distribution of length of using E-ZPass by geography

Table 71 shows the average number of E-ZPass tags, fleet size (of E-ZPass users), and average number of tags per truck by carrier type and geography. For E-ZPass users, 88 percent of all trucks have E-ZPass tags; 73 percent of private carriers' trucks and 89 percent of for-hire carriers' trucks have E-ZPass tags; almost all New Jersey carriers' trucks (91 percent) and only about half (48 percent) of New York carriers' trucks have E-ZPass tags.

Table 71. E-ZPass tag ownership by carrier type and geography

	Private Carriers	For-Hire Carriers	New Jersey Regular Users	New York Regular Users	All E-ZPass Users
Average Number of E-ZPass Tags	22.4	65.9	57.3	11.7	51.1
Fleet Size of E-ZPass Users	30.9	74.3	63.1	24.2	58.3
Average Number of Tags per Truck	0.73	0.89	0.91	0.48	0.88

Reasons for Not Using E-ZPass

Cash users provided the main reasons for not using E-ZPass. Figure 54 shows the distribution of the main reason by carrier type. No comparison was made by geography because of the small sample of New York cash users. As shown in Figure 54, 16.6 percent of all cash users cited driver abuse / need receipts for use; 15.0 percent cited seems complicated to use; 12.2 percent cited would not use it enough, which seems reasonable since trip frequency for E-ZPass users is about seven truck trips per day while only three for cash users; 4.8 percent cited afraid of being overcharged or fined if tag does not work. Interestingly, 4.7 percent of cash users cited monthly fee as a reason. Compared by carrier type, for-hire carriers seem to be more concerned about issues like driver abuse, being overcharged, and giving out company information. It is also interesting to note that 25.3 percent of private carriers think E-ZPass seems complicated to use, while no for-hire carriers think so.

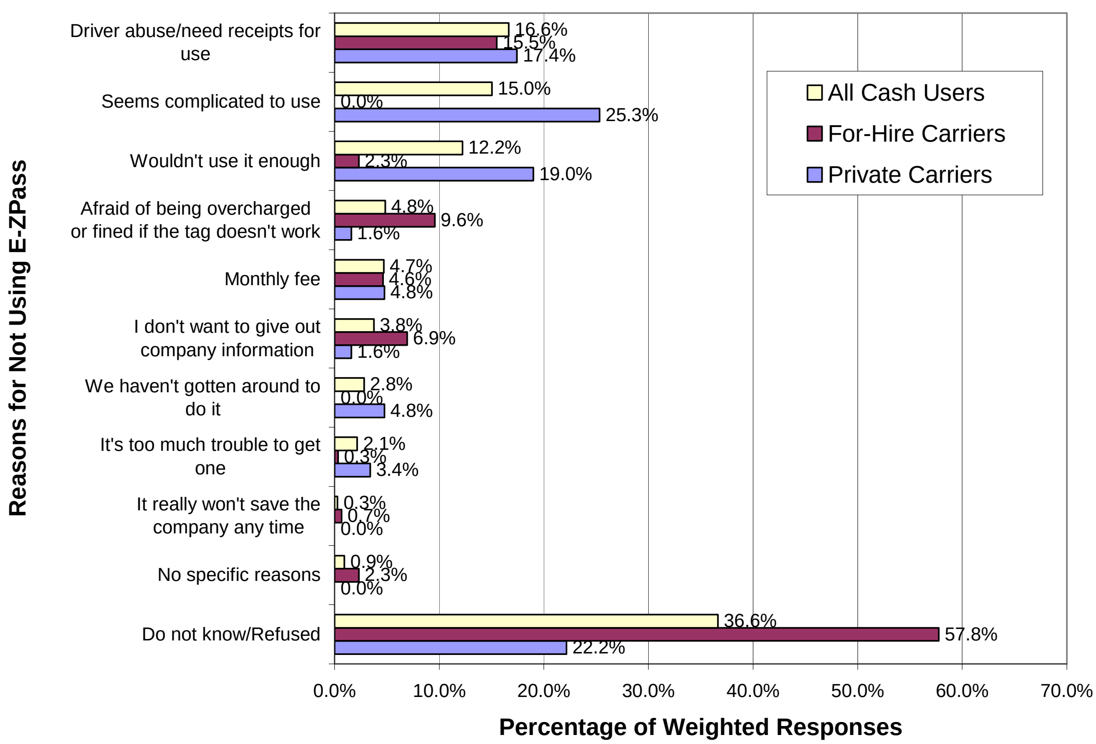
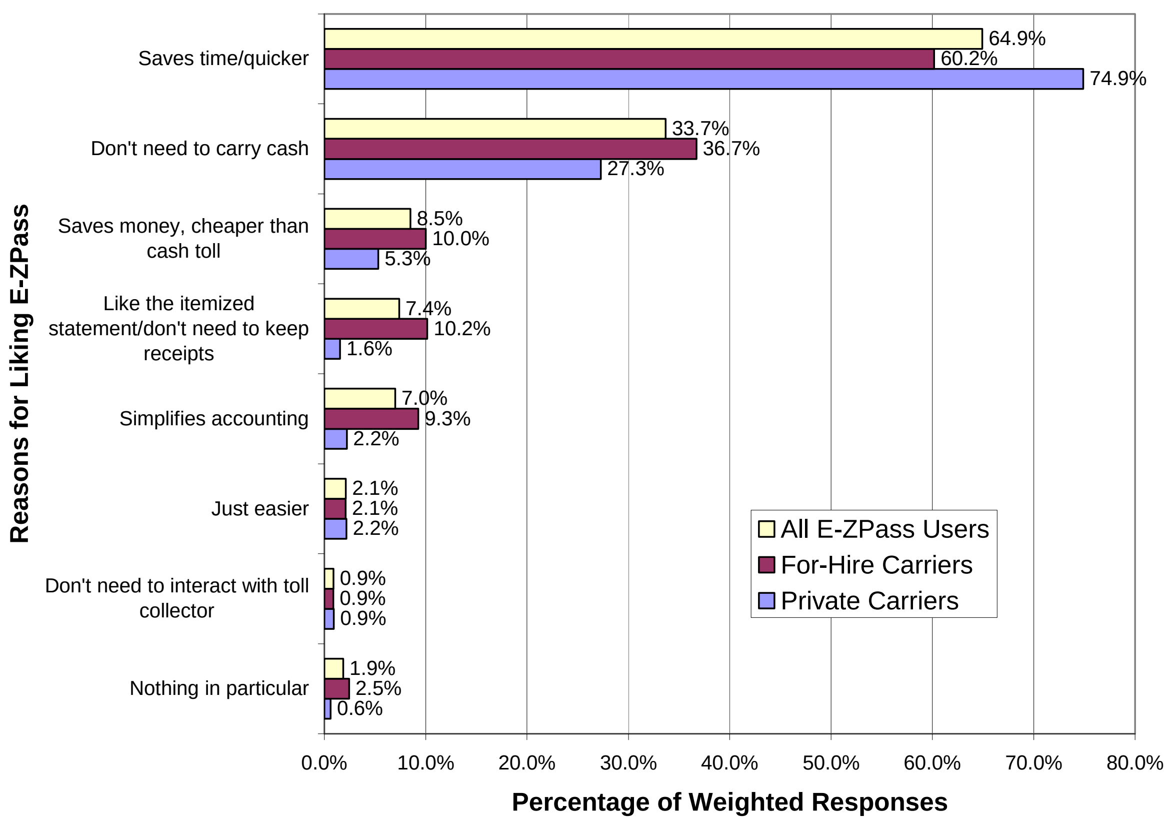


Figure 54. Reasons for not using E-ZPass by carrier type

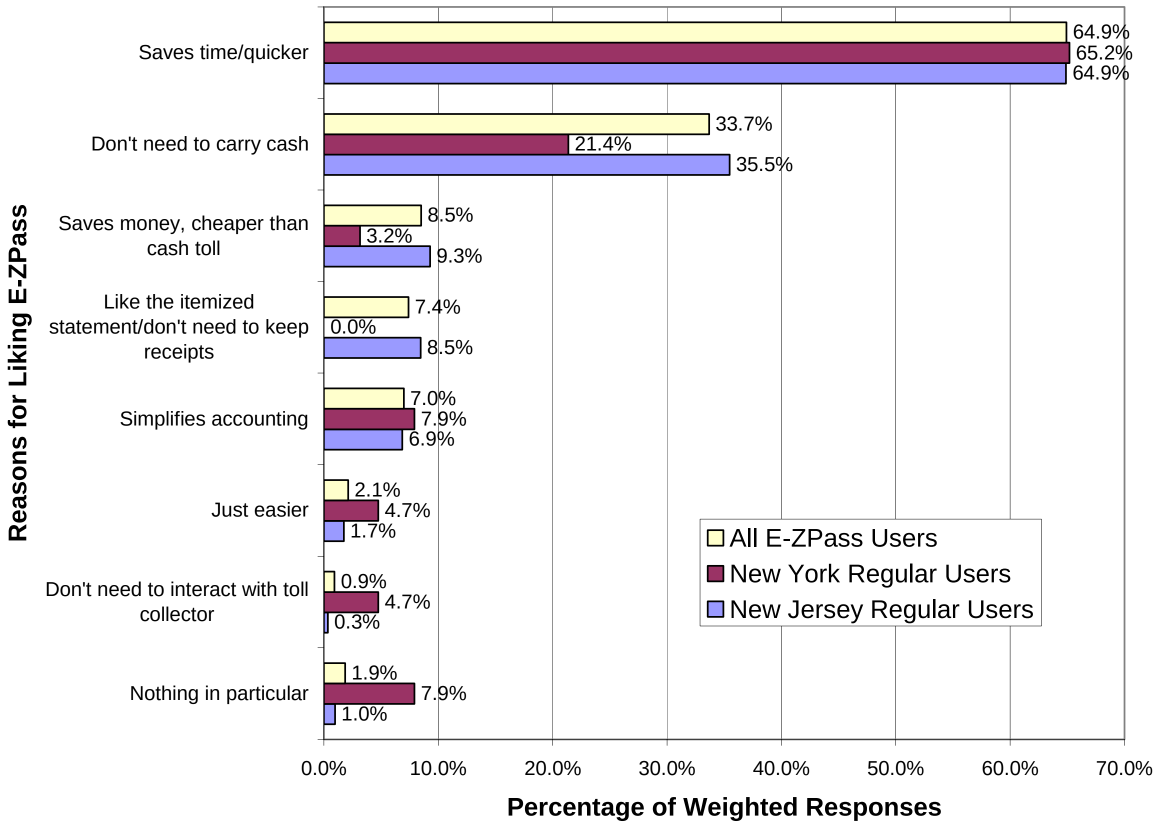
Reasons for Liking E-ZPass

All E-ZPass users provided reasons why they like E-ZPass. Figure 55 and Figure 56 show the cited reasons by carrier type and geography. Note that the percentages do not add up to 100 percent since respondents could have multiple answers. In general terms, 64.9 percent of E-ZPass users cited saves time / quicker, 33.7 percent cited do not need to carry cash, 8.5 percent cited saves money, cheaper than the cash toll, 7.4 percent cited like the itemized statement / do not need to keep receipts, and 7.0 percent cited simplifies accounting. Compared by carrier type, a higher percentage of private carriers cited saves time / quicker, and a higher percentage of for-hire carriers cited do not need to carry cash. Compared by geography, a higher percentage of New Jersey carriers cited do not need to carry cash (14.1 percent higher).



Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

Figure 55. Reasons for liking E-ZPass by carrier type



Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

Figure 56. Reasons for liking E-ZPass by geography

Awareness of Toll Discounts

Participants were asked if they were aware of any toll discounts for commercial vehicles. Figure 57 to Figure 59 show the behavioral responses for all current regular users. As shown in Figure 57, 35.9 percent of all current regular users do not know of any discounts. About one third (31.5 percent) of current regular users heard of discount, do not know specifics, 25.4 percent knew about off-peak or non-rush hour use discounts, 3.7 percent knew about general E-ZPass discount, and only 2.0 percent knew about overnight use discounts. The comparison between E-ZPass and cash users indicates that E-ZPass users seem to have lower awareness of toll discounts, even though these discounts are linked to E-ZPass usage. About one third (35.2 percent) of E-ZPass users do not know of any discounts compared to 26.0 percent of cash users; 33.1 percent of E-ZPass users heard of discount, do not know specifics, while 22.8 percent for cash users; 37.9 percent of cash users and only 25.7 percent for E-ZPass users knew about off-peak or non-rush hour use discounts; 13.2 percent of cash users and only 2.9 percent for E-ZPass users knew about general E-ZPass discount; only 2.3 percent of E-ZPass users knew about overnight use discounts, and 0.1 percent for cash users.

The comparison between for-hire and private carriers using E-ZPass, as shown in Figure 58, indicates that private carriers seem to be less informed than for-hire carriers: a higher percentage of private carriers (40.9 percent) than for-hire carriers (32.5 percent) do not know of any discounts; a higher percentage of for-hire carriers (35.9 percent) than private carriers (27.3 percent) heard of discount, do not know specifics; a higher percentage of for-hire carriers (28.8 percent) than private carriers (19.1 percent) knew about off-peak or non-rush hour use discounts; though a slightly higher percentage of private carriers knew about general E-ZPass discount and overnight use discounts.

The comparison among cash users shown in Figure 59 indicates that a vast majority (86.3 percent) of for-hire carriers knew about off-peak or non-rush hour use discounts although they do not use E-ZPass, while only 4.8 percent of private carriers did so. A higher percentage of private carriers do not know of any discounts (33.3 percent higher) or heard of discount, do not know specifics (34.2 percent higher). These analyses indicate poor awareness of toll discounts among all current regular users, and that E-ZPass users seem to have poorer awareness than cash users.

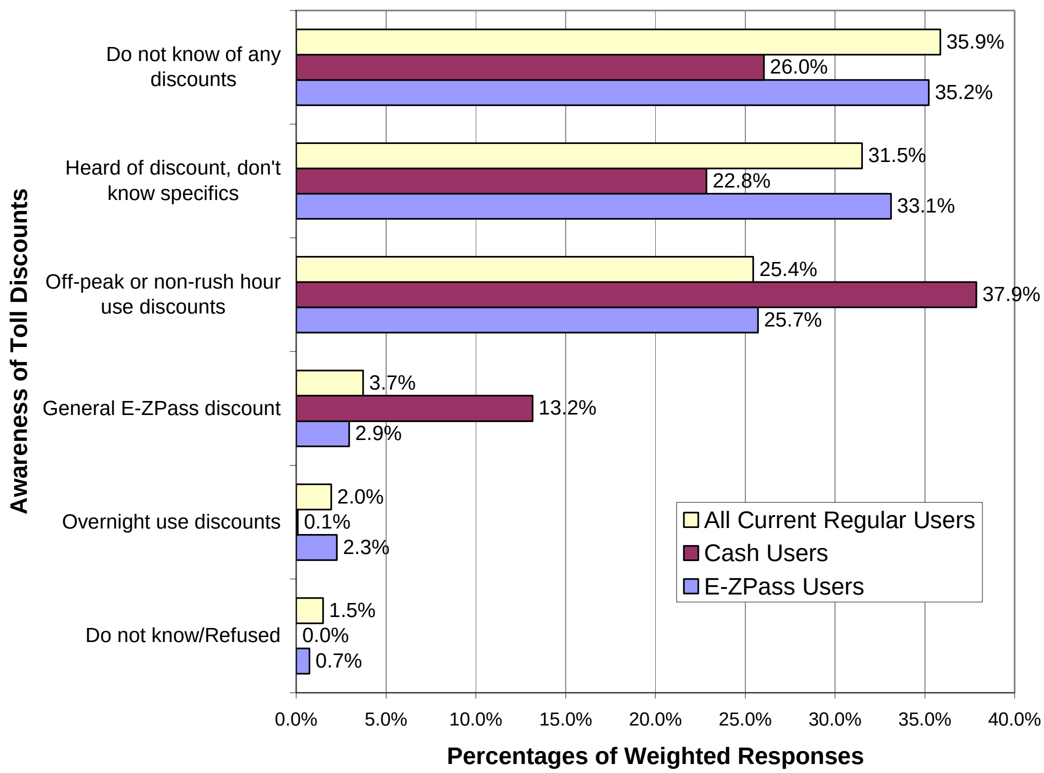


Figure 57. Awareness of toll discounts among all current regular users

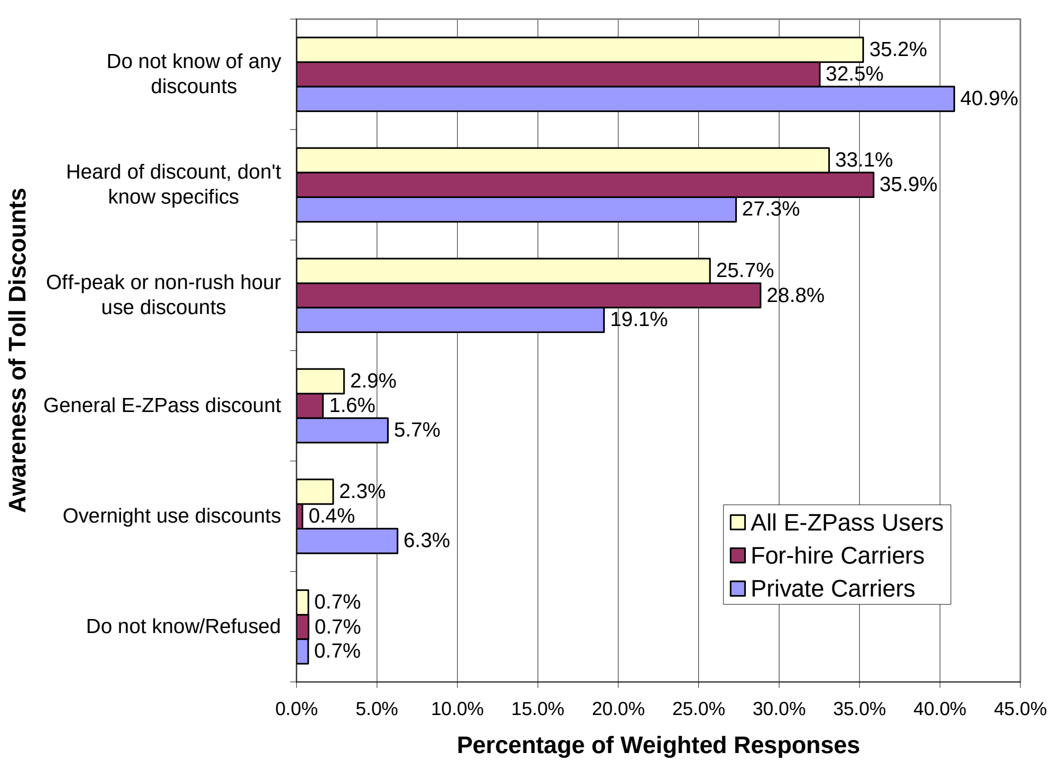


Figure 58. Awareness of toll discounts among E-ZPass users

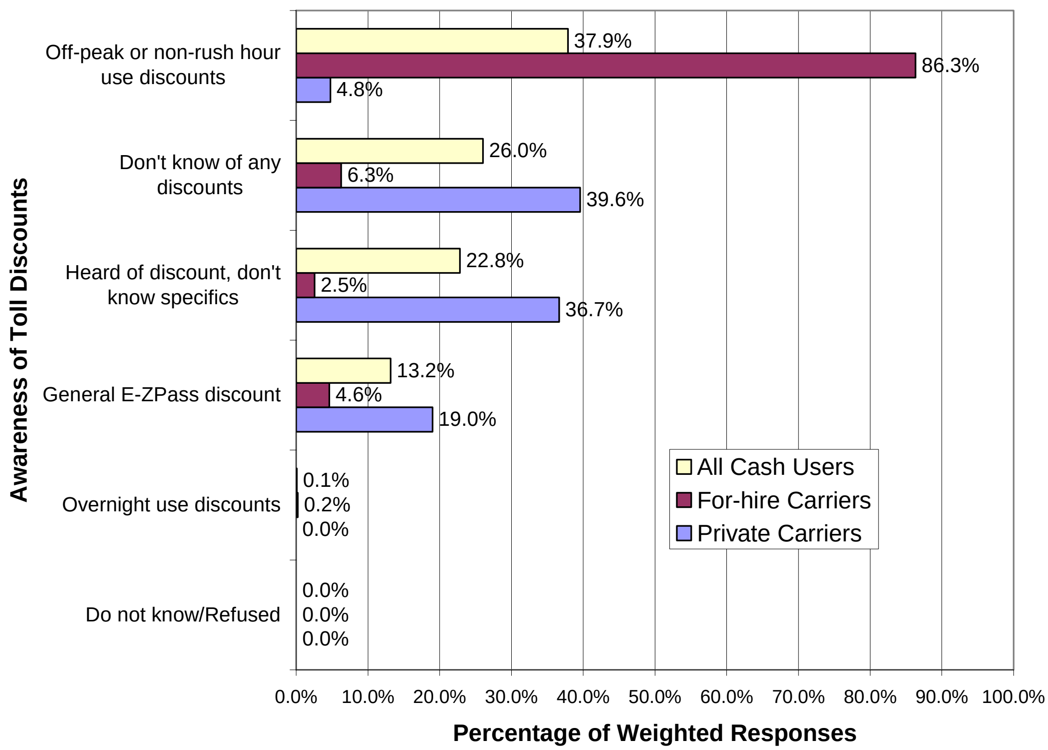


Figure 59. Awareness of toll discounts among cash users

Impact of Time of Day Pricing on E-ZPass Use

The majority of participants reported that they remembered the March 2001 toll increase: 83.7 percent of all current regular users, 78.5 percent of private carriers, 86.3 percent for for-hire carriers, 81.4 percent of E-ZPass users, 83.8 percent of New Jersey carriers, and 83.2 percent of New York carriers indicated they remembered the toll increase; almost all cash users (96.9 percent) remembered the toll increase.

Figure 60 shows the impact of the time of day pricing initiative on E-ZPass use by carrier type and geography. In general, most (88.3 percent) current regular users reported no change, 8.2 percent reported switched to E-ZPass, 2.2 percent reported increased use of E-ZPass, and only 1.0 percent did both. Compared by carrier type, a higher percentage of private carriers (9.7 percent) than for-hire carriers (7.5 percent) switched to E-ZPass, and a higher percentage of for-hire carriers (2.9 percent) than private carriers (0.8 percent) increased use of E-ZPass. Compared by geography, the only change reported by New York carriers was increased use of E-ZPass (9.8 percent); while 9.3 percent of New Jersey carriers switched to E-ZPass, 1.2 percent increased use of E-ZPass, and 1.1 percent did both. This result shows that time of day pricing did attract more carriers to use E-ZPass although it did not encourage many trips to be switched from peak to off-peak hours as will analyzed in the section of the impact of the time of day pricing.

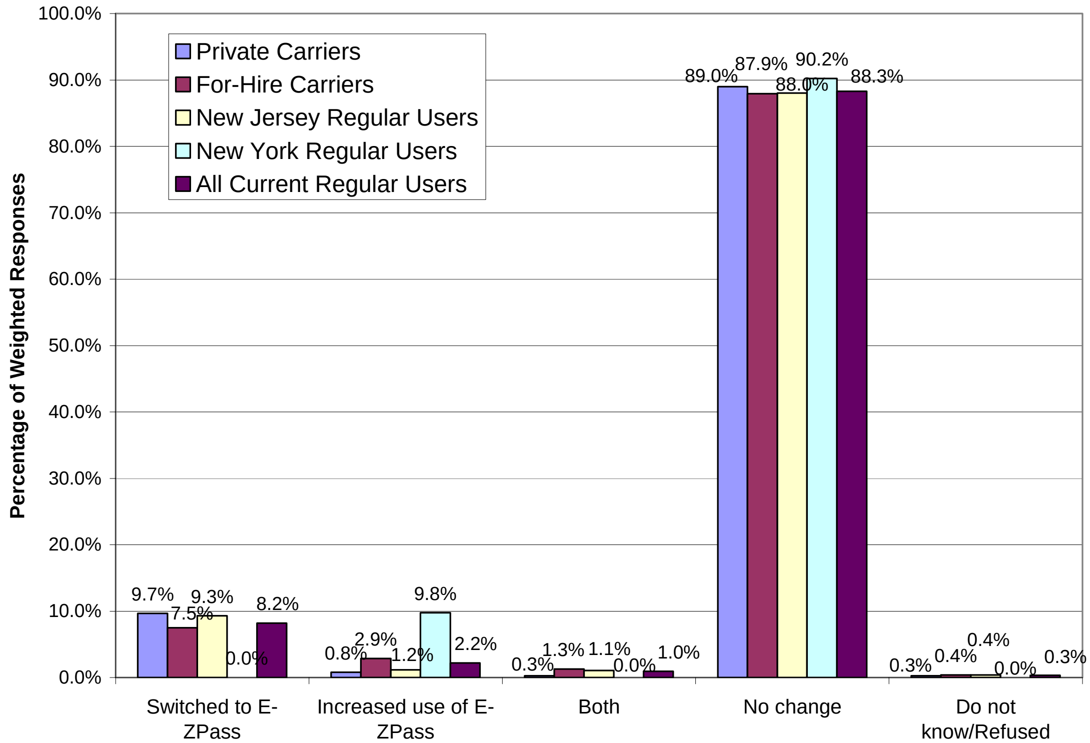


Figure 60. Impact of time of day pricing on E-ZPass use

Suggestions for Improving the E-ZPass System

All current regular users provided suggestions for improving the E-ZPass system. Table 72 and Table 73 show the breakdown of suggestions by user type and carrier type, note that the percentages do not add up to 100 percent since respondents could provide multiple choices. In general, 18.8 percent of all current regular users cited give a bigger discount for use, 9.7 percent cited high speed toll lanes, 7.0 percent of current regular users cited give a discount for use, 6.5 percent cited make the E-ZPass toll lanes separate from other traffic, move quicker, 6.0 percent cited simplified / accurate billing with receipts, 5.6 percent cited better public relation, communications, 4.6 percent cited lower deposit requirement, among others. The comparison between E-ZPass users and cash users shown in Table 72 suggests differences of opinions about how to improve the E-ZPass system: E-ZPass users are more likely to suggest bigger discount and separate E-ZPass toll lanes, move quicker; cash users are more likely to cite give a discount for use and expand use to other venues. Comparison between for-hire and private carriers shown in Table 73 indicates that for-hire carriers are more like to suggest bigger discount, separate E-ZPass toll lanes, move quicker, better public relation, communications; private carriers are more likely to suggest high speed toll lanes, give a discount for use, and simplified / accurate billing with receipts.

Table 72. Suggestions for improving the E-ZPass system by user type

Suggestions	Percentage of Weighted Responses		
	E-ZPass Users	Cash Users	All Current Regular Users
Give a bigger discount for use	21.2%	6.4%	18.8%
High speed toll lanes	9.9%	13.9%	9.7%
Give a discount for use	5.7%	25.4%	7.0%
Make the E-ZPass toll lanes separate from other traffic, move quicker	7.3%	2.1%	6.5%
Simplified/accurate billing with receipts	6.1%	8.6%	6.0%
Better public relation, communications	3.5%	0.0%	5.6%
Lower deposit requirement	5.3%	0.0%	4.6%
Expand use to other venues	0.7%	12.7%	1.7%
Better customer service	1.7%	0.0%	1.4%
Make scanner easier to read/different position	1.1%	0.0%	1.0%
Make sure that information is not used to track people	0.5%	1.1%	0.5%
Don't place a hold on credit card accounts/don't require prepayment	0.3%	0.2%	0.3%
Get rid of monthly fees	0.2%	0.0%	0.2%
No, nothing in particular	43.2%	45.5%	44.0%

Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

Table 73. Suggestions for improving the E-ZPass system by carrier type

Suggestions	Percentage of Weighted Responses		
	Private Carriers	For-Hire Carriers	All Current Regular Users
Give a bigger discount for use	12.7%	21.8%	18.8%
High speed toll lanes	13.7%	7.8%	9.7%
Give a discount for use	13.4%	3.9%	7.0%
Make the E-ZPass toll lanes separate from other traffic, move quicker	1.1%	9.1%	6.5%
Simplified/accurate billing with receipts	11.5%	3.3%	6.0%
Better public relation, communications	1.1%	7.8%	5.6%
Lower deposit requirement	7.1%	3.3%	4.6%
Expand use to other venues	4.6%	0.3%	1.7%
Better customer service	1.6%	1.3%	1.4%
Make scanner easier to read/different position	2.2%	0.4%	1.0%
Make sure that information is not used to track people	0.3%	0.7%	0.5%
Don't place a hold on credit card accounts/don't require prepayment	0.0%	0.4%	0.3%
Get rid of monthly fees	0.5%	0.0%	0.2%
No, nothing in particular	36.0%	47.9%	44.0%

Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

Detailed Findings: Impacts of the Time of Day Pricing Initiative

This section analyzes the impacts of the 2001 PANYNJ time of day pricing on carriers' behavior. Current regular users (182 users in the sample) reported their operational changes due to time of day pricing. Former regular users (18 users in the sample) were only asked if time of day pricing is a contributing factor for them to stop using the toll facilities since they are not regular users any longer. The two types of users represent 1156 and 115 trip-based weighted responses respectively.

The data indicate that 36 carriers changed behavior because of the time of day pricing initiative, which represents 257 trip-based weighted responses and accounts for 20.2 percent of the entire trip-based weighted sample (Table 74). This includes 31 current regular users (225 weighted responses) that changed behavior in different ways though still remained using the PANYNJ facilities; and five former regular users (32 weighted responses) that stopped using the facilities because of time of day pricing. These five carriers include only two carriers (13 weighted responses) that cited toll costs as the key reason, and three carriers (19 weighted responses) that indicated that toll costs were a contributing factor that—when added to other costs that went up—contributed to their decision of not to use the PANYNJ facilities anymore. Table 74 shows the breakdown of these carriers in terms of user type, carrier type and geography.

21 out of these 36 carriers are for-hire carriers (11.8 percent of the entire weighted sample) while the remaining 15 are private carriers (8.4 percent). Although this would suggest that for-hire carriers are more sensitive to pricing strategies than private carriers, it needs to be noted that the dominant behavioral changes reported by current regular users were *switching to or increasing the usage of E-ZPass*, or *increasing the shipment charges*. This seems to suggest that for-hire carriers take advantage of strategies that do not imply fundamental changes to their operations that may upset the receivers (e.g., changes in routes or delivery times).

Table 74. Breakdown of carriers that changed behavior

User Type	Carrier Type	Geography	Raw Sample		Weighted Sample (1)	
			Responses	% of raw sample (200 observations)	Weighted responses	% of weighted sample (1271 weighted observations)
Current regular users	**For-hire carriers**	New Jersey	14	7.0%	114	9.0%
		New York	4	2.0%	17	1.4%
		Subtotal	**18**	**9.0%**	**131**	**10.3%**
	Private carriers	New Jersey	10	5.0%	61	4.8%
		New York	3	1.5%	33	2.6%
		Subtotal	**13**	**6.5%**	**94**	**7.4%**
	All current regular users	**Total**	**31**	**15.5%**	**225**	**17.7%**
Former regular users	**For-hire carriers**	New Jersey	2	1.0%	13	1.0%
		New York	1	0.5%	6	0.5%
		Subtotal	**3**	**1.5%**	**19**	**1.5%**
	Private carriers	New Jersey	2	1.0%	13	1.0%
		New York	0	0.0%	0	0.0%
		Subtotal	**2**	**1.0%**	**13**	**1.0%**
	All former regular users	**Total**	**5**	**2.5%**	**32**	**2.5%**
All users	**For-hire carriers**	New Jersey	16	8.0%	127	10.0%
		New York	5	2.5%	24	1.9%
		Subtotal	**21**	**10.5%**	**151**	**11.8%**
	Private carriers	New Jersey	12	6.0%	74	5.8%
		New York	3	1.5%	33	2.6%
		Subtotal	**15**	**7.5%**	**107**	**8.4%**
	All users	**Total**	**36**	**18.0%**	**257**	**20.2%**

Note: (1) The values are obtained by expanding the data set by the daily trip frequency reported by each company. Since former regular users did not report their trip frequency, the average trip frequency of current regular users (6.4 truck trips per day) was assumed for them.

In the following analyses, after discussing how current regular users and former regular users were affected by time of day pricing, a series of comparisons are conducted to illustrate the difference between the carriers that changed behavior and those that did not. Then, the key dimensions of operational changes are described to show how these carriers reacted to the time of day pricing initiative. As mentioned earlier, former regular users were not asked their detailed behavioral changes and, for that reason, the analyses focus on current regular users.

Impacts on Current Regular Users

The analyses of the data indicate that 31 carriers out of 182 current regular users changed their operations because of the implementation of time of day pricing, which accounts for 225 weighted responses and 17.7 percent of the sample once weighted by trip frequency (1271 weighted responses in the entire sample). Table 74 shows the detailed information about these carriers in terms of user type, carrier type and geography.

As discussed before, the data show that for-hire carriers are more sensitive to time of day pricing strategies than private carriers. As shown in Table 74, 18 for-hire carriers reported behavioral changes (10.3 percent); while the remaining 13 private carriers (7.4 percent) indicated changes in behavior.

From the viewpoint of company location, 24 companies are from New Jersey (13.7 percent) while 7 companies are from New York (4.0 percent). However, when taking into account the sample breakdown by geography, it was found that relatively speaking more New York carriers changed behavior than New Jersey carriers. As shown, 24 out of 150 New Jersey current users (17.2 percent of the weighted responses from New Jersey current users) reported changes while 7 out of 32 New York current users (36.8 percent of the weighted responses from New York current users) changed behavior. However, since the sample New York carriers is relatively small, these results must be interpreted with great caution.

In the survey, only those current regular users who are aware of the toll increase were asked questions about behavioral changes..

Impacts on Former Regular Users

Former regular users (who were not asked questions about behavioral changes) were asked why they stopped using the toll facilities. It was found that only five out of eighteen former regular users cited the 2001 toll increase as a reason to stop using the PANYNJ toll facilities, accounting for 2.5 percentage of the entire trip-based weighted sample. Only two out of eighteen former regular users (1.0 percent) cited the toll increase as the key reason; while three others (1.5 percent) mentioned that tolls are a contributing factor to the high costs that forced them to change their business patterns. This puts the total number of former regular users that changed behavior because of the time of day pricing initiative at five. Among them, three companies are for-hire carriers (1.5 percent) while two companies are private carriers (1.0 percent).

Reasons for Not Changing Behavior

The survey also asked current regular users that did not change behavior why they did not make any change after time of day pricing (Table 75). The largest group of reasons is that they do not have a choice (75.3 percent of weighted responses). They felt that either *they cannot change schedule due to the customers' requirements* (68.9 percent) or *they must use the quickest route* (6.4 percent). A large proportion of carriers did not change their behavior because the travel cost (including tolls) is paid by someone else and thus they do not need to worry about the toll change (19.8 percent). Some of them said customers absorb costs, or the cost is paid by shippers or receivers. Only two percent cited *price difference not all that much / can afford it* as the main reason that their operations did not change. A very small proportion of carriers seem to be off-peak users since 0.4 percent said *there was no change in the cost for off-peak travel*.

In general, for-hire carriers and private carriers reported the same main reasons for not changing their behavior: they either do not have flexibility due to their schedule or route choice constraints or their shipment costs are paid by someone else. On the other hand, they exhibit some differences. For-hire carriers seem more likely to be constrained by their schedules while private carriers tend to be less willing to change their routes (though, as discussed previously, they show more flexibility in implementing behavior changes that do not upset the receivers, e.g., switch to E-ZPass and increase shipment charges). 72.3 percent of for-hire carriers cited *cannot change schedule due to customer requirements* while approximately 11 percent less of private carriers reported the same reason. Meanwhile, the percent of for-hire carriers that are constrained by the need to use the quickest route is about 10 percent less than the corresponding value for private carriers. It was also found that a larger proportion of for-hire carriers (21.2 percent) did not worry about the cost change since they transferred costs to their customers (19.1 percent) or receivers (2.1 percent). In contrast, about five percent less of private carriers cited *cost paid by others*.

Table 75. Reasons for not changing travel behavior

Reasons	For-hire carriers	Private carriers	Carriers who did not change
No flexibility:			
Can't change schedule due to customer requirements	72.3%	61.0%	68.9%
Must use quickest route	3.3%	13.6%	6.4%
Cost paid by others:			
Customers absorb costs	19.1%	15.9%	18.2%
Cost paid by shippers	0.0%	0.4%	0.1%
Cost paid by receivers	2.1%	0.0%	1.5%
Price difference not all that much/can afford it	0.2%	6.1%	2.0%
There was no change in the cost for off-peak travel	0.3%	0.4%	0.4%
Do not know/Refused	2.6%	2.5%	2.6%
Total	100.0%	100.0%	100.0%
Based on weighted responses of	**573**	**245**	**817**

<u>Characteristics of the Carriers that Changed vs. Carriers that Did Not</u>

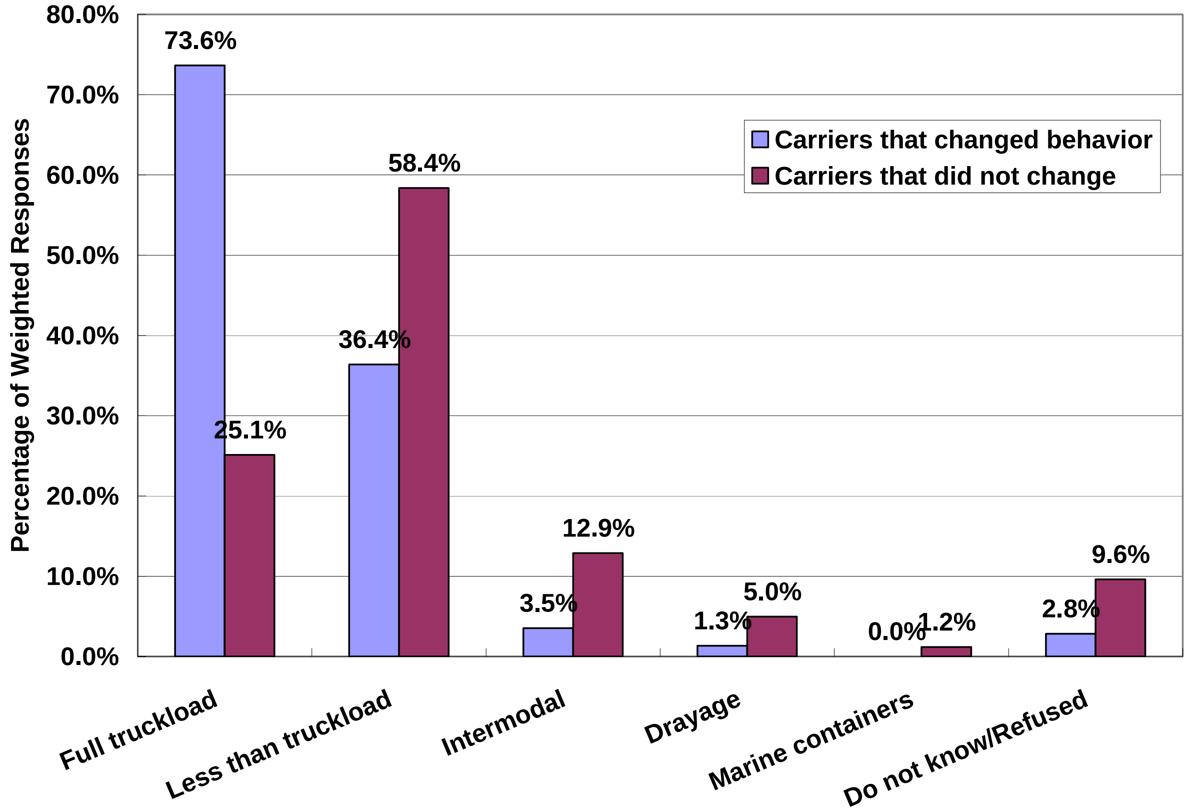
This section summarizes a comparative analysis of the characteristics of the carriers that changed vs. those that did not change behavior. Since only current regular users were asked detailed behavior changes, the following analysis is based on the responses from current regular users. In this context, the carriers that changed behavior due to time of day pricing and those that did not change account for 225 and 931 trip-based weighted responses respectively.

It is important to stress, once again, that these comparisons are not meant to provide statistically conclusive findings (which is not possible given the very small sample of carriers that changed behavior). Instead, the comparisons are intended to provide the reader with a qualitative idea of what may be the differences between these two groups of users.

The analyses suggest that the carriers that changed their travel behavior are different in some key dimensions considered in the survey. Carriers that changed behavior are more likely to: (a) focus on full truckload services; (b) own relatively smaller fleets on average; (c) employ relatively fewer interstate truck drivers on average but the same interstate truck drivers per truck; and (d) venture in the areas out of New Jersey and New York. The following subsections summarize the key findings.

(1) Differences in business type

As shown in Figure 61, there seems to be a difference in the type of business performed by the carriers that changed behavior when compared to those that did not change. The vast majority of those carriers that changed behavior (73.6 percent) are Full-Truck-Load (FTL) operators. Conversely, less than truckload (LTL) operators were the core of those that did not change operations after the time of day pricing initiative (58.4 percent).



Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

Figure 61. Distributions of business type (changed vs. not change)

(2) Differences in fleet size

As shown in Table 76, the carriers that changed behavior have relatively smaller fleet size than those that did not change. As shown in Table 76, the average fleets for these that changed behavior (51.6 trucks) is a little bit less than the one for those that did not change (54.5 trucks). In terms of the vehicle type, the average fleet sizes for each truck type are very similar. The only exception is for three / four-axle trucks. Carriers that changed behavior because of time of day pricing own less three / four-axle trucks (2.4 trucks) than those that did not change (5.2 trucks) on average. As shown by Figure 62, the breakdown by fleet size for carries that changed and did not change behavior tend to roughly follow the same pattern. Again, the small sample size is to be kept in mind at the moment of interpreting these results.

Table 76. Average number of trucks owned (changed vs. not change)

Truck type	Carriers that changed behavior	Carriers that did not change
Two axle trucks	10.2	10.3
Three / four axle trucks	2.4	5.2
Trailers / semi-trailers	38.0	38.0
Average fleet size (trucks)	**51.6**	**54.5**

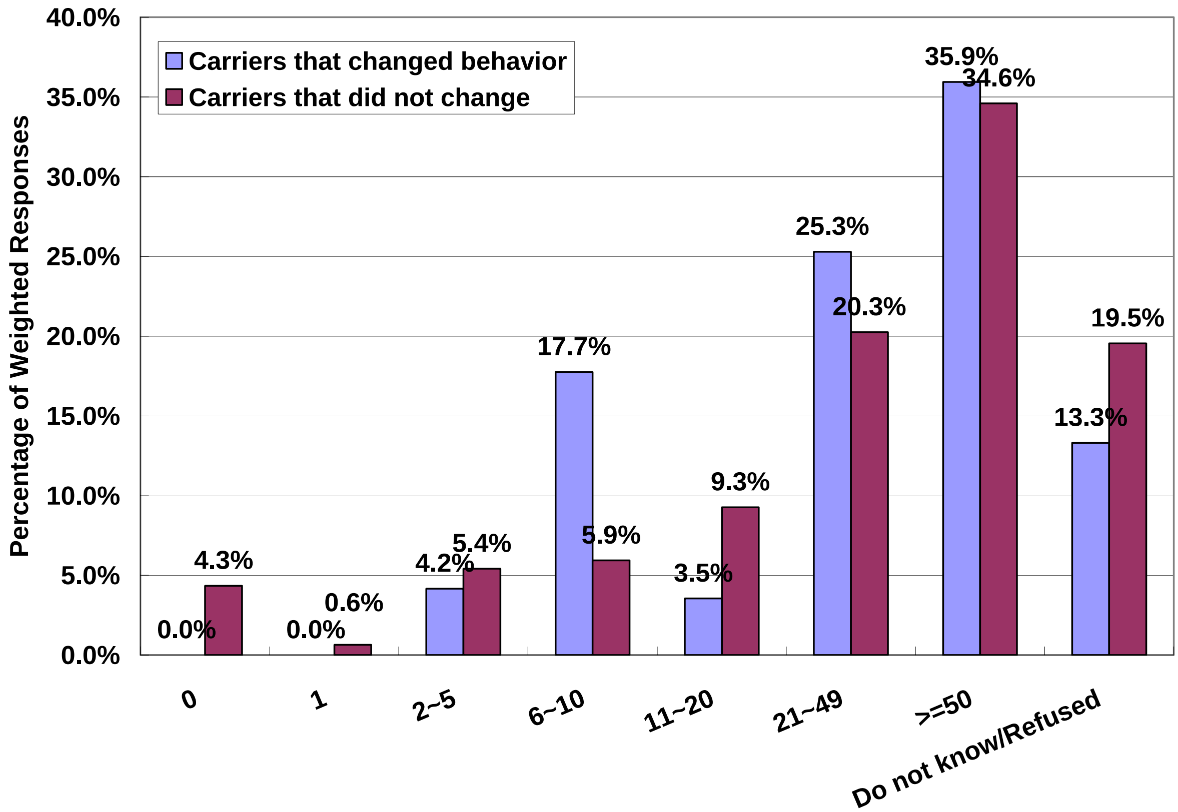


Figure 62. Distribution of fleet size (changed vs. not change)

(3) Differences in the numbers of interstate truck drivers employed

Both the number of interstate truck drivers and the ratio of interstate truck drivers per truck were used to analyze the differences between carriers that changed behavior and those that did not change. In general, the carriers that changed behavior tend to have relatively fewer interstate truck drivers but similar number of interstate drivers per truck.

The average number of interstate truck drivers employed by the carriers that changed their behavior is relatively less than those that did not change (Table 77). Carriers that changed behavior hire 34.2 interstate drivers on average while those that did not change have an average of 39.3 drivers. As shown in Figure 63, the carriers owning two to five trucks or six to ten trucks stand out as the groups most likely to change their operations in reaction to time of day pricing. About 39.7 percent of these carriers that changed their behavior have two to five trucks (22.8 percent) or six to ten trucks (16.9 percent) in their fleets, while the two groups represents 20.0 percent of those that did not change. Meanwhile, the group of these carriers with more than 50 interstate drivers seems to be less sensitive towards time of day pricing. About one-quarter of these carriers that changed their behavior (25.3 percent) employ more than 50 interstate drivers while 34.5 percent of those that did not change fall to the same range of interstate drivers.

Table 77. Average number of interstate truck drivers (changed vs. not change)

Carrier type	**Average number of interstate truck drivers**
Carriers that changed behavior	34.2
Carriers that did not change	39.3
All current regular users	38.3

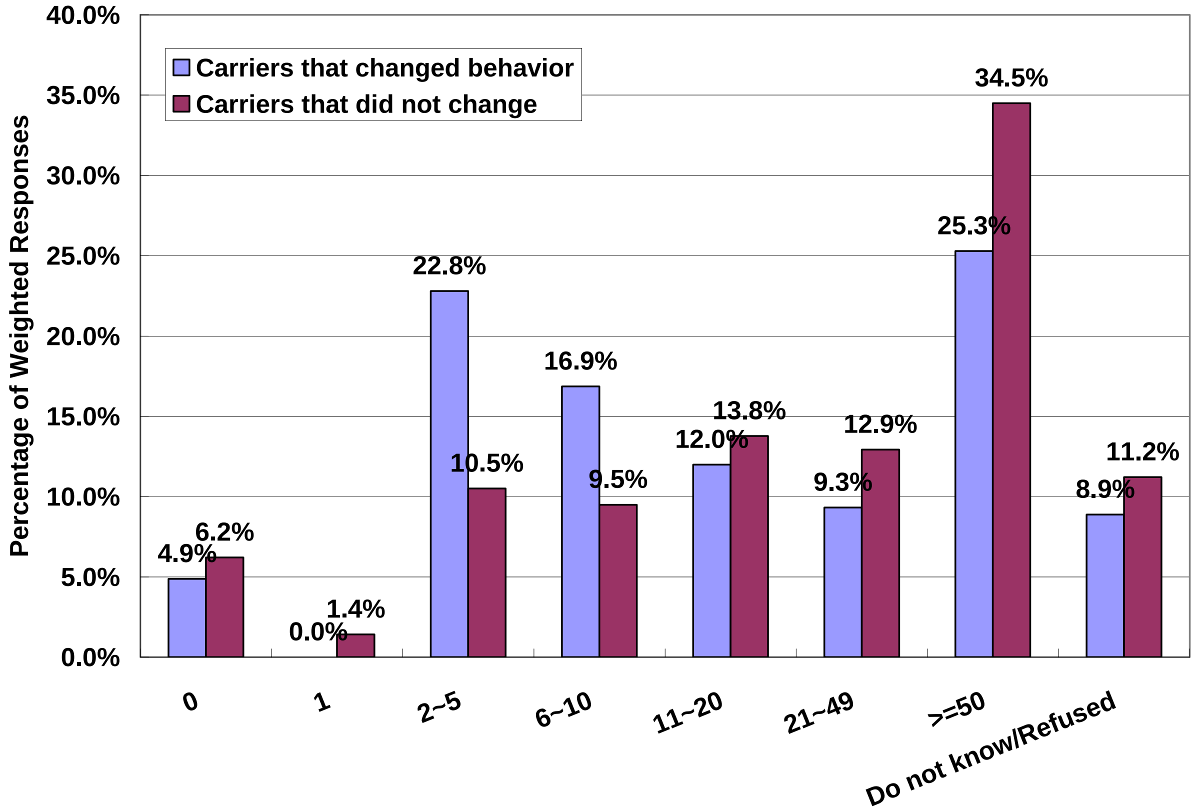


Figure 63. Distribution of interstate truck drivers (changed vs. not change)

Figure 64 and Table 78 show the difference in interstate truck drivers per truck between carriers that changed behavior and those that did not change. As shown in Figure 64, two groups of current regular users, those owning zero to 0.25 interstate drivers per truck or owning 1.0 to 1.5 interstate drivers per truck, are more likely to be sensitive towards time of day pricing. For both ranges, the proportions of the companies that changed behavior are higher than those that did not change (although because of the small sample size one must interpret the results with caution). Table 78 shows that current regular users, no matter they changed behavior or not, have the same average value of the interstate truck drivers per truck (0.7 interstate truck drivers per truck).

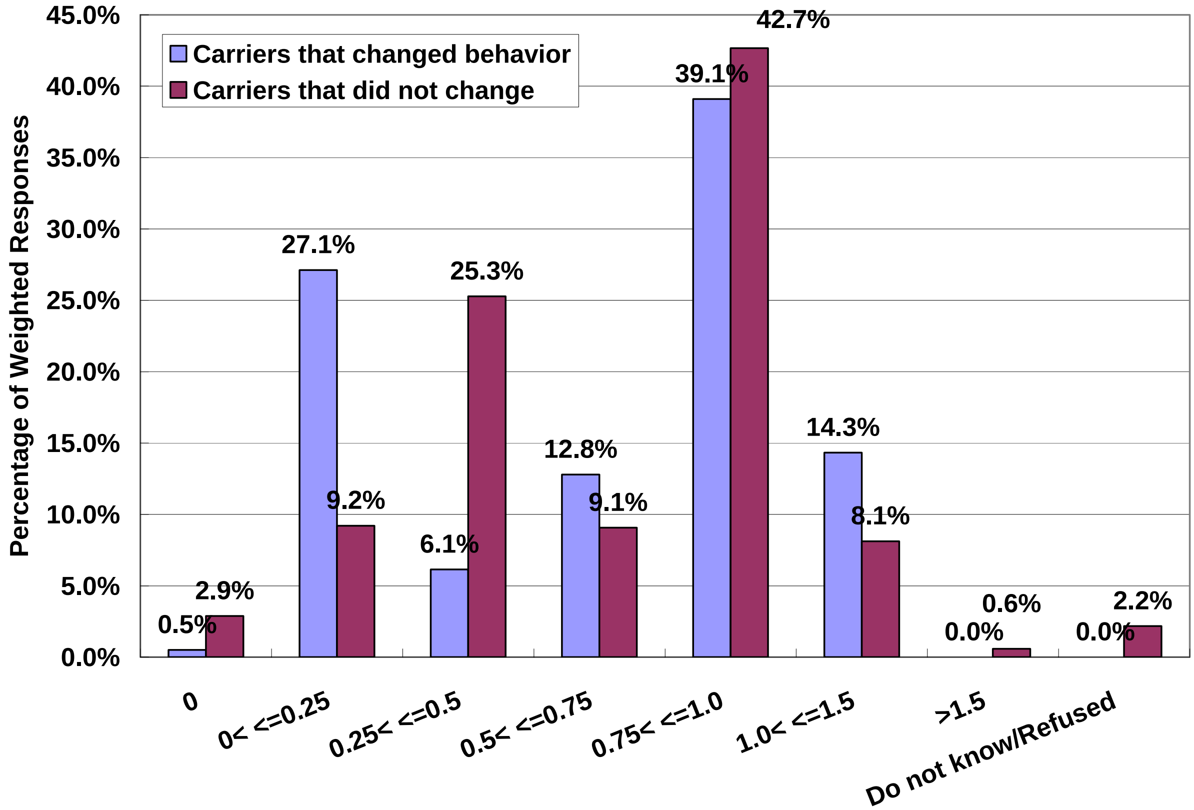


Figure 64. Distribution of interstate drivers per truck (changed vs. not change)

Table 78. Average interstate truck drivers per truck (changed vs. not change)

Carrier type	**Average interstate truck drivers per truck**
Carriers that changed behavior	0.7
Carriers that did not change	0.7
All Current Regular Users	0.7

(4) Differences in origins and destinations of most of shipments

The distributions of origins and destinations of shipments indicate that the carriers that changed their behavior are more likely to originate in areas other than New Jersey and New York and deliver their shipments to the areas outside the Mid-Atlantic region. The analyses of origin-destination (OD) patterns suggest that the segment of the carrier industry most impacted by the time of day pricing initiative is the group of companies that tend to make thru trips (external-external). It is important to highlight that, since the sampling process focused on New Jersey and New York companies, the data only include companies that at some point in their logistic processes use New York or New Jersey as bases of distribution to other destinations. In this context, the finding here indicates that carriers that are making through trips tend to be more sensitive towards time of day pricing. This highlights an important limitation of the survey process implemented, i.e., the inability—because of the prohibitive cost—to collect data from carriers doing through trips. This may be important because this segment of the commercial market is likely to be more sensitive to road pricing because they tend to have more flexibility in terms of time of travel and route choices.

As can be seen in Table 79, a significant proportion of the carriers that changed behavior have shipments originating in Pennsylvania (14.2 percent) or Maryland (12.0 percent), which is much higher than the ones among those that did not change (0.4 percent for Pennsylvania and 0.0 percent for Maryland). Although the four large states in the Mid-Atlantic region are still the destinations where most of these carriers transport shipments to, the states outside the Mid-Atlantic region are also important for them (Table 80). About 47.9 percent of these carriers send their cargoes to the areas outside the Mid-Atlantic region such as Massachusetts and Maryland, while only 26.6 percent of those that did not change their behavior did so.

Table 79. Origins of majority of shipments (changed vs. not change)

Origin	Carriers that changed behavior	Carriers that did not change
New Jersey	64.3%	72.7%
New York	7.7%	8.7%
Pennsylvania	14.2%	0.4%
California	0.4%	7.1%
Ohio	1.3%	0.0%
Georgia	0.0%	0.1%
Maryland	12.0%	0.0%
Regional	0.0%	1.9%
Overseas	0.0%	0.3%
Do not know/Refused	0.0%	8.7%
Total	100.0%	100.0%
Based on weighted responses of	**225**	**931**

Table 80. Destinations of majority of shipments (changed vs. not change)

Destination	Carriers that changed behavior	Carriers that did not change
New Jersey	13.5%	32.7%
New York	73.8%	74.4%
Connecticut	14.2%	9.3%
Pennsylvania	8.0%	14.5%
California	0.0%	10.2%
Massachusetts	15.5%	4.0%
Florida	1.3%	3.9%
Maryland	12.9%	2.6%
Delaware	0.4%	0.6%
North Carolina /Virginia/Georgia	0.0%	1.1%
Michigan/Ohio	1.3%	0.0%
Minnesota	1.3%	0.0%
Rhode Island/Vermont/Maine	4.4%	0.4%
Illinois	5.3%	0.5%
Texas	5.3%	3.2%
Do not know/Refused	0.0%	6.6%
Total	157.4%	164.1%
Based on weighted responses of	**225**	**931**

Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

Table 81 and Table 82 show the OD pairs reported by current regular users that changed and that did not change behavior, respectively. The carriers that changed their behavior because of time of day pricing tend to make more shipments between outside Mid-Atlantic areas while those that did not change are more likely to focus on shipments around New Jersey and New York.

In contrast to those that did not change behavior, the carriers that changed their behavior are more likely to ship between the areas outside the four large Mid-Atlantic States, (i.e., New Jersey, New York, Connecticut, and Pennsylvania). About 13.3 percent of the carriers that changed behavior made this type of external to external trips while only 4.8 percent of those that did not change did so. In terms of the trips internal to the Mid Atlantic region, the OD pair Connecticut or Pennsylvania to New York (14.2 percent) represents a sizable portion of the carriers that changed behavior, as opposed to representing only 0.5 percent of the carriers that did not change.

Table 81. OD pairs of majority of shipments (Carriers that changed behavior)

Origin	Destination: New Jersey	New York	Connecticut or Pennsylvania	Other areas	Total
New Jersey	5.8%	50.1%	12.0%	18.6%	86.5%
New York	6.4%	5.5%	2.2%	0.0%	14.1%
Connecticut or Pennsylvania	0.0%	14.2%	0.0%	0.0%	14.2%
Other areas	1.3%	1.8%	0.0%	13.3%	16.4%
Based on weighted responses of	**225**	**225**	**225**	**225**	**225**

Note: (1) the percentages are calculated based on the carriers that reported both their origins and their destinations;
(2) Multiple answers were accepted for the question about the destinations.

Table 82. OD pairs of majority of shipments (Carriers that did not change)

Origin	Destination: New Jersey	New York	Connecticut or Pennsylvania	Other areas	Total
New Jersey	27.7%	66.4%	15.5%	8.7%	118.4%
New York	6.9%	6.1%	3.4%	2.3%	18.7%
Connecticut or Pennsylvania	0.0%	0.5%	0.5%	0.0%	1.0%
Other areas	1.2%	5.5%	1.3%	4.8%	12.9%
Based on weighted responses of	**830**	**830**	**830**	**830**	**830**

In closing, although there appear to be some intriguing differences in both behavior and characteristics of carriers that changed behavior and those that did not change, the small sample size is not conducive to produce statistically solid conclusions. This significantly limits the generalization of these results.

Behavioral Change Patterns

A very small sample of the current regular users reported behavioral changes. This suggests that the findings in this section be read with great caution, and that the reader must be careful not to generalize conclusions to the larger New York-New Jersey commercial traffic markets. As discussed in several places in this chapter, the small sample of carriers that changed behavior does not lead to statistically conclusive comparisons and inference about overall behavior.

Current regular users were asked their behavioral changes in detail. The data show that the 31 current regular users that reported behavior changes due to the time of day pricing initiative made multiple adjustments in their operations (see Table 83). In Table 83, each row represents the behavioral changes reported by the carriers as a result of the time of day initiative. As can be seen, the majority of carriers implemented combinations of strategies to deal with the time of day pricing initiative.

Table 83. Behavioral changes reported by current regular users

Respondent ID	Carrier type	E-ZPass usage	Shipments charges	Use of the facilities	Business moved	Routes changed	Number of stops per trip	Load factor	More off-peak trips	Number of small trucks	Number of straight trucks	Number of semi-trailers	Shipment size	Waiting longer for mixing	One of their runs was cut	Number of changes	Trips/day (expansion
262	FC	I	I (1)			Y										3	5
603	FC	S	I	D												3	27
12	FC		I			Y		I					I			4	1
87	FC		I	D		Y	D	I								5	1
170	FC		I	D		Y										3	8
269	FC		I			Y										2	10
243	PC		I	D		Y										3	12
482	PC		I			Y		D								3	1
685	PC		I	D	Y	Y										4	30
90023	PC		I			Y					I	I				4	2
21	FC		I													1	1
194	FC		I													1	5
534	FC		I													1	3
680	FC		I													1	1
82	PC		I													1	1
617	PC		I	I			I		Y						Y	5	1
90013	PC		I						Y					Y		3	5
171	FC	I				Y	D									3	6.4
230	FC	I														1	6
465	FC	I														1	5
649	PC	I														1	2
90025	PC	I														1	1
203	FC	S		D		Y				D						4	1
642	PC	S				Y	I									3	2
181	FC	I/S														1	10
345	FC	S														1	30
39	PC	I/S														1	1
73	PC	S														1	35
706	FC							I								1	3
90029	FC															0	8
213	PC			I			I									2	1
Direction of changes	I	25	114	2	0	0	4	5	0	0	2	2	1	0	0		
	S	95	0	0	0	0	0	0	0	0	0	0	0	0	0		
	I/S	11	0	0	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	79	0	0	7	1	0	1	0	0	0	0	0		
	Y	0	0	0	30	79	0	0	6	0	0	0	0	5	1		
Total		131	114	81	30	79	11	6	6	1	2	2	1	5	1	**2.19**	

Notation: Private carrier (PC), For-hire carrier (FC), Increased (I), Decreased (D), Increased and switched (I/S), Yes (Y).

The last column shows the daily truck trips made by these carriers, which are used as expansion factors to weigh the raw individual responses; the total numbers computed in the last part of the table are based on the trip-based weighted responses.

The 31 firms that indicated a reaction to the 2001 time of day pricing initiative cited a switch to or increase the usage of E-ZPass most often. 10.4 percent of the entire trip-based weighted sample either switched to E-ZPass (7.5 percent), or increased use of E-ZPass (2.0 percent), or did both (0.9 percent). Another typical reaction was to increase the shipment charges to the end customers. This was done by 9.0 percent of the trip based weighted sample. As reported by these carriers, the increase in shipment charges is 15.5 percent on average, which is generally lower than the toll changes since 2001 (50 percent increase in cash tolls, 25 percent increase in E-ZPass peak tolls, no change for E-ZPass off-peak tolls, and 12.5 percent decrease in E-ZPass overnight tolls). However, since it is very likely that the 15.5 percent increase was transferred to different customers, as a result, the carriers are expected to transfer the full toll cost to their customers. As expected, for-hire carriers increased shipment charges in larger amounts than private carriers. The average increased in shipment charge was 18.5 percent for for-hire carriers and 11.0 percent for private carriers. A significant proportion of the carriers that changed behavior decreased the frequency of travel through the PANYNJ toll facilities (6.2 percent).

Changing routes to avoid the toll cost is also cited by a significant proportion of carriers (6.2 percent). There are two main types of changes in routes specified by this group of carriers: switching to less tolled roads (95.3 percent) and visiting more customers during the way towards New York (4.7 percent). For these that reported route switching, most said they even chose longer routes to avoid the toll costs. As a consequence, 3.1 percent of the trip-based weighted sample reported the increase in travel time of a round trip.

However, only a very small proportion of carriers (0.5 percent) reported switching to off-peak periods due to time of day pricing. This indicates that the time saving feature of E-

ZPass, as reported in the section of E-ZPass Use and Awareness of Toll Discounts, attracted more carriers to use E-ZPass than the toll discounts. This suggests that, because of the carriers' high values of time, travel time savings are usually more important than toll savings.

Some carriers decreased the number of stops (0.6 percent) or increased their typical load of trucks (0.4 percent). Another group of carriers adjusted their fleet compositions: some of them increased the number of big trucks such as straight trucks (0.2 percent) or semi-trailers (0.2 percent) while others decreased the number of small trucks (0.1 percent). Changing the typical shipment size is the least cited reaction. Only 0.1 percent increased their shipment size.

Some carriers mentioned other types of operational changes due to time of day pricing, including *a change of business focus from New York to other areas such as Pennsylvania or New Jersey* (2.4 percent). Other stated impacts include: *increase in expenses* (0.6 percent), *increase in waiting time for mixing pickups* (0.4 percent), or *one of their runs were cut* (0.1 percent).

Compared with for-hire carriers, the private carriers that adjusted operations because of time of day pricing are more likely to cite four types of changes: increasing shipment charges, reducing truck trips, changing delivery routes, and increasing travel time. A higher proportion of private carriers (12.2 percent) increased shipment charges than for-hire carriers (7.3 percent). However, it needs to be noted that the magnitudes of the increases are significantly different. For-hire carriers' average increase in shipment charges was 18.5 percent in contrast to 11.0 percent for private carriers.

Meanwhile, the proportion of private carriers that changed their delivery routes (11.0 percent) is about three times higher than the one of for-hire carriers (3.8 percent). A similar pattern can be seen for the changes in the travel frequency through the toll facilities and the travel time per round trip. This suggests again that private carriers, by virtue of the fact they are part of integrated operations, tend to have more flexibility in adjusting delivery times simply because their receivers are accommodating than for-hire’s receivers.

Table 84. Dimensions of changes in operations

Dimensions of changes	For-hire carriers		Private carriers		Entire Sample	
	% of Valid (1)	% of Sample (2)	% of Valid	% of Sample	% of Valid	% of Sample
1. E-ZPass usage						
Switched	44.3%	6.9%	39.4%	8.7%	42.2%	7.5%
Increased use	17.1%	2.7%	3.2%	0.7%	11.3%	2.0%
Both switched and increased use	7.6%	1.2%	1.1%	0.2%	4.9%	0.9%
2. Charge for shipments						
Up	47.3%	7.3%	55.3%	12.2%	50.7%	9.0%
Down	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
3. Frequency of using the toll facilities						
More	0.0%	0.0%	2.1%	0.5%	0.9%	0.2%
Fewer	28.2%	4.4%	44.7%	9.8%	35.1%	6.2%
4. Change delivery routes	24.7%	3.8%	50.0%	11.0%	35.3%	6.2%
5. Tavel time of a round trip						
Longer	14.0%	2.2%	22.3%	4.9%	17.5%	3.1%
Shorter	2.3%	0.4%	0.0%	0.0%	1.3%	0.2%
6. Number of stops per trip						
More	0.0%	0.0%	4.3%	0.9%	1.8%	0.3%
Less	5.6%	0.9%	0.0%	0.0%	3.3%	0.6%
7. Travel more during off peak	0.0%	0.0%	6.4%	1.4%	2.7%	0.5%
8. Typical load of the truck's cargo capacity						
More	3.8%	0.6%	0.0%	0.0%	2.2%	0.4%
Less	0.0%	0.0%	1.1%	0.2%	0.4%	0.1%
9. Straight trucks in fleets						
Increased	0.0%	0.0%	2.1%	0.5%	0.9%	0.2%
Decreased	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10. Semi-trailers in fleets						
Increased	0.0%	0.0%	2.1%	0.5%	0.9%	0.2%
Decreased	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
11. Small trucks in fleets						
Increased	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Decreased	0.8%	0.1%	0.0%	0.0%	0.4%	0.1%
12. Shipment size						
Increased	0.8%	0.1%	0.0%	0.0%	0.4%	0.1%
Decreased	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
13. Other changes						
Business was switched to other areas	0.0%	0.0%	31.9%	7.0%	13.3%	2.4%
Expenses increased	6.1%	0.9%	0.0%	0.0%	3.6%	0.6%
Waiting longer for mixing pickups	0.0%	0.0%	5.3%	1.2%	2.2%	0.4%
One of their runs was cut	0.0%	0.0%	1.1%	0.2%	0.4%	0.1%
Based on weighted responses of	**131**	**844**	**94**	**427**	**225**	**1271**

Note: (1) Percentage among the weighted responses that reported in the corresponding category;

(2) Percentage among all the weighted responses in the corresponding category.

Most of the companies that adjusted their operations because of time of day pricing indicated multiple and simultaneous changes in behavior. Switching to E-ZPass and increasing the usage of E-ZPass were cited by a significant proportion of carriers. However, switching to off-peak periods was found to be a minor strategy to deal with the time of day pricing initiative among this heavily New Jersey-oriented sample (as discussed before, the inability to include companies doing thru trips that may have greater flexibility in terms of time of travel and route choice is bound to affect the results). For-hire carriers and private carriers follow similar distributions of behavioral change, though it is clear that private carriers tend to use a wider set of behavioral adjustments. The major two-dimension combinations of changes, as well as the minor ones, are listed in Table 85.

As shown in Table 85, the major two-dimension combinations are related to several main operational strategies analyzed before, which are switching to or increasing use of E-ZPass, increasing shipment charges, decreasing truck trips, changing route, increasing travel time, and switching business to other areas. These strategies are jointly used by carriers to reduce the impact of toll increases.

The most widely used two-dimension combination is *passing the additional costs generated by the toll changes to their customers* + *decreasing the truck trips through the toll facilities* + other changes. This combination represents 6.1 percent of the entire trip-based weighted sample of the 31 firms. Another popular combination is *changing routes* + *increasing charges* + other changes (5.5 percent) followed by *decreasing truck trips* + *changing routes* + other changes (4.1 percent).

Table 85. Major two-dimension combinations of changes in operations

Major two-dimension combinations of changes	For-hire carriers		Private carriers		Current users	
	% of Valid (1)	% of Sample (2)	% of Valid	% of Sample	% of Valid	% of Sample
Increase shipment charge + decrease truck trips + … (3)	27.5%	4.3%	44.7%	9.8%	34.7%	6.1%
Change routes + increase shipment charge + …	19.1%	3.0%	47.9%	10.5%	31.1%	5.5%
Decrease truck trips + change routes + …	7.6%	1.2%	44.7%	9.8%	23.1%	4.1%
Increase shipment charge + switch business to other areas + …	0.0%	0.0%	31.9%	7.0%	13.3%	2.4%
Decrease truck trips + switch business to other areas + …	0.0%	0.0%	31.9%	7.0%	13.3%	2.4%
Change routes + switch business to other areas + …	0.0%	0.0%	31.9%	7.0%	13.3%	2.4%
Decrease truck trips + switch to E-ZPass + …	21.4%	3.3%	0.0%	0.0%	12.4%	2.2%
Increase shipment charge + switch to E-ZPass + …	20.6%	3.2%	0.0%	0.0%	12.0%	2.1%
Decrease truck trips + increase travel time + …	6.1%	0.9%	12.8%	2.8%	8.9%	1.6%
Based on weighted responses of	131	844	94	427	225	1271

Note: (1) Percentage among the companies that changed their behaviors in the corresponding category;
(2) Percentage among all the companies in the corresponding category;
(3) Each combination may have more than two dimensions of changes although only two main dimensions of changes were identified.

Conclusions

The analyses conducted are based on 200 complete carrier surveys collected during the period from mid November to mid December, 2004. The analyses conducted are based on the total number of truck trips made by the users. These are the key findings:

- The data indicates that 36 carriers (20.2 percent) changed behavior because of the time of day pricing initiative. This number includes 17 carriers (9.0 percent) that reacted by increasing shipping charges to receivers, which illustrates the need to find out more about how receivers reacted to the time of day pricing initiative.
- The main reasons why trucks travel at the time they do were: *customer requirements dictate schedule (*61.6 percent), *to avoid congestion (*26.0 percent), and *to deliver*

*during a normal business / daytime hours (*20.8 percent). Only 3.5 percent mentioned *toll is cheaper* as a reason.

- The time of travel flexibility data indicate that only 25.6 percent of respondents have flexibility, averaging 37.3 minutes (early arrival) and 48.8 minutes (late arrival).
- Though 85.5 percent of respondents use E-ZPass, they are not fully aware of the toll discounts: 67.4 either *do not know of any discounts* (35.9 percent) or *heard of discount,* or *do not know specifics* (31.5 percent); only 27.4 percent could identify a specific discount program.
- When specifically asked about if and how the time of day pricing initiative impacted their E-ZPass usage, 88.3 percent of respondents reported *no change*, 8.2 percent reported *switched to E-ZPass*, and 2.2 percent reported *increased use of E-ZPass*.
- Carriers that changed behavior because of the time of day pricing tend to: a) focus on full truck load service; b) own smaller fleets; c) employ fewer interstate truck drivers on average but the same interstate truck drivers per truck; d) venture to areas outside New Jersey and New York; and e) use multiple combinations of strategies to deal with the time of day pricing.
- The key combinations of change patterns include: *passing the additional costs generated by the toll changes to their customers* + *decreasing the truck trips through the toll booths* + other changes (6.1 percent); *changing routes* + *increasing charges* + other changes (5.5 percent); and *decreasing truck trips* + *changing routes* + other changes (4.1 percent).

CHAPTER VIII

ESTIMATION OF PRICE ELASTICITIES FROM OBSERVED TRAFFIC DATA

Introduction

The objective of this chapter is to investigate the relationship between toll price and travel demand at PANYNJ facilities by estimating price elasticities of demand shifts occurring in off-peak periods utilizing traffic data before and after the implementation of time of day pricing program. Also, long run elasticities are estimated to assess the validity of the hypothesis that elasticities tend to increase over time since the users will have more time to adjust to price changes.

The analyses discussed in this chapter focus on the PANYNJ facilities connecting New York and New Jersey, consisting of four bridges and two tunnels, namely, George Washington Bridge (GWB), Lincoln Tunnel, Holland Tunnel, Bayonne Bridge, Goethals Bridge, and Outerbridge Crossing, as shown in Figure 65. In this study, the three toll plazas of the GWB (upper, lower, and Palisades Interstate Parkway (PIP)) are considered separately since each of them is a toll operation.

Figure 65. PANYNJ Crossings to Manhattan and Staten Island (59)

This chapter has six sections. The next section provides background information on price elasticities and reviews the previous studies in the literature. In the analysis part, a brief description of the data is provided, after which the estimates of elasticities for the study area are discussed. After presenting the results and discussions concluding remarks are given in the last section.

Background and Literature Review

The demand for travel is a derived demand. People undertake trips because they seek to participate in socioeconomic activities from which they are separated spatially. The demand for transportation depends on the characteristics of the users of the system (e.g. income, age, auto-ownership, gender, etc.) and the characteristics of the transportation system such as toll levels and travel times. A convenient way to summarize the relationship between the quantity demanded and an independent variable of the corresponding demand function is through the use of elasticities.

The elasticity of traffic demand with respect to toll changes is calculated as the percentage change in quantity demanded in response to a one percent change in price. The elasticity of traffic demand is expected to be negative, i.e., a price increase in the facility will result in a reduction in the traffic. Demand is said to be "price-elastic" if the absolute value of the own-price elasticity is greater than one, i.e., a price change elicits a more than proportionate change in the quantity demanded. A "price-inelastic" demand has a less than proportionate response in the quantity demanded to a price change, i.e., an elasticity between 0 and -1.0. Transportation demand tends to be inelastic, since it is a derived demand. [60]

Price elasticity changes over time. This might be due to time lag in information about price levels, lack of information about substitution possibilities, reductions in the constant value (after adjusting for inflation) of the toll, and to the fact that over time users have more flexibility in arranging for substitutes goods and services. This adjustment process makes the long-term elasticities larger than the short-term elasticities. [61]

A brief review of the literature reveals that there have been numerous empirical studies of the price elasticity of demand for transport in the past decades. As it will be shown, elasticity values show differences based on vehicle type (passenger cars, trucks), time of day (peak, off-peak), commodity type (for commercial trucks) and analysis type.

May conducted an overall comparison of different elasticity studies and calculated an average of -0.45 for the demand elasticity with respect to toll levels. [62] Mauchan et al. estimated the elasticity of traffic level for bridges and motorways at UK, respectively. [63] Based on the analysis conducted using traffic counts, it was shown that, elasticity values for a bridge located in Southampton changes between -0.21 to -0.36 for peak hours, and between -0.14 and -0.29 for off-peak hours. Similarly from the simulation model developed for the motorways located at West Yorkshire it was shown that whole motorway has an elasticity value of -0.40 whereas intercity motorway elasticity is -0.25.

Another study carried out by Matas et al. analyzed the elasticities of demand in tolled motorways in Spain with respect to the main variables influencing it. [64] The demand equation was estimated using a panel data set, taking into account dynamic effects of economic activity. Cross-section observations correspond to the different Spanish tolled motorways sections, and the temporal dimension ranges from the beginning of the eighties until the end of the nineties. The results from that study showed a high elasticity with respect to the economic activity level. These motorway sections were classified into four groups according to the estimated toll elasticity with values that range from -0.21 for the most inelastic to -0.83 for the most elastic. The main factors that explain such differences were determined to be the quality of the alternative road and the length of the section. The long-term elasticities were about 50 percent higher than the short term ones; however, the period of adjustment was relatively short.

Harvey investigated the impacts of toll levels on the San Francisco, California area bridge by estimating the toll elasticities for automobiles using traffic counts before and after the toll changes. (65) The analysis results indicated a value of -0.1 on the average. Mekky analyzed Toronto, Canada's Highway 407 and calculated the elasticity values in a similar way to Harvey using traffic counts. (65, 66) However, elasticity values were found to be much higher compared to other studies with a value of -4.0. Arentze et al. used a public survey to determine traveler response to congestion pricing incentives in Netherlands. (67) The price elasticity of overall vehicle travel was found to vary -0.13 to -0.19, and -0.35 to -0.39 depending on the route selected and time of day.

Yan et al. developed route choice models for SR 91 toll road, in California, by estimating logit models based on traveler surveys. (68) The estimation of elasticities with respect to different toll levels was accomplished through a sample enumeration method, where weighted average of individual probabilities obtained from logit models was used. The estimated elasticity values for the SR91 Express lanes range between -0.7 and -1.0 depending on the time of day. On the other hand, estimated the demand elasticity values for the Lee County, Florida time of day pricing project where the drivers crossing the two bridges with variable tolls in 1999 were much lower. Burris et al. examined the long-run changes in driver behavior in an existing variable pricing project in Lee County, Florida, implemented on August 3, 1998. (69) After calculating the price elasticities using traffic data of eligible drivers over the period 1998 to 2002, it was found that, over time the relative price elasticity of demand has decreased from -0.42 to -0.11 during the early morning discount period, as opposed to the general results found in the literature. The study also found that the elasticities have decreased, but to a lesser extent during the late morning and early afternoon discount periods. The authors explained the results of their research, which are generally different from other studies, by factors such as alternative routes, different travel demographics, traffic congestion levels, and the size of toll discount, which is only $0.25.

Burris investigated how different price elasticities of travel demand would impact the traffic on a toll road with a time-of-day variable toll rate. (70) Using data from the Lee

County variable pricing project, price elasticities of travel demand were calculated by time of day in one case and based on the socioeconomic and commute characteristics of drivers in the second case. Aggregate elasticities were found to range between -0.36 and -0.03 depending on the time of day. Disaggregate elasticities varied based on the driver's employment, household income, trip purpose, availability of flextime at work, and flexibility of his or her current trip. Applying the results from the Lee County project to a congested toll road resulted in a reduction in travel times between 8.8 and 13.3 percent and an average yearly savings in the value of reduced travel times of over $400,000.

Kockelman et al. derived a nested logit model using Roy's Identity for Austin, Texas travel-diary data. (71) Estimated demand elasticities with respect to travel price were found to be between -0.022 and -0.22. Table 86 presents a summary of elasticity studies under time of day pricing. As it can be followed from the performed studies, bridges tend to have elasticity values ranging between -0.03 and -0.36 depending on the time of the day. On the other hand elasticities for road ways tend to have larger values and involve a larger interval increasing up to -1.0 and -4.0.

Table 86. Elasticity of traffic demand with respect to toll levels, passenger cars

Source	Location - Type	Elasticity Value
May [62]	literature review of number of previous studies	-0.45 (Average)
Oum et al. [60]	Southampton, UK - bridges	(-0.21)-(-0.36) (peak) (-0.14) – (-0.29) (off-peak)
Harvey [65]	San Francisco, USA – bridges	-0.1 (average)
Cain et al. [72]	Lee County Florida, USA - bridges	(-0.03) (post-peak p.m.) (-0.36) (pre-peak a.m.)
Burris et al. [69]	Lee County Florida, USA – bridge (early morning discount period)	-0.42 (1998) -0.11 (2002)
Mauchan et al. [63]	West Yorkshire, UK - motorway	-0.4 (whole motorway) -0.25 (intercity motorway)
Matas et al. [64]	Spain – toll motorways	(-0.21) – (-0.83)
Mekky [66]	Toronto Highway 407	-4.0
Arentze et al.[67]	Netherlands – motorways	(-0.13) – (-0.19) (route) (-0.35) – (-0.39) (time of day)
Yan et al. [68]	SR 91, USA - motorway	(-0.7) – (-1.0) (time of day)
Kockelman et al. [71]	Austin, Texas, USA - motorways	(-0.022) – (-0.22)

Apart from the studies mentioned above, some studies specific to New York metropolitan area have been conducted as well. The study performed by Hirshman et al. for the New York area bridge and tunnel elasticities for automobiles indicate a value of -0.1 are on the average. [73] URS developed set of elasticity factors for each crossing on Triborough Bridge and Tunnel Authority (TBTA), depending on the historical toll increases to estimate the impact on traffic when tolls are increased in the future. [74] The estimated values represent the relationship between traffic and toll charges. The factors estimated by URS are updates of previously-derived factors and are based on the analysis of traffic data for periods before and after toll increases. The elasticity values are lastly developed in 1997, after the toll increase in 1996. Two sets of forecasts are developed one at present level and the other with toll increases in January 2004 and January 2008. The toll values are assumed to be \$4.00 and \$2.00 for major and minor crossings, respectively in January 2004, \$4.50 and \$2.25 in 2008 (cash toll for passenger cars). In addition, E-ZPass tolls are determined to be 50 cents less than respective cash tolls. Overall toll increase will be, therefore, 14.3 percent in 2004 and 12.5 percent in 2008. Table 87 and Table 88 indicate the elasticity values for present level and future levels in each crossing of TBTA. As it is observed from the tables, for most of the bridges elasticities tend to have values around -0.1 which is more inelastic compared to studies conducted for other bridges located in US. Besides, based on the proposed toll increases in 2004 and 2008, it is estimated that the traffic flow would decrease by 2.78 percent in 2004, and by 2.4 percent in 2008.

Table 87. Elasticity values for each TBTA crossing at present level (74)

Facility	Elasticity Value
Throgs Neck and Bronx-Whitestone Bridges	-0.085
Triborough Bridge	-0.196
Queens Midtown Tunnel	-0.208
Brooklyn-Battery Tunnel	-0.386
Verrazano-Narrows Bridge	-0.12
Henry Hudson Bridge	-0.298
Marine Parkway-Gil Hodges Memorial Bridge	-0.11
Cross Bay Bridge	-0.149

Table 88. Elasticity values in each TBTA Crossing for future toll levels (74)

Facility	Elasticity Value	Estimated % change in Toll Rates and Traffic			
		2004		2008	
		toll	Traffic	Toll	Traffic
Throgs Neck and Bronx-Whitestone Bridges	-0.085	14.30%	-1.2%	12.5 %	-1.1%
Triborough Bridge	-0.196	14.3	-2.8	12.5	-2.4
Queens Midtown Tunnel	-0.208	14.3	-3.0	12.5	-2.6
Brooklyn-Battery Tunnel	-0.386	14.3	-5.6	12.5	-4.8
Verrazano-Narrows Bridge	-0.12	14.3	-1.7	12.5	-1.5
Henry Hudson Bridge	-0.298	14.3	-4.3	12.5	-3.7
Marine Parkway-Gil Hodges Memorial Bridge	-0.11	14.3	-1.6	12.5	-1.4
Cross Bay Bridge	-0.149	14.3	-2.1	12.5	-1.9

The price elasticity of freight transport (measured in ton-miles) in Denmark was calculated to be -0.47, while the elasticity of freight traffic (measured in truck-kilometers) is -0.81 and the elasticity of freight energy consumption is only about -0.1 according to a study by Bjørner. [(75)] A 10 percent increase in shipping costs reduces truck traffic by eight percent, but total shipping volume by only five percent. Some freight is shifted to rail, while other freight is shipped using existing truck capacity more efficiently.

Bailly estimated a wide range of long-run price elasticity of truck freight transport with depending on the type of freight. [(76)] As summarized by Small et al. various estimates of freight elasticities vary between -0.04 and -2.97 at the disaggregate level, and between -0.25 to -0.35 at the aggregate level. [(77)]

Abdelwahab estimated the mode choice elasticities for the intercity freight transport market based on probit models. [(78)] The own price elasticities of truck choice probabilities are found to vary from -0.749 to -2.525 depending on commodity type and geographic territories.

Holguín-Veras estimated elasticities using a discrete-continuous formulation to model the decision of the type of commercial vehicle to use, on the basis of data collected for Guatemala City. [(79)] The estimates of (direct) elasticity ranged between -0.027 to -0.064. He also found evidence of statistically significant cross-elasticities.

A summary of truck elasticity values found in the literature is provided in Table 89. The results indicate that, truck elasticity values highly depend on the commodity type. Elasticity values range between -0.02 and -3.0, covering very inelastic and very elastic ranges.

Table 89. Elasticity of traffic demand with respect to toll levels, trucks

Source	Location - Type	Elasticity Value
Oum et al. (80)	literature review of number of previous studies, US	(-0.1) – (-0.9) (commodity type)
Babcock et al. (80)	Inland and costal carriers – US Annual data, 1958 - 1980	(-0.28) – (-1.49) (commodity type)
Bureau of Transport Economics (80)	Australia	(-0.02) – (-3.0) (commodity type)
Bjørner. (75)	Denmark	(-0.47) (freight in ton miles) (-0.81) (truck kilometers) (-0.1) (energy consumption)
Oum. (80)	Canadian CFTM data base, 1979	(-0.65) – (-1.25) (commodity type)
Wilson et al. (80)	US Monthly Data, 1973 - 1983	-0.73 (wheat transport)
Bailly. (76)	literature review of number of previous studies, US	(-0.04) – (-2.97) (disaggregate) (-0.25) – (-0.35) (aggregate)
Abdelwahab. (78)	US Commodity Transportation Survey	(-0.75) – (-2.525) (commodity type, disaggregate)
Holguin-Veras. (79)	Guatemala City	-0.027 to -0.064 (depending on commodity type)

Data Sources

The extensive data used in this study was obtained from PANYNJ. (81) Tolls are collected in the eastbound (New York bound) direction only on the PANYNJ facilities. The data includes hourly, daily, weekly and monthly traffic distributions in the eastbound direction, during weekdays and weekends for a period from January 2000 to August 2001 and April 2002 to December 2003, which excludes the time period between September 2001 and April 2002. The details of the data set are provided in Table 90. Between January 2000 to August 2001 and May 2002 to August 2002, the database contains a variety of information including vehicle types (i.e., bus, truck, and car) and types of payment performed (i.e., E-ZPass, cash). The weekday data were collected for three days: Monday, Wednesday and Friday. Weekend data were collected for both Saturday and Sunday. The elasticity values are estimated using the data set between April 2000 – August 2000, April 2001 – August 2001 and May 2002 and August 2002.

Table 90. Data Sources (81)

Time Period	Day Type	Vehicle Type	Payment Type	Location
Jan 2000 – Aug 2001	Weekday,	Cars, buses,	Cash,	GWB_lower, GWB_upper,
May 2002 – Oct 2002	weekend	trucks	E-ZPass	GWB_PIP HT, LT, BB, GB, OC

GWB: George Washington Bridge
PIP: Palisades Interstate Parkway
OBX: Outerbridge Crossing
HT: Holland Tunnel
LL: Lincoln Tunnel
BB: Bayonne Bridge
GB: Goethals Bridge

Traffic data during the eight-month period between September 2001 and April 2002 were not used in the analyses because it was deemed to be impacted by the traffic restriction and the overall downturn in the economy following 9/11. After 9/11, various operational restrictions were placed at three of the PANYNJ's six crossings. These restrictions significantly altered regional traffic behavior. Over time, the restrictions were lifted or modified. In the short term, the travel restrictions imposed on the PANYNJ's traffic flows shifted traffic between corridors, caused shifts in time of day travel at the Lincoln Tunnel, and brought about changes in the usage of the Exclusive Bus Lane at the Lincoln Tunnel. By August 2002, however, the overall traffic-flow distribution among the six PANYNJ interstate facilities appeared to be returning to the pre–9/11 patterns.(82)

Components of Demand Elasticity

In general, elasticity of transportation demand is computed with respect to both tolls and value of time, since the total cost function is assumed to change relative to both toll price and congestion. (83) As mentioned before in the literature review section, Burris investigated the impact of Lee County variable pricing project on travel behavior. (70) In that case, the absence of several confounding factors such as congestion, convenient alternative routes, and change in mode use all indicated that a driver's decision to alter his or her time of travel due to the variable toll was primarily a monetary decision. In this case, the analyses focused only on the elasticity of demand and did not consider the other, time value component of the demand elasticity. The reasoning behind this decision is the lack of alternative equally attractive route and mode choices for the types of trips analyzed in this study. Therefore, in this study primarily the elasticity of demand is considered.

Another important limitation of the analyses conducted in this chapter that must be acknowledged upfront is the lack of consideration of cross-effects between the quantity of users choosing to travel during the peak hours and the tolls during the off-peak hours. From the standpoint of micro-economic behavior, the two times of travel (peak vs. off-peak) represent substitute services. As such, one may expect that the number of users at the peak hour be a function, not only of the tolls at the peak hour, but of the off-peak tolls as well. Since the analytical consideration of such cross-effects require econometric modeling—which was not part of this effort—there was no way to consider them when estimating the elasticities. The lack of consideration of the cross effects is likely to translate into an overestimation of the direct elasticities, though there is no way to even guess the magnitude of this overestimation.

Estimation of Price Elasticities

In this section, the method used to measure the demand shift due to time of day pricing in this study was to define and compare two time periods, the first period being before and the second period being after the time of day pricing implementation. In this chapter, two types of elasticity values are estimated; short term elasticity and long term elasticity. In the estimation of short term elasticity values, the before-after period is chosen to be in a time period before 9/11. Accordingly, the period before and after the implementation of time of day pricing program was chosen as April to August 2000 and April to August 2001, respectively. Using the same five months of traffic data from subsequent years minimized the potential for bias due to seasonal variation, while maximizing the amount of available data. On the other hand long term elasticity values cover a longer time period which includes 9/11 is considered. Therefore, long term elasticity values include the operational restrictions, regulations and economic impacts of 9/11, on the traffic flow as well.

The toll levels for passenger cars and semi-trailers before and after the time of day pricing implementation are shown in Table 91. (12) Based on the information obtained from PANYNJ (2001), the peak toll rates are in effect between 6:00 AM – 9:00 AM and 4:00 PM – 7:00 PM on weekdays, and between 12:00 PM – 8:00 PM on weekends. As shown in Table 91, the highest increase on toll levels was applied to cash users, whereas after the time of day pricing, off-peak E-ZPass users experienced the lowest base toll rate increase, excluding the frequency-based State Island Bridges discount program and the carpool discount program. With this implication only E-ZPass users were eligible for toll discounts at off-peak hours, such that a 27.8 percent ($1.00) reduction in base auto toll prices and 69.4 percent ($2.50) reduction in truck toll prices were offered via the PANYNJ time of day pricing. (84)

Table 91. Toll levels for passenger cars and semi-trailers (84)

Vehicle Type	Before VP	After VP
Passenger Cars		
Cash Peak hour	$4	$6
Cash Off-peak hour	$4	$6
E-ZPass Peak hour	$3.60	$5
E-ZPass Off-peak hour	$3.60	$4
Trucks (per axle)		
Cash Peak hour	$4	$6
Cash Off-peak hour	$4	$6
E-ZPass Peak hour	$3.60	$5
E-ZPass Off-peak hour	$3.60	$5
E-ZPass Overnight (12 AM-6 AM)	$3.50	$3.50

Elasticities were estimated for regular E-ZPass users only (excluding the special discount programs) due to the fact that the time of day discounts are only available to them. Different analyses were carried out for weekday and weekend car and truck (commercial) traffic for each facility separately considering the percent demand shifts in pre-AM peak (6:00 AM – 7:00 AM), post-AM peak (9:00 AM – 10:00 AM), pre-PM peak (3:00 PM – 4:00 PM) and post-PM peak (7:00 PM – 8:00 PM) traffic. For this study, only one hour before and one hour after the peak period were included in the total traffic analysis, which is composed of two main tasks:

Task 1: Estimation of short-term toll-price elasticities by using disaggregate monthly traffic data from April through August 2000 versus April through August 2001, which provides a one-year analysis period. Since, this period is before 9/11 changes in demand can be attributed to the change in prices

Task 2: Estimation of long-term toll-price elasticities by using disaggregate monthly traffic data from May through August 2000 versus May through August 2002, which provides a 2-year analysis period.

All of the price elasticities were calculated using Equation 6.

$$E_p = \frac{\Delta Q}{\Delta P} \qquad (6)$$

where,

E_p: Price elasticity of traffic demand

ΔQ: The change in percent of off-peak traffic flow after the time of day pricing for the same month

ΔP: Reduction in toll price for traveling during off-peak periods (percentage) after the time of day pricing

The next section summarizes the results obtained and provides a discussion.

<u>Short Term Elasticities</u>

The short term price elasticities of demand calculated for cars with E-ZPass as explained in Task 1 are shown in Table 92. By studying these results, some interesting conclusions can be drawn. As far as the weekday short term elasticities are concerned, one important pattern that emerges is that for almost all of the crossings pre-peak elasticity values are higher compared to post-peak elasticity values during both AM and PM periods. The only exceptions to this pattern are the Bayonne Bridge and

Outerbridge Crossing during AM pre-peak period. This interesting observation indicates that travelers tend to shift their time of travel to take advantage of the off-peak discounts towards the AM pre-peak (5:00 AM-6:00 AM) and PM pre-peak (3:00 PM- 4:00 PM) hours. This result is consistent with the authors' expectations that are based on the fact that travelers may have greater flexibility in changing the time of travel in the morning to arrive early at work. Since all the trips in this study are eastbound trips, the afternoon trips are not necessarily all 'work-to home' type trips. However, the fact that travelers might also be choosing E-ZPass to take advantage of shorter delays at the toll booths should not be overlooked. When compared with previous studies that performed similar analysis to estimate short-term elasticity values for passenger cars, it can be concluded that the pattern of shifting to pre-peak periods rather than post-peak periods observed at PANYNJ facilities is consistent with the findings of these previous studies. (See References 60,67,68,69,70,72) On the other hand, short-term price elasticities estimated in this study are larger than some of the previous studies including elasticity studies conducted for TBTA crossings. (74) The range of the elasticities estimated in this study is comparable with the elasticity values estimated for SR 91 Express Lanes. (68,85)

Table 92. Elasticity of demand for weekday and weekend periods for cars

Facility	Weekday				Weekend	
	5AM-6AM	9AM-10AM	3PM-4PM	7PM-8PM	11AM-12PM	8PM-9PM
Bayonne	-0.316	-0.959	-0.833	-0.526	-1.680	-1.146
Goethals	-0.992	-0.806	-0.811	-0.395	-1.155	-1.006
GWB_LL	-1.565	-0.709	-1.240	-0.898	-1.283	-1.047
GWB_PIP	-1.284	-0.632	-0.954	-0.582	-0.883	-0.609
GWP_UL	-1.586	-0.825	-0.869	-0.691	-1.401	-0.799
Holland	-1.601	-1.036	-1.110	-0.835	-1.482	-1.387
Lincoln	-1.973	-0.794	-1.271	-1.074	-1.660	-1.155
Outer	-0.461	-0.608	-0.652	-0.458	-0.946	-0.550

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway, LL: Lower Level, UL: Upper Level

As far as weekend passenger car traffic is concerned, it is observed that weekend short term elasticity values are higher than the corresponding weekday elasticity values. While in Chapter II the traffic impact study results indicated that the change in weekend traffic is statistically insignificant for most of the crossings. At first glance, these two results seem to be contradictory. However, it is important to highlight that the traffic analyses included both cash and E-ZPass users; whereas elasticity values are estimated for E-ZPass users only since they are the ones who take advantage of the price differentials. Therefore the trend of E-ZPass usage on weekdays and weekends is investigated separately. To achieve this goal, total daily E-ZPass percentage before time of day pricing initiative (between April 2000 and August 2000) and after the time of day pricing initiative (between April 2001 and August 2001) are calculated for both weekdays and weekends. As illustrated in Table 93, E-ZPass usage trends show differences for weekdays and weekends. Even if E-ZPass percentage is higher on weekdays compared to weekends, the increase in daily E-ZPass percentage is higher for weekends compared to weekdays for all crossings. This different trend explains the reason of higher weekend short term elasticity values compared to weekday short term elasticity values. It is important to note that the E-ZPass elasticity values include both the shift to peak shoulder periods due to time of day pricing and the increase in E-ZPass usage regardless of the time of day pricing.

Table 93. E-ZPass usage before and after time of day pricing on weekday and weekends for cars

Facility	Weekday E-ZPass%		Weekend E-ZPass%		Change%	
	Before	After	Before	After	Weekday	Weekend
Bayonne	62.43	74.39	50.01	65.65	19.16	31.26
Goethals	54.17	64.37	45.11	55.86	18.81	23.84
GWB_LL	54.31	66.74	44.92	56.12	22.89	24.95
GWB_PIP	64.89	76.56	56.54	68.91	17.99	21.87
GWB_UL	49.91	60.55	37.84	47.55	21.32	25.66
Holland	47.73	61.07	36.31	49.32	27.94	35.85
Lincoln	52.81	66.40	40.88	54.60	25.73	33.56
Outerbridge	62.44	71.94	64.89	76.56	15.21	17.99

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway, LL: Lower Level, UL: Upper Level

According to Table 94, commercial vehicles have lower short term elasticity values compared to passenger cars during weekdays and weekends. This result indicates that commercial trucks are more inelastic in terms of toll levels than passenger cars during AM pre-peak periods on weekends. This trend may be explained by the fact that commercial vehicles may have strict delivery deadlines depending on the commodity type, which reduce their flexibility and prevent them from shifting between peak and off-peak hours. This trend may also be explained by the fact that commercial vehicles have much higher overall costs of operations that are not related to tolls, contributing to more inelastic toll pricing responses.

Table 94. Elasticity of demand for weekday and weekend periods for trucks

	Weekday	**Weekend**	
	5AM-6AM	**11AM-12PM**	**8PM-9PM**
Bayonne	0.169	-0.401	-0.119
Goethals	-0.387	-0.489	-0.455
GWB_LL	-0.286	-0.205	-0.413
GWB_PIP	NA	-0.352	-0.243
GWP_UL	-0.559	-0.379	-0.208
Holland	-0.255	-0.245	-0.417
Lincoln	-0.389	-0.438	-0.285
Outer	-0.262	-0.300	-0.116

Note: GWB: George Washington Bridge, PIP: Palisades Interstate Parkway, LL: Lower Level, UL: Upper Level.

When short term elasticity estimates of trucks between this study and previous studies are compared, it is observed that in the previous studies a similar range of short term elasticity values for trucks are found. Moreover, in those studies as well as in this one, truck elasticity values are found to be lower for commercial trucks compared to passenger cars. [See references 75,76,77,80]

As frequently mentioned in the literature and according to the estimates produced by the project team, delays tend to decrease when E-ZPass usage increases as a percentage of total demand. Thus, the toll differential as a result of time of day pricing can only partially explain the change in elasticities and other components of the cost function, namely congestion and value of time should be considered as well.

Long Term Elasticities

For the second task, the monthly changes in the long term elasticities are analyzed by considering the months within the second quarter of years 2000 and 2002 (i.e., May through August). The comparison of the results obtained from Task 2, revealed that as the amount of time passed after the implementation of time of day pricing increases (i.e., as we go from 2001 to 2002), elasticity values of passenger cars for most of the crossings generally kept increasing for weekday post-peak periods, and all periods of weekends. However, elasticity values of trucks usually increased during weekday morning pre-peak periods. The summary of the results are shown in Table 95 and Table 96 for passenger cars and commercial trucks, respectively. The shaded regions show the time periods and crossings for which the long term elasticity values are higher than the short term elasticity values.

Table 95. Comparison of short-term and long-term elasticities for passenger cars

Crossing	Type of elasticity	Weekdays				Weekends	
		5AM-6AM	9AM-10AM	3PM-4PM	7PM-8PM	11AM-12PM	8PM-9PM
Bayonne	short term	-0.270	-0.915	-0.837	-0.567	-1.664	-1.040
	long term	-0.760	-0.978	-0.760	-0.613	-1.819	-1.455
Goethals	short term	-0.939	-0.816	-0.817	-0.356	-1.140	-1.010
	long term	-0.892	-0.628	-0.892	-0.500	-1.477	-1.139
GWB_LL	short term	-1.434	-0.679	-1.322	-0.987	-1.240	-1.065
	long term	-1.318	-0.748	-1.318	-0.877	-1.435	-1.078
GWB_PIP	short term	-1.292	-0.569	-1.074	-0.587	-0.916	-0.631
	long term	-1.141	-0.798	-1.141	-0.654	-0.938	-0.940
GWB_UL	short term	-1.622	-0.807	-0.881	-0.710	-1.432	-0.700
	long term	-0.820	-0.803	-0.820	-0.753	-1.641	-0.945
Holland	short term	-1.505	-1.073	-1.157	-0.908	-1.494	-1.354
	long term	-1.094	-0.768	-1.094	-1.083	-1.804	-1.583
Lincoln	short term	-1.936	-0.880	-1.300	-1.059	-1.540	-1.170
	long term	-1.345	-0.837	-1.305	-1.260	-1.928	-1.474
Outer	short term	-0.450	-0.577	-0.677	-0.490	-0.932	-0.536
	long term	-0.778	-0.848	-0.778	-0.631	-1.439	-0.595

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway, LL: Lower Level, UL: Upper Level

Table 96. Comparison of short-term and long-term elasticities for trucks

Crossing	Type of elasticity	Weekdays	Weekends	
		5AM-6AM	11AM-12PM	8PM-9PM
Bayonne	short term	0.153	-0.215	0.162
	long term	-0.375	-0.264	0.014
Goethals	short term	-0.414	-0.451	-0.565
	long term	-0.739	-0.290	-0.718
GWB_LL	short term	-0.235	-0.187	-0.442
	long term	0.179	0.215	-0.388
GWB_PIP	short term	NA	NA	NA
	long term	NA	NA	NA
GWB_UL	short term	-0.620	-0.405	-0.248
	long term	-0.483	-0.634	-0.508
Holland	short term	-0.249	-0.198	-0.530
	long term	-0.359	-0.174	-0.365
Lincoln	short term	-0.382	-0.355	-0.295
	long term	-0.799	-0.201	-0.357
Outer	short term	-0.274	-0.323	-0.017
	long term	-0.141	-0.452	-0.107

Note: GWB: George Washington Bridge, PIP: Palisades Interstate Parkway, LL: Lower Level, UL: Upper Level.

The relationships between the short-term and long-term price elasticities for each facility are shown in Figure 66 and Figure 67, for passenger cars and commercial trucks, respectively. Each graph shows the temporal fluctuations in price elasticities (which were computed as average daily off-peak period values) over the elapsed time since the beginning of the time of day pricing program.

As shown in Figure 66 and Table 95 the elasticity values for passenger cars range between -0.5 and -1.3. Between May 2001 and August 2001 elasticity values for all crossings decreased. On the other hand, the elasticity values in two distinct time periods August 2001-May 2002 and May 2002 – August 2002 exhibit different behaviors for different crossings. The long term elasticity values increased for GWB lower level, Outerbridge Crossing, Bayonne Bridge and Goethals Bridge, decreased GWB upper level, Lincoln Tunnel and Holland Tunnel during the weekday AM period and PM pre-peak period, for May 2002 compared to August 2001. The reason for these different behaviors in terms of elasticity values may be due to the fact that the Single Occupant

Auto (SOA) restrictions imposed after September 2001 were in affect during the morning peak periods at the Lincoln Tunnel until April 2002 and at the Holland Tunnel until November 2003. In addition, truck restrictions at the Holland Tunnel and GWB lower level contributed to shifting traffic from Lincoln and Holland Tunnels to GWB lower level, GWB PIP, Goethals Bridge and Bayonne Bridge and Outerbridge Crossing. (82) This shift resulted in an increase in elasticity values. In 2002 when Outerbridge Crossing rehabilitation work had started and some of the restrictions were lifted or eased in April 2002, as supported by long term elasticity values and additional traffic data, fluctuations in traffic flows occurred. Some of traffic returned to Holland Tunnel, Lincoln Tunnel especially from GWB, which resulted in an increase in long term elasticity values of Lincoln and Holland Tunnels, and a reduction in elasticity values of GWB and Outerbridge Crossing, by August 2002 compared to May 2002. On the other hand, traffic shifted to Bayonne Bridge, and Goethals Bridge remained unchanged.

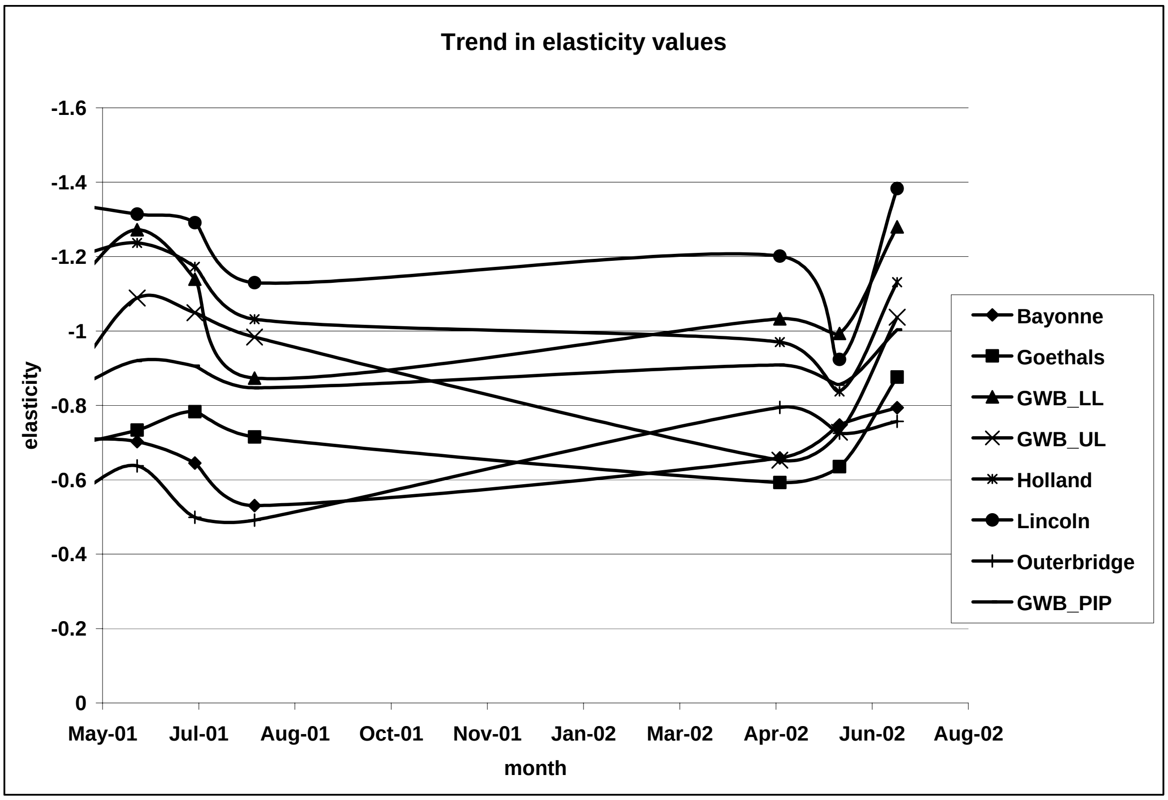


Figure 66. Trends in weekday elasticity for each crossing for passenger cars

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway, LL: Lower Level, UL: Upper Level

Figure 67 and Table 96 show the elasticity values for trucks range between -0.2 and -0.8 for different crossings which is lower compared to passenger cars. From May 2001 to August 2001, for all crossings except Outerbridge Crossing, the truck elasticity values have a decreasing trend. Within this time period, GWB upper level experiences the highest short elasticity values. On the other hand similar to car traffic at two distinct time periods between August 2001 – May 2002, and May 2002 – August 2002, elasticity values show differences for different crossings. During the first time period from August 2001 to May 2002, the elasticity values of GWB lower level, Outerbridge Crossing and Holland Tunnel decreased and elasticity values for Bayonne Bridge and Goethals Bridge increased; whereas no elasticity estimation is conducted for GWB_PIP, due to truck restrictions. These different trends in the long term elasticity values on May 2002 can be attributed to several factors. The most obvious possible cause is the restrictions imposed on these crossings after the 9/11. Beginning in October 2001, truck traffic was limited to upper levels of GWB (weekdays and weekends), and truck traffic was prohibited in Holland Tunnel eastbound lanes until April 2002 (weekdays and weekends). With these restrictions truck traffic had to shift to other crossings from Holland Tunnel, GWB lower level, and GWB PIP. In April 2002, the Holland Tunnel eastbound truck ban was lifted for two- and three-axle, single-unit trucks. However, the ban on tractor trailers crossing Holland Tunnel and truck traffic limitation to upper level of GWB remained the same. And as mentioned above, rehabilitation work has started on Outerbridge Crossing in 2002. With these updated truck regulations and rehabilitation work, from May 2002 to August 2002, the long term elasticity values of Holland Tunnel, Lincoln Tunnel, Goethals Bridge, and Bayonne Bridge increased, whereas long term elasticity value of GWB lower level became positive. Other crossings elasticity values experience a stable trend between May 2002 and August 2002.

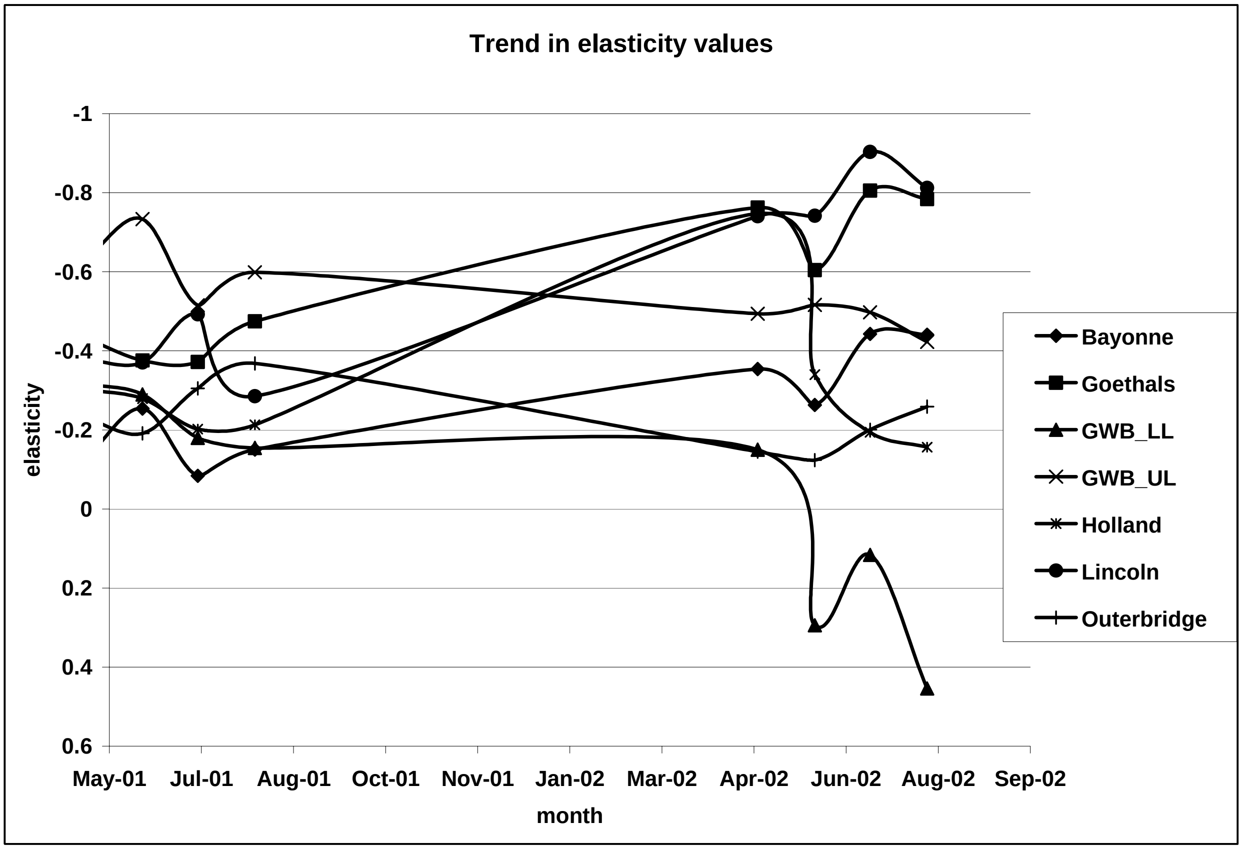


Figure 67. Trends in weekday elasticity values within time for each crossing, trucks

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway, LL: Lower Level, UL: Upper Level

These findings indicate that, apart from the impacts of time of day pricing, on May 2002 these restrictions applied after 9/11 tragedy still had an impact on the traffic flow of the various crossings. Therefore these visibly unstable “long-term” elasticity values reflect not only the impact of the new variable toll structure but also the regulations related to security as well. In order to test whether the operational restrictions and regulations put in place after 9/11 still had an impact on the elasticity values of each bridge/tunnel, one tailed t-tests are conducted using the following hypothesis for each crossing and time-period. [86]

$$H_0 : (\mu_i)_1 - (\mu_i)_2 = 0$$
$$H_1 : (\mu_i)_1 - (\mu_i)_2 > 0 \qquad (7)$$

where;

$(\mu_i)_1$ = mean percent share of period i between months of May and June 2002,

$(\mu_i)_2$ = mean percent share of period i between months of July and August 2002

i: 1=AM pre-peak, 2=AM post-peak, 3=PM pre-peak, 4=PM post-peak

The results of these t-tests are shown in Table 97 and Table 98 for cars and trucks, respectively. The shaded regions show the time periods and crossings for which the change in elasticity values is statistically significant. As shown in Table 97, the change in long term elasticity values for passenger cars is significant mostly during weekends. Among all crossings, Lincoln Tunnel experiences the highest fluctuation in terms of elasticity values. The increase in long term elasticity values for Goethals Bridge, GWB lower level, and GWB upper level are statistically significant only for weekends. However, the increase in long term elasticity values is statistically insignificant for Bayonne Bridge, GWB PIP, and Outerbridge Crossing irrespective of the day type and time period. These results indicate that for most of the bridges, the change in long term elasticity values from May 2002 to August 2002 during weekdays is not statistically significant except for Holland and Lincoln Tunnels. However on weekends, long term elasticity values change in a statistically significant manner for some of the crossings.

Thus it may be concluded that, the operational restrictions and regulations still had an impact on weekday car traffic of Holland and Lincoln Tunnels from May 2002 to August 2002. However, for weekend car traffic restrictions and regulations still had an impact on Goethals Bridge, GWB lower level, and GWB upper level between May 2002 and August 2002. For all other crossing, the increase in elasticity values in the long term reached a stable trend after May 2002.

Table 97. P-values for long term elasticity comparison, cars

Facility	Weekday				Weekend	
	5 – 6 AM	9 – 10 AM	3 – 4 PM	7 – 8 PM	11 AM – 12 P.M	8 – 9 PM
Bayonne Bridge	0.048	0.241	0.048	0.401	0.180	0.161
	(S)[a1]	(NS)[b]	(S)[a1]	(NS)	(NS)	(NS)
Goethals Bridge	0.077	0.232	0.077	0.278	0.186	0.072
	(NS)	(NS)	(NS)	(NS)	(NS)	(S)*[2]
GWB Lower Level	0.163	0.339	0.163	0.094	0.070	0.092
	(NS)	(NS)	(NS)	(S)*[1]	(S)*[2]	(S)*[2]
GWB PIP	0.013	0.156	0.289	0.305	0.191	0.233
	(S)[a1]	(NS)	(NS)	(NS)	(NS)	(NS)
GWB Upper Level	0.003	0.371	0.003	0.492	0.356	0.067
	(S)[a1]	(NS)	(S)[a1]	(NS)	(NS)	(S)*[2]
Outerbridge Crossing	0.314	0.174	0.314	0.168	0.353	0.174
	(NS)	(NS)	(NS)	(NS)	(NS)	(NS)
Holland Tunnel	0.073	0.099	0.073	0.10	0.093	0.233
	(S)*[1]	(S)*[1]	(S)*[1]	(S)*[2]	(S)*[2]	(NS)
Lincoln Tunnel	0.074	0.299	0.074	0.422	0.091	0.256
	(S)*[2]	(NS)	(S)*[2]	(NS)	(S)*[2]	(NS)

[a1]Significant decrease, at 95% CL. [a2]Significant increase, at 95% CL. [b] Not significant
[*1]Significant decrease, at 90% CL [*2]Significant increase, at 90% CL
GWB: George Washington Bridge, PIP: Palisades Interstate Parkway

As shown in Table 98, the increase in elasticity values of trucks is statistically significant only for Bayonne Bridge (weekday AM pre-peak period) and Lincoln Tunnel (weekend, all periods). For all other crossings the change in long term elasticity values for trucks are statistically insignificant at all time periods and day types. These results indicate that most of the bridges, long term elasticity values of trucks do not significantly change from May 2002 to August 2002 during weekdays and weekends with the exceptions of Bayonne Bridge and Lincoln Tunnel. It can thus be concluded that, the operational restrictions and regulations after they have been lifted or eased on April 2002 still had an impact on weekday truck traffic of Bayonne Bridge between May 2002 and August 2002. For weekend traffic on the other hand, restrictions and regulations still had an impact on Lincoln Tunnel only between May 2002 and August 2002. For all other crossing the increase in elasticity values for trucks in the long term reached a stable trend after May 2002.

Table 98. P-values for long term elasticity comparison, trucks

Facility	Weekday	Weekend	
	5 – 6 AM	11 AM – 12 PM	8 – 9 PM
Bayonne Bridge	0.100	0.291	0.112
	(S)*2	(NS)b	(NS)
Goethals Bridge	0.195	0.018	0.448
	(NS)	(S)a1	(NS)
GWB Lower Level	0.265	0.417	0.270
	(NS)	(NS)	(NS)
GWB Upper Level	0.216	0.421	0.444
	(NS)	(NS)	(NS)
Outerbridge Crossing	0.051	0.280	0.156
	(S)*1	(NS)	(NS)
Holland Tunnel	0.160	0.008	0.177
	(NS)	(S)a1	(NS)
Lincoln Tunnel	0.118	0.087	0.022
	(NS)	(S)*2	(S)*2

a1Significant decrease, at 95% CL. a2Significant increase, at 95% CL. b Not significant
*1Significant decrease, at 90% CL *2Significant increase, at 90% CL

GWB: George Washington Bridge, PIP: Palisades Interstate Parkway,

Conclusions

In this chapter the relationship between toll prices and travel demands at PANYNJ facilities is investigated through the computation of price elasticities of demand using traffic data before and after the time of day pricing program. The analysis focuses on the regular, non-discount program E-ZPass users only, based on the reasoning that such travelers are the ones able to take advantage of the toll differentials. Two main approaches were used to perform the analysis. First, elasticity of demand was derived by considering the changes in percent share of pre-AM peak, post-AM peak, pre-PM peak and post-PM peak traffic in response to a reduction in toll prices offered by the PANYNJ time of day pricing program for traveling during these off-peak hours. For the first approach, short-term elasticities were calculated by using percent share of traffic flow at each period from April through August 2000 versus May through August 2001, which provided a 1-year analysis period prior to 9/11. Second, long-term elasticities were calculated using disaggregate monthly traffic data from May through August 2000 versus May through August 2002, which provides a 2-year analysis period. The analyses lead to several important findings listed below:

- On weekdays for almost all of the crossings short term pre-peak elasticity values are higher compared to post-peak elasticity values during both AM and PM periods. The only exception to this pattern is observed for Bayonne Bridge and Outerbridge Crossing during the AM pre-peak period. This interesting observation indicates that travelers tend to shift their time of travel to take advantage of the off-peak discounts towards the AM pre-peak (5AM-6AM) and PM pre-peak (3PM-4PM) off peak hours. This result is consistent with the authors' expectations that are based on the fact that travelers may have greater flexibility in changing the time of travel in the morning to arrive early at work.
- As far as weekend passenger car traffic is concerned, it is observed that weekend short term elasticity values are higher compared to weekday elasticity values. Total daily E-ZPass percentages before time of day pricing initiative (between April 2000 and August 2000) and after the time of day pricing initiative (between April 2001 and August 2001) indicate that, E-ZPass usage trends show differences on weekdays and weekends. Even if the E-ZPass percentage is higher on weekdays compared to weekends, the increase in the daily E-ZPass percentage is higher on weekends compared to weekdays for all crossings. This different trend explains the reason of higher weekend elasticity values compared to weekday elasticity values. It is important to note that the E-ZPass elasticity values include both the shift to peak shoulder periods due to time of day pricing and the increase in E-ZPass usage regardless of the time of day pricing.
- Commercial vehicles have lower short term elasticity values compared to passenger cars for both weekdays and weekends. This result indicates that demand of commercial trucks is more inelastic to tolls than passenger cars during AM pre-peak periods on weekends. This trend may be explained by the fact that commercial vehicles may have strict delivery deadlines depending on the commodity type, which reduces their flexibility and prevents in terms time period shifts between peak and

off-peak hours. This trend may also be explained by the fact that commercial vehicles have much higher overall costs of operations that are not related to tolls, contributing to more inelastic toll pricing responses.

- Elasticity tends to increase over time for passenger cars at most of the crossings during weekday post-peak periods, and all periods of weekends. However, elasticity values of trucks usually increased during weekday morning pre-peak periods. This result is also consistent with the findings presented in Matas et al., who concluded that the long-term elasticities were about 50 per cent higher than the short term ones. [(64)] However, these results have to be studied with care given the fact that an event such as 9/11 occurred in the middle of our analysis period and its effects need to be taken into account when interpreting our findings.
- 14 months after the beginning of the time of day pricing program, many of the traffic restrictions imposed due to 9/11 were lifted or eased and the transportation system involving the PANYNJ facilities started to return to a new normal. Therefore, this is the point at which price elasticities start to become stable at almost all the crossings.
- The t-tests are conducted to test the significance level of the increase in long term elasticity values after the lifting of the operation bans namely, after April 2002. If a continuing change in elasticity values is observed between subsequent months in 2002, it is hypothesized that the system has still not reached a steady state and some shifts among time periods and facilities continue to occur. It is further hypothesized that these changes are mainly due to the after effects of the operational restrictions and regulations not to the toll differentials since the time between the first introduction of the time of day pricing program and 2002 is long enough for the users to make necessary shifts based on the toll differentials. Thus, the only way to explain month-to-month changes in elasticities in 2002 is to take into account the impact of the operational restrictions and regulations on the travel behavior of users. Based on this hypothesis, t-tests show that the operational restrictions and regulations still had an impact on weekday car traffic of Holland Tunnel and Lincoln Tunnel from May 2002 to August 2002. However on weekends, long term elasticity values change in a statistically significant manner on Goethals Bridge, GWB lower level, and GWB upper level from May 2002 to August 2002. For

all other crossing the increase in car elasticity values in the long term reached a stable trend. Besides, the operational restrictions and regulations still had an impact on weekday truck traffic of Bayonne Bridge from May 2002 to August 2002. For weekend traffic on the other hand, restrictions and regulations still had an impact only on Lincoln Tunnel from May 2002 to August 2002. For all other crossing the increase in truck elasticity values in the long term reached a stable trend.

Essentially, the ultimate goal of the analysis carried out in this chapter was to determine whether time of day pricing policy has been well accepted by the road users in terms of increased demand during the discount periods. As shown in Chapter II, during the first two years of the program there was a 7 percent increase in the number of patrons eligible for time of day pricing discounts, i.e., the number of E-ZPass users. Also, as shown Chapter II, the time when a large number of cash users started switching to E-ZPass coincides with the initiation of time of day pricing program. These could be partly attributable to the success of the value-pricing program implemented by PANYNJ. However, the fact that travelers might also be choosing E-ZPass to take advantage of shorter delays at the toll booths should not be overlooked. Exactly how much of the improvements in delay and traffic conditions are caused by E-ZPass usage or time of day pricing is not known since the total cost is a function of travel time (delay) and toll, and delay itself is a function of demand and capacity. Still, increased off-peak usage as evident by the results of this study can be considered as an important indicator of the success of the PANYNJ time of day pricing program.

CHAPTER IX

MEDIA AND DECISION-MAKERS’ REACTION

Introduction

The main objective of this chapter is to document the overall process followed by the Port Authority of New York and New Jersey (PANYNJ) to implement its time of day pricing initiative. As part of these analyses, the project team undertook a descriptive analysis of the decision-making process to gauge the acceptability of value pricing to opinion leaders and decision-makers before and after implementation of the new toll schedule. The project team relied on two primary sources of information: (1) interviews with the key stakeholders, opinion leaders, and decision-makers involved in the process; and, (2) a thorough review of media statements both prior to and immediately following implementation of the new toll schedule. At the time of the events described in this chapter, the term "value pricing" was used by the PANYNJ to refer to the new pricing schedule; thus, to maintain consistency with the written record, the project team decided to use "value pricing" instead of "time of day pricing" in the following discussion.

A Word about Successes and Failures and Objections Often Raised

Though there are still few examples of value pricing, a review of those that have succeeded (at least in terms of being implemented) and those that have failed, have generated some initial findings. First, in terms of the kinds of objections often raised, among the most common are the following:

- Privacy issues.
- Undue burdens on low-income individuals.
- Negative impact on business.
- Lack of return for most motorists, especially when revenues are not spent on the roadways. [87]

All of these objections were raised with respect to the PANYNJ's proposal, with particular emphasis on the last three bullet points. According to Gomez-Ibañez and Small, most of these objections are relatively easy to overcome; indeed, doing just that is critical since "winning political approval is the most serious obstacle to congestion pricing…." [87] In terms of privacy, for example, systems can be used that do not store certain types of data collected. With respect to undue burdens, many low-income individuals already utilize transit. Perhaps the most cogent objection is the lack of return for most motorists. Again, this appears to have been the longest-standing point of contention made by skeptics of the PANYNJ initiative as well. Reinvesting in the facilities is helpful but sometimes, as the authors point out, the monies generated are far more than are needed on the roadways themselves.

When gauging acceptability, Edward Sullivan identifies five attributes often shared by those projects successfully implemented in the United States. (88)

- Effective advertising and public relations.
- Emphasis of the benefits gained by travelers.
- Benefits were identified in simple, tangible terms and evidence of their existence was clear after implementation.
- Traveler participation optional.
- Strong proponents willing to overcome objections.

Failed projects, according to Sullivan, not only lack the attributes of the successful projects, but also often share some of their own common characteristics. Among them, the presence of influential adversaries, the perception that new pricing proposals are little more than schemes to extract additional revenues, the concern that promised benefits are unlikely to be realized, and concerns over the technology practicality of implementing the pricing plans. (88)

Interestingly, the PANYNJ initiative shares attributes both from the successes and failures. In terms of the former, the efficacy of the PANYNJ's advertising and public relations shows a mixed picture when looking at the media coverage and when speaking with stakeholders. The PANYNJ certainly "got the word out" but as will be shown in the section of In the News – Media Coverage, most of the coverage focused on the toll hikes rather than on the value pricing concept. Certainly, the PANYNJ was weak on the second bullet as evidenced by so many questions of "where's the value" in the value pricing plan. Similarly, with Sullivan's third attribute, several stakeholders are still asking to clearly see the benefits. (Admittedly, this may take time as the initiative has only been in place a little over two years, but it does speak to the need for greater public follow up in a more timely manner.) The PANYNJ initiative clearly fails on the fourth attribute since no new capacity was added and few alternatives are available. Indeed, from the beginning, this was not a goal of the PANYNJ plan. Instead, the value pricing component was wedded to the much needed toll hike as a way to take the first step in the direction of congestion management. Finally, on the fifth point that Sullivan makes, the PANYNJ's plan did have strong supporters, but also very strong opponents.

Admittedly, the PANYNJ plan was not a straightforward value pricing initiative as Sullivan's other examples; nevertheless, it is important to note that in terms of Sullivan's attributes of failed value pricing plans, the PANYNJ shared three of the four. Yet, it still managed to overcome these obstacles and implement its initiative. Why this is the case is not entirely clear but may be related to the that same fact – that this plan was explicitly packaged with a general toll increase and an E-ZPass incentive unlike other value pricing initiatives where the goal was purely on the pricing strategies.

As with many decisions in the public sector, the decision-making process leading up to the implementation of value pricing on the PANYNJ's facilities, had both an internal and an external dimension. The following pages outline the process that took shape and the dynamics that played out in terms of support for and opposition against the plan, both in its original form and the modified version eventually instituted.

The Internal Dynamics

According to Mark Muriello, Assistant Director of Policy and Business Programs at the PANYNJ's Tunnels, Bridges and Terminals Department, the PANYNJ had been looking at value pricing at least since the early 1990s. In fact, according to Jeffrey Zupan, an internal PANYNJ report had been produced as early as the late 1970s on differential prices by time of day. However, the report concluded that implementing such a system would be impractical and unsafe without a more streamlined means for collecting tolls.(11)

In 1993 the PANYNJ again revisited the concept of differential pricing based on time of day, going so far as to conduct behavioral analyses and stated-preference surveys. In 1994, the Caliper Corporation distributed surveys during a nine-day period on the six PANYNJ crossings. Information on origin and destination addresses, trip purpose and duration, plaza delay, vehicle occupancy, payment method, other facilities used, out of pocket costs, and the facility planned for the return trip was collected. A technical manual on auto pricing demand prepared for the PANYNJ by Caliper Corporation in 1995 detailed the results of the survey, providing the data relating to demand and operational impacts of changes to the tolling structure. (89) Thus, the PANYNJ's research preceded many applications of value pricing on roadways, but the results of that research were generally not disseminated beyond the agency, primarily because they wanted to focus first on deploying the necessary technology before taking any action on implementing value pricing. (90)

The impetus leading to the renewed interest in value pricing seven years later was financial necessity. Financial projections out to 2015 showed that the PANYNJ's "Interstate Transportation Network"[4] would be unable to ensure financial self-sufficiency even in the short-run without raising fares and tolls or dramatically cutting operations and maintenance expenses and capital investments. With no taxpayer and State subsidies, the PANYNJ was looking for new ways to sustain its capital program as a whole, while recognizing that some of its business generated positive net revenues (e.g., airports, the World Trade Center site (at the time), and the tunnels and bridges) and others operated at a loss (e.g. PATH, the seaport, and bus terminals).

Discussions about the financial situation of the PANYNJ had been taking place against the backdrop of ongoing policy disputes revolving around the share of expenditures in

[4] The Interstate Transportation Network includes: six tunnels and bridges; the PANYNJ bus terminal; the George Washington Bridge Bus Station; the Journal Square Transportation Center in Jersey City; PATH; and private ferry contributions.

each State and which was benefiting more. The resulting impasse was characterized as the worst stalemate in the agency's history even as key issues – including whether the PANYNJ should be in the real estate business (i.e. collecting rent from the World Trade Center site), whether it should continue to operate the New York City airports, and whether it should combine its airport and seaport businesses and think of them more as gateway areas – were in need of resolution. [(91)] Among these policy discussions, value pricing once again was raised, particularly after the 1997 deployment of E-ZPass on PANYNJ facilities (which made such a tolling schedule technologically possible) and the positive results from initiatives in other parts of the country, most notably Lee County, FL, and Interstate 15 in San Diego and State Route 91 in Orange County, CA.[5]

Given the bleak projections with respect to financial self sufficiency of the PANYNJ's Interstate Transportation Network, finding internal agreement on the need to raise fares and tolls was relatively simple, particularly when there had not been an increase in over a decade.[6] However, the key leadership at the PANYNJ preferred to institute straight increases without incorporating value pricing. (While the reason for their reluctance is unclear, it is likely that given the need to enhance revenues and a political climate in which this would be hard to achieve, the tendency was to lean toward the expeditious and not complicate matters with a new and potentially objectionable pricing scheme.) To gather support, the Tunnels and Bridges staff developed several analyses and policy dimensions demonstrating the long-term effects of both a straight fare increase and an increase incorporating value pricing, and found several internal champions for their cause. After three months of multiple rounds in which several different combinations of pricing and fare increases were modeled, the staff was able to demonstrate that a value pricing plan could be incorporated without detriment to expected revenues. They were able to obtain the final internal support necessary for implementation, at which point the external effort began.

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[5] Mr. Muriello noted that while these examples were pointed to, they did not offer solid models for the New York metropolitan region. Though a nationally recognized example, Lee County was a much smaller and less densely populated and utilized area and Southern California's plan instituted value pricing on expansion roadways rather than an already existing system.

[6] In 1991, the PANYNJ raised round-trip passenger car tolls on its bridges and tunnels to $4.00 from $3.00.

The Initial Plan [7]

The Tunnels and Bridges staff made a strong argument for the benefits of value pricing. They noted that the annual cost of congestion in the region was $10 billion and that peak volumes at key links throughout the system exceeded capacity leading to air quality concerns, decreased competitiveness, and continuously increased delays. The key objectives of instituting a value pricing policy, in addition to helping deal with the financial concerns noted above, were to:

- Encourage shifts in travel to off-peak periods to address peak-level congestion.
- Encourage increased use of mass transit where possible.
- Eliminate frequency-based toll discounts to support traffic management objectives (these had been eliminated on tunnels in 1991 but still remained on the bridges).
- Create pricing incentives targeted toward commercial traffic management.
- Establish toll rates that would be easy to implement and collect.
- Increase the E-ZPass market share.

Thus, the initiative included variable pricing based upon two factors: geography and time of day. With respect to geography, the plan distinguished among three key corridors of the Interstate Transportation Network: (1) the Southern Corridor, which included the Goethals and Bayonne Bridges as well as the Outerbridge Crossing; (2) the Midtown/Downtown Corridor, which included the Holland and Lincoln Tunnels; and, (3) the Northern Corridor, which included the George Washington Bridge. Each was different in terms of market characteristics, levels of congestion, and degrees of access to alternate routes or modes of transportation. As such, it made sense to the Tunnels and Bridges staff to target them differently in the value pricing initiative. In particular, facilities with the most limited capacity and the greatest number of transit options were targeted with the highest prices (e.g., the tunnels); tolls for the George Washington Bridge, which had some additional capacity but no transit options were a bit lower, and

[7] The overall budget plan also included an increase in the PATH fares. However, since this report focuses on the value pricing portion of the plan, only information pertaining to the toll increases will be described here.

the lowest tolls were indicated for the Staten Island links where there was a great deal of capacity but no alternate modes.

As it stood at the time, all facilities were tolled at the same rate with E-ZPass offering a 10 percent discount on all toll rates. Passenger cars were charged $4.00 cash per trip with a $0.40 discount to use E-ZPass. The toll for trucks was $4.00 per axle, with a similar discount so using E-ZPass resulted in a toll of $3.60 per axle. Buses were charged $3.00 cash and $2.70 if they used E-ZPass. There were several additional discounts, including a carpool program in which the E-ZPass toll was only $0.50 if three or more people were in the car; an “All Bridges Program” that reduced the toll to $3.00 per trip for 20 trips at all PANYNJ bridges in a 35-day period; and, recognizing that the options for travel to/from Staten Island are especially limited, a “Staten Island Bridges program” that decreased the toll to $2.00 per trip for 20 trips in a 35-day period over the Goethals and Bayonne Bridges and Outerbridge Crossing.

The new proposal put forth by the Tunnels and Bridges staff dramatically increased the cash toll for passenger cars and trucks at all facilities (from $4.00 per trip to $7.00 per trip for cars and the same increase per axle for trucks). Though the E-ZPass tolls were also significantly increased, deep discounts were provided in the off-peak periods for passenger cars, and during overnight hours for trucks (Table 99).

Table 99. The original proposal

Facility	Passenger Cars (1)			Trucks (per axle)			Buses	
	E-ZPass Off-Peak	E-ZPass Peak (2)	Cash	E-ZPass Overnight (3)	E-ZPass Daytime	Cash	E-ZPass All times	Cash
Lincoln & Holland Tunnels	$4.00	$6.00	$7.00	$4.00	$5.60	$7.00	$2.70	$3.00
G. Washington Bridge	$4.00	$5.50	$7.00	$4.00	$5.60	$7.00	$2.70	$3.00
Staten Island Bridges	$3.00	$4.50	$7.00	$4.00	$5.60	$7.00	$2.70	$3.00

Note: (1) The Carpool program provided an additional $1.00 discount on E-ZPass trips if three or more people were verified in the vehicle.

(2) Peak period is defined as Weekdays 6-9 AM and 4-7 PM, and Weekends 12 Noon–8 PM.

(3) Overnight is defined as weekdays from 12 Midnight– 6 AM.

(4) Source: The Port Authority of NY and NJ.

The External Dynamics

Once internal agreement had been reached, the next step moved the plan out into the public domain for comment. All stakeholders were identified, including business and industry groups, elected officials and community groups, transportation agencies, and other special interests. A series of individual meetings with key stakeholders were held prior to making the plan public. Once public, special attention was paid to reaching out to the media, including the editorial boards of key newspapers around the region, radio, and television stations. As Mr. Muriello explained, their philosophy at the time was that "a well-informed opponent is better than an ill-informed opponent." Several different modes of interaction were utilized, including distribution of materials, a web site, toll-free telephone information, direct mail, limited print advertising, in-lane materials, and toll plaza handouts, as well as public hearings[8] in New York and New Jersey.

In the News – Media Coverage [9]

A search on Lexis/Nexis and ProQuest, as well as on specific sites of major newspapers and magazines in the region resulted in 41 articles prior to the Board's approval of the PANYNJ's value pricing initiative and another 7 thereafter.[10] Another 16 articles were found on specific media web sites or, in some cases, copies were supplied by individuals from their organizations' files. Shorter articles which solely noted that an increase might occur or had occurred without further explanation are not included in this assessment, though there are at least as many of these as the longer discussion articles described here. In reviewing the media coverage, two aspects were focused upon in particular: (1) the apparent ability or inability of the PANYNJ to make clear the

[8] It is important to note here that the public hearings were not a statutory or regulatory requirement but reflected an agency policy to seek input from the public and stakeholders.

[9] Unfortunately, as a result of the events on September 11, 2001, much of the formal media documentation was lost. However, sufficient information existed in the form of news articles that ran in the newspapers and magazines.

[10] Search terms included "Port Authority of New York and New Jersey" and "value pricing" or "congestion pricing" or "tolls."

concept of value pricing, thus demonstrating effective use of the media; and, (2) the general tenor of the coverage and the support or opposition conveyed regarding the public participation process.

Media coverage of the PANYNJ's plan began to be seen in November 2000. Coverage was most comprehensive in *The New York Times*. An initial article by Randy Kennedy on November 16, 2000 described the proposal and provided a balanced overview but focused on the increase in tolls rather than on the use of value pricing. (92) A second article one day later, by Ronald Smothers, went a little further in describing some of the other goals of the plan, but again focused on the increases and financial ramifications for the PANYNJ, still not mentioning value pricing. (93) Articles in the *Daily News* were similar, though an editorial on November 17, 2000 made use of the term "congestion pricing," and an editorial in *New York Newsday* noted that "congestion pricing is worth a careful look." (94, 95)

The Star Ledger carried the most comprehensive discussion early on, describing how the PANYNJ assigned different pricing plans for each crossing, noting that the different price structures were related to the proximity of mass transit or alternate transportation means. This article also focused on the differences in pricing between E-ZPass users and cash users and pointed to the benefits being structured for trucks. (96) However, in an editorial that same day (November 11, 2000), the tenor was very different. "The Port Authority of New York and New Jersey should look up "reasonable" in the dictionary – because raising cash bridge and tunnel tolls 75 percent…doesn't fit the definition of the word," they wrote even as they noted that the overall plan deserved an "open-minded review." (97)

On November 18, 2000, an editorial in *The New York Times* expressed similar support for the "congestion pricing" plan, noting that "beyond its fairness, the plan's embrace of congestion pricing is most heartening. Transportation authorities can no longer ignore basic economics and price a vehicle's use of a regional asset…with no regard to demand for that asset when used." (98) However, an editorial in the November 19, 2000 edition of the *Bergen Record* was more critical, observing that while the plan was not "half-bad," it was "no excuse for a toll increase of 75 percent...." (99)

Within a week, the first Letter to the Editor appeared expressing opposition to the initiative. Written by John Corlett, Assistant Director of Government Affairs at the Auto Club of New York. Mr. Corlett noted in his letter that "The Port Authority of New York and New Jersey has not offered any study demonstrating that congestion pricing…will benefit commuters or reduce traffic congestion in Manhattan." (100) Two days later, an article in *New York Newsday* described the toll hike plan as "outrageous" and depicted the public process as one in which "the fix was in." (101)

Of particular note here is the lack of the appearance of the phrase "value pricing" in both the news articles and editorials. "Value pricing" was a term that had already been used quite extensively at that point to describe the earlier initiative by the New Jersey Turnpike Authority. It is also the expression the PANYNJ used in all of its early public statements and discussions. Less than eighteen months earlier, on June 29, 1999, an article appeared in *The Record* (Bergen County, NJ) describing the plan to introduce value pricing on the New Jersey Turnpike. The article provided a more in-depth discussion and description of value pricing than any of the early news articles covering the PANYNJ plan. The author described the benefits and the concerns related to value pricing and identified other initiatives around the country as well as the interest in such types of initiatives on the part of the Federal Highway Administration and other states and cities. (102) A follow up article on November 19, 1999 provided a much more positive spin on the headline than was the case with most of the coverage related to the PANYNJ plan. Again, the article stressed the value pricing concept and highlighted the discounts rather than the toll increases. The article further pointed out that "of all the components of the plan, value pricing may be the most controversial," pointing to the opposition by the trucking industry in particular. (103) Additional articles throughout December 1999 and September 2000 all made mention of the "value pricing" plan. (104)

Yet, only two months later, there was scant attention paid to the value pricing part of the PANYNJ's plan. Not only did the print media focus on the toll hikes, even when they mentioned price differentials they used different language from that of the PANYNJ. This leads one to wonder several questions related to the efficacy of the PANYNJ's advertising, educating, and public relations: (1) Why was there so little discussion of the value pricing component of the initiative and so much focus on the magnitude of the toll hikes? (2) Why, when the value pricing component was discussed, was the use of the phrase "value pricing" so inconsistent when it had been consistently used to describe the Turnpike initiative only a few months earlier?

When asked these two questions, Mr. Muriello agreed that the PANYNJ's message on value pricing and congestion relief was lost in the news media, though he felt that the PANYNJ was much more successful with the editorial boards. As to the second question, he suggested that the PANYNJ backed off the use of the term "value pricing" in the midst of discussions as various people expressed confusion over the phrase and "congestion pricing" seemed more readily understandable to those outside the transportation community. This may have resulted in the lack of consistency and to some degree clarity seen throughout the articles covering the plan. [(105)] Finally, one must consider that the value pricing initiative was implemented at the same time as a major toll hike, thus even though discounts were being offered, all prices were still higher than previously. As a result, this fact became the news, overshadowing the pricing initiative.

Almost one month passed before the next flurry of articles. On December 14, 2000, the phrase "value pricing" rather than "congestion pricing" was used for the first time in the print media when Lewis Eisenberg, Chairman of the PANYNJ, was quoted in an article that described the cash toll increases and mentioned that public hearings were being considered. [(106)] Articles in *The Record* and The Associated Press that same day also mentioned that public hearings were being considered and would be held in January 2001. Notably, while the *Times* article focused only on the cash toll increases, *The Record* and The Associated Press described the discounted tolls and the differences between the Corridors. [107, 108] After approval of the public hearings by the PANYNJ Board, *The New York Post*, *The Daily News*, and *The Record* all ran articles further describing the "congestion pricing" plan, with *The Post* emphasizing the cash toll increase of 75 percent, but also describing some of the projects under the capital plan that would benefit from the increase in funds. [109, 110, 111]

This last point relating back to the capital plan had been one of the key aspects of the approach used by the PANYNJ to convey the need for the initiative to the general public and other interested parties. The feeling was that if they placed the new value pricing plan within the context of the greater capital program that would benefit many people around the region, they would generate greater support for the initiative. It is unclear that this occurred. Certainly, in some cases – most notably the trucking industry – portraying the value pricing scheme in the broader framework of the capital program appears to have exacerbated skepticism.

In a *Journal of Commerce* article published on January 22, 2001, John Schulz described in detail the opposition of the trucking industry to the PANYNJ's plan. In particular, he wrote:

> "But truckers won't see the benefit of much of that money. The lion's share ($3 billion) will go to New York area airports…. Another $1.8 billion goes to port projects, including dredging to allow larger cargo ships, which tangentially helps truckers in that end of the business. About $1.6 billion would actually go to improving Hudson River crossings in and out of New York City…. The tolls increase would reinforce New York City's image among truckers as the most expensive place in the country to do business. " [112]

As the first public hearings approached, several articles focused on opposition to the PANYNJ plan, beginning with "Molinari Rips PA Proposal to Hike Tolls," which focused on the opposition by Staten Islanders to the abolition of the Staten Island Discount

Program.[11] (See reference 113) Others highlighted the support the plan was finding from transit advocates, business, labor, and environmental groups. In particular, an Associated Press article on January 11, 2001 noted the Tri-State Transportation Campaign's recommendation to support the PANYNJ plan. (114) A more detailed article in *The Record* on that same day described the plan with much more specificity than any prior news statements, though several in following days followed suit. (See references 115, 116, 117) However, in none of these articles did the phrase "value pricing" occur. Though mention was repeatedly made of how the plan would help decrease congestion, even the phrases "congestion pricing" and "variable pricing" were rarely used, the focus instead often on the "toll increases" or new "toll pricing."[12]

Coverage of the public hearings themselves was similar, the *Daily News* at least made mention of "congestion pricing though the headlines remained focused on the toll hikes, while *The New York Times* referred to the PANYNJ's "pricing plan." (See references 118, 119, 120) While both papers noted that supporters for the plan were present and briefly mentioned opposition to the plan, neither provided much more detail of the discussions. (Following the hearings, *The New York Times* continued to refer to the "proposed toll and fare increases," though it did mention "another goal" of "variable pricing," in its description of the modifications being considered as a result of the public debate. (121)) *The Star Ledger*, however, provided additional nuance, pointing out that while the trucking and automobile associations were the most vocal opponents (not to mention New York City's planning department), support was to be found among several regional planning and environmental groups as well as among some of the contractors and unions. (122) Moreover, an editorial in *The Star Ledger* on January 18, 2001 was particularly supportive, noting that "what initially seemed to be a case of picking the pockets of those who don't have much choice doesn't look all that unreasonable." Indeed, although suggesting a modification such as phasing in the highest toll increase, the editorial urged the two Governors to accept the proposal. (123) (A concurrent

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[11] Guy Molinari is a well-known political figure in New York City, having served as a Republican Congressman for District 14 (1981-1990) and Staten Island Borough President (1990-2001).

[12] The first time the phrase "variable pricing" was seen in the press coverage on the PANYNJ plan was in Smothers, "Hearings Put Port Authority's Toll Pan on the Line." See reference 116.

argument found in *The Star Ledger*'s editorial section that same day was that while toll increase on the bridges and tunnels were justified, simultaneous fare increases on the PATH were not. [124])

The Final Plan

Though mention was made from time to time in the print media of the internal political debate, on January 25, 2001 articles in *The New York Times* and *The Star Ledger* clearly noted then Governor Christie Whitman's opposition to the "increases in tolls and PATH rail fares" as proposed by the PANYNJ staff, stating that they were "much too high." [125, 126] However, the next day's news articles focused primarily on the Board vote (10-1-1) and the changes made to the "congestion pricing" plan (Table 100), with only brief mention in the *Daily News* about the internal difficulties in getting the Board to approve the plan. [See references 127, 128, 129] Further, even though the changes to the plan were described, again the focus was on the degree of the toll hikes, not on the other changes made, like doing away with the differentials according to corridor.

Table 100. The final proposal

Passenger Cars [1]			Trucks (per axle)				Buses	
E-ZPass		Cash	E-ZPass			Cash	E-ZPass	Cash
Peak [2]	Off-Peak		Peak	Off-Peak	Overnight [3]			
$5.00	$4.00	$6.00	$6.00	$5.00	$3.50	$6.00	$2.70	$3.00
$5.00	$4.00	$6.00	$6.00	$5.00	$3.50	$6.00	$2.70	$3.00

Note: (1) The Carpool program provided an additional $1.00 discount on E-ZPass trips if three or more people were verified in the vehicle.

(2) Peak period is defined as Weekdays 6-9 AM and 4-7 PM, and Weekends 12 Noon – 8 PM.

(3) Overnight is defined as weekdays from 12 Midnight– 6 AM.

(4) Source: The Port Authority of NY and NJ.

Articles over the next few weeks focused on the critics' point of view. One article in *The New York Times* described earlier critics and proponents as both unhappy with the outcome, noting that "those who vehemently opposed the original plan to raise cash tolls…were not mollified by the lesser increase to $6.00." and that "those who supported the original plan…were skeptical that the lesser discounts in the approved plan would be enough to decrease congestion or alter driver behavior." [130] Several articles described the public and interested parties as not feeling there was a true open process; for example, Steve Carellas, Executive Director of the New Jersey Motorist Association, was quoted as saying "You could see this whole process being set up to ram this down our throats" [130] and Gail Toth, Executive Director of the New Jersey Motor Truck Association noted that her constituency was "extraordinarily upset" and felt like "a safe that doesn't have a bottom to these people." [131] An article in *Car and Travel*'s February 2001 issue noted,

> "While motorists are not opposed to paying their fair share, PANYNJ tolls exceed the expenses necessary to maintain bridges and tunnels. It is bad enough that few of the projects will benefit motorists who pay for them, but this time the PANYNJ adds insult to injury by parading its toll hike as some grand scheme to ease traffic congestion." [132]

The new toll schedule was implemented on March 25, 2001. Three days prior to this, the *Tri-State Transportation Campaign* (TTC), an early advocate for value pricing in the New York metropolitan region, released a press statement commending the PANYNJ for its initiative. Janine Bauer, Executive Director of the TTC predicted that "other metropolitan toll agencies won't be able to ignore the success of the PANYNJ in moving traffic better and faster with value pricing." [133]

Very few articles were published immediately thereafter. Those that were tended to focus on the effect the new pricing scheme was having on traffic. For example, on March 26, 2001 and March 27, 2001, articles in *The New York Times*, *The Journal News*, and *The Star Ledger* all noted that traffic was moving smoothly at the George Washington and the Tappan Zee bridges as well as at the tunnels, and that there was no increased flow to the latter as many skeptics had predicted. [See references 134, 135, 136, 137] Beyond that, little more was said until mid-late 2002 when another flurry of articles appeared making mention of the PANYNJ initiative as a backdrop to discussions over the tolling of New York City's East River crossings.

Selected Stakeholders' Perspectives

Information on stakeholders' perspectives was gathered through a series of one-on-one interviews with representatives of several organizations which were particularly vocal in their opposition or support for the plan. Interviewees were asked to respond to questions both on the substance of the original plan and modified version as well as on the public process and their perceptions of it.

The Motor Truck Associations

Among the opposition, the New Jersey and New York State Motor Truck Associations were particularly critical of the new pricing initiative. Founded in 1914 as a non-profit trade association, the New Jersey Motor Truck Association (NJMTA) has over 1,000 members. Most are family-owned and operate truck fleets of less than 10 vehicles, though NJMTA also represents several large corporate carriers as well. The New York State Motor Truck Association (NYSMTA) was founded in 1932 and also has over 1,000 members.

In a phone interview on March 4, 2003, Gail E. Toth, Executive Director of the New Jersey Motor Truck Association, highlighted the key concerns of her Association at the time the initial plan was unveiled and more recently. The truckers, according to Ms. Toth, saw no incentives in the initial plan. Instead, they viewed the initiative as an "enforced pricing mechanism" on an industry that does not control its hours since it needs to deliver goods when the recipients want them. Further, placing the increase in tolls within an overall capital program was perceived as paying for someone else to benefit (and, in some cases, competing industries) while the facilities used by truckers continued to be under-maintained. Finally, Ms. Toth noted that for the trucking industry there appeared to be no "value" in the value pricing plan. She mentioned that there had been some discussion about express lanes for trucks, which would have added such value, but that no such lanes materialized once the plan was put in place.

As to the process, Ms. Toth was skeptical. "It didn't seem to matter if we went to the meetings and voiced our opinions," she noted. In fact, she characterized the process as unfair and one in which the trucking industry felt “extraordinarily frustrated.” With respect to any changes that may have occurred, Ms. Toth believes that trucking habits have not changed except that many companies are sending smaller trucks rather than larger trucks because it is cheaper for them to do so. The result is presumably more congestion and pollution.

Ms. Toth was quick to point out that the Port Authority of New York and New Jersey is not the only Authority with which the trucking industry has been unhappy from time to time. There are many examples of Authorities around the country waiting years and then implementing large toll increases, making it difficult to fit into budgets. There are also many examples of Authorities not utilizing the tolls paid on the facilities where they are collected. However, she noted that there are some examples of better planning and maintenance, and she pointed to the New Jersey Turnpike Authority as one.

When asked as to what would have made the value pricing initiative more palatable to her organization and its members, Ms. Toth responded that better consideration and understanding is needed in terms of the critical nature of the goods movement. Value pricing in itself is not a bad concept – it should not, however, be forced upon industries that do not control their own behaviors and do not have many alternative routes.

In a phone interview on April 4, 2003, Mr. William Joyce, Executive Director of NYSMTA, echoed Ms. Toth’s concerns regarding both the substance and the process of the PANYNJ’s initiative. He noted that the PANYNJ approached NYSMTA early on in the process, but that his perception was the plan was already a “done deal.” Among the concerns that were somewhat different than others voiced, Mr. Joyce suggested that the plan’s focus was too heavily centered on New York City as a termination point rather than a “pass through.” (This was of importance to NYSMTA since many of its members serve upstate New York and bordering states, passing through New York City rather than stopping there.) As a result, there was not enough effort given to coordinating other value pricing initiatives to make sense for the trucks moving through the region (e.g. the NJ Turnpike and New York City’s congestion pricing initiative for commercial parking).

Mr. Joyce emphasized that “congestion pricing is not incompatible with trucking.” However, with respect to the specific plan posed by the PANYNJ, NYSMTA expressed interest in having a post-pay alternative with a volume discount, similar to what exists on the New York State Thruway and the Pennsylvania Turnpike. Such systems can benefit smaller truck companies who can benefit from deeper discounts when their volume is aggregated.

Both Ms. Toth and Mr. Joyce were unhappy with follow up after the plan was implemented, each noting that there was no immediate follow up nor was there any continued discussion of how to improve the new system. (According to the PANYNJ, the lack of follow up is in part related to the events of September 11, 2001. Having lost their headquarters and key documentation, as well as colleagues, the PANYNJ was focused on dealing with emergency operations and introducing appropriate security measures and was unable to revisit a number of issues at the time.)

Automobile Club of New York, Inc.

The Automobile Club of New York, Inc. is the New York Club of the American Automobile Association (AAA). The Club, which helped form the AAA, has been in existence since 1902, and currently has 1.2 million members throughout a 14-county region that includes New York City, Nassau and Suffok Counties on Long Island, and Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster, and Westchester Counties.

Mark J. Kulewicz, Director of Traffic Engineering and Safety Services of the American Automobile Association, Automobile Club of New York, Inc. (ACNY), and Mr. John Corlett, Assistant Director of Governmental Affairs, shared their institution’s perspective in separate interviews. The ACNY was opposed to the PANYNJ’s plan on two grounds – the magnitude of the proposed toll increases and the congestion pricing plan. In terms of the former, Mr. Corlett had noted in his testimony at the public hearing in Staten Island that “the scale of the Authority’s toll increases is unprecedented” and that “motorists should not be asked to bear the burden of paying for the Authority’s ambitious capital plans.” [138]

With respect to the latter, in an interview on March 5, 2003, Mr. Kulewicz explained that ACNY's basic concern with congestion pricing was with implementing it *here* in the New York metropolitan region, not with the concept itself. According to Mr. Kulewicz, ACNY does not believe congestion pricing will result in reduced overcrowding in this region for the following five reasons:

1. There is so much latent demand for highway space that if some travelers change their behavior, there are many others to fill the space.
2. Rush hours in the region are already 3-4 hours long so asking travelers to further delay or divert is unlikely to be successful.
3. This region already has tolls that are much higher than the rest of the country and it has not yet helped with congestion.
4. All the alternate routes are already overcrowded, so diverting does not help to reduce overall congestion in the region.
5. Trying to move travelers to transit is unrealistic for two reasons:
    a. Existing transit lines in the region are already at or over capacity.
    b. Many areas in the region are not well served by transit.

As a result, the ACNY views congestion pricing plans in this region as little more than toll hikes. Indeed, in a phone interview on June 18, 2003, Mr. Corlett likened the PANYNJ's value pricing plan to a "marketing pitch."

Like the trucking industry, ACNY shared the concern that the increased toll revenues would not be spent on the facilities generating them, though Mr. Kulewicz did point out that, however unlikely in terms of it coming to pass, the ACNY liked the PANYNJ's plan to add the second Goethals Bridge crossing. He also mentioned that the ACNY was sympathetic to road-related projects that would help other modes (e.g. roads leading to/from the airports) since they at least provided direct or indirect benefits to motorists, even if elsewhere in the region.

With respect to the process, Mr. Kulewicz shared that ACNY believed the toll hike was a given, regardless of the public hearings and discussions, so their strategy was to mitigate the impact of the increases and at least make their position known. He did not believe that ACNY specifically influenced the PANYNJ; indeed he noted that “the motorists’ voice is undervalued in the stakeholder process,” and that even with over 100,000 motorists in the region, they are not given the weight of other stakeholders who present “exaggerated negative impacts” of motor vehicles. Thus, while the process was acceptable on procedural terms, he believed that substantively it was flawed since stakeholders were given different weights of importance. However, Mr. Kulewicz did believe that incremental adjustments were made on the basis of feedback from a variety of sources.

Asked whether anything could have been done to make the PANYNJ plan more palatable for the ACNY, Mr. Kulewicz suggested that plans demonstrating more value for the additional revenues would have been welcomed (e.g. new lanes or new uses of current lanes). Mr. Corlett noted that the PANYNJ showed the ACNY several plans for road improvements, but it remains unclear as to whether these will occur. ACNY’s position continues to be that, as the toll schedule is currently structured, motorists are paying more for the same levels of traffic with virtually no road improvements. Looking forward, Mr. Kulewicz shared ACNY’s ongoing concern that Sundays still have a peak period associated with them. He also mentioned that the ACNY will be watching closely to see which highway projects, if any, move ahead within the capital program that the value pricing plan is financing.

Mr. Kulewicz concluded by noting that the ACNY respects the PANYNJ and the two institutions do not have an adversarial relationship although Mr. Corlett conceded that they have been involved in litigation before. Nevertheless, on many projects the two institutions have agreed and the ACNY has been supportive of several PANYNJ initiatives. On a final note, Mr. Corlett echoed the statements made by the Motor Truck Associations regarding the lack of follow up and continued dialogue.

Regional Plan Association

Founded in 1922, the Regional Plan Association (RPA) recommends policy initiatives and physical and human infrastructure investments in the 31-county New York-New Jersey-Connecticut metropolitan area. RPA's First Plan (1929) provided the blueprint for the transportation and open space networks in the New York metropolitan region, while its Second Plan (1968) was instrumental in restoring the region's deteriorated mass transit system.

Mr. Jeffrey Zupan, Senior Fellow for Transportation at the RPA shared his thoughts and perceptions of the PANYNJ's initiative during an interview on July 22, 2003. The RPA has been a long-time supporter of the concept of value pricing and avidly endorsed the PANYNJ's plan. He described the original plan as "very well conceived." Mr. Zupan believed that the final proposal was also very good and that, in fact, the revisions relating to commercial traffic fares were particularly good. However, he was quick to point out that by reducing the price differentials and by moving away from the geographic differentials, "Governor Whitman emasculated the proposal."

With respect to the process, Mr. Zupan found no fault with it. He personally testified at several of the public hearings held around the region, asserting in his testimony that the proposed toll increases were "consistent with sound transportation policy, and are necessary if we are to create the transportation capacity that the region will need to grow in the years and the decades to come." [(139)]

Tri-State Transportation Campaign

The Tri-State Transportation Campaign (TTC) is an alliance of public interest, transit advocacy, planning and environmental organizations working to reverse deepening automobile dependence and sprawl development in the New York/New Jersey/Connecticut metropolitan region. Like the RPA, the TTC was a strong advocate for the PANYNJ's value pricing initiative. During a phone interview on August 14, 2003, John Orcutt, Associate Director of the TTC, explained that the PANYNJ's effort is "the most aggressive congestion pricing plan in the country." Mr. Orcutt characterized the initial proposal as “very intelligent from variety of points of view – especially the differences in pricing for different crossings.” In fact, he noted that although it is the most interesting case in the country – in terms of the number of people it affects, the size of the region, and the severity of the congestion problems – the PANYNJ’s initiative is often neglected in discussions on this topic.

According to Mr. Orcutt, the implementation of this plan is seen as a tremendous victory for the TTC as well, which has made value pricing one of its key agenda items. Indeed, he believes that the successful application of value pricing on PANYNJ facilities is likely to provide leverage to institute value pricing on other facilities in the region, most notably New York City’s East River crossings.

With respect to process, Mr. Orcutt also testified at the public hearings. He explained that the PANYNJ involved the TTC early on in the process and that they were made aware of the proposal several weeks prior to the formal announcement. He admitted that the public hearing process was basically *pro forma*, but suggested that the broader process, including speaking with the editorial boards of key media, was particularly helpful to generating support.

Finally, when asked if anything could be done differently, Mr. Orcutt suggested that for value pricing to truly work (i.e. change behavior), motorists need to be aware of what they are saving. The TTC would like to see more mechanisms for doing this – for example, having the sign at the toll gate light up with “You just saved $2.00” instead of “Go” or including wording to this effect on customers’ E-ZPass quarterly statements.

Summary

Several points can be discerned from this review. First, while internal discussions over the PANYNJ's initiative revolved around how best to include value pricing in a decisive financing plan, the external debate was much more heated with respect to the magnitude of the toll increases than on the possibility of value pricing. In fact, much of the congestion mitigation planning was lost in the media attention. Second, and related to the first point, several interviewees and many of the press articles expressed dissatisfaction with the magnitude of those toll hikes. This would seem to suggest that if such increases were better planned so they could be put in place incrementally over time, there might be less opposition. Third, it is clear from the stakeholder statements that both proponents and opponents of the PANYNJ initiative would like to see additional actions taken. From the point of view of those organizations more skeptical, results of whether the new toll schedule has helped change behavior in positive ways will be important. Further, ongoing dialogue related to the question of "where's the value" will be important. In terms of the points made by the TTC regarding behavior, they were well taken. If one wants behavior to change, travelers need to see that they are saving or spending more money on tolls at different times during the day. Finally, while the PANYNJ succeeded in implementing its proposal, results are critical and must be clearly placed in the context of what the PANYNJ had hoped to achieve. Though the goals were marginal (i.e. the first steps rather than an entire overhaul of the system), many of the organizations that opposed the plan still do not support it and would be likely to oppose other value pricing initiatives in the region without some clear data demonstrating that it has had a positive effect.

Conclusions

The perspective of the PANYNJ is that they truly listened at the public hearings and smaller meetings that were held with the various stakeholders and that they changed the proposal based on what they heard. Among the concerns noted:

- Size of the increase in toll. This was voiced primarily by passenger car customers and advocacy groups, the trucking industry, and elected officials.
- Effect that shifting the toll schedule on PANYNJ facilities would have on other bridges and their surrounding communities, in particular the Tappan Zee Bridge. This concern was expressed primarily by other toll agencies and the local communities in Westchester and Rockland Counties.
- Lack of sufficient incentives for the trucking industry, in particular the lack of incentives for mid-day deliveries and the lack of a post-paid toll program similar to that on the NYS Thruway.

These concerns were addressed by reducing the magnitude of the increase on all forms of toll, offering trucks an additional discount during midday hours, speaking with the NYS Thruway Authority and Rockland and Westchester Counties, reinstating a modified Staten Island Bridge Program,[13] and eliminating the different Corridor charges. This last point, according to Mr. Muriello, was felt to be a significant loss in terms of where the PANYNJ was trying to take the initiative. Once the final proposal was vetted with the public and opinion leaders, it was taken to the PANYNJ's Board for approval. Several additional options were requested by the Board (e.g. a $5.50 cash toll instead of $6.00) and the Tunnels and Bridges staff presented several different options, with the final proposal being described as part of a larger plan that provided the "best balance between mobility, finance, and operations."

[13] The Staten Island Bridge Program was reinstated, but at $50.00 for 20 E-ZPass trips during a 35-day period at the Goethals and Bayonne Bridges and Outerbridge Crossing.

Results and Lessons Learned

According to Mr. Muriello, the time of day pricing initiative and the process leading up to its implementation was successful in several ways. First, and most notably perhaps, in trying to make incentives more powerful, the process helped increase coordination of efforts among a number of agencies throughout the region. Second, initial data demonstrated at least some shift from peak to off-peak periods. (A more in-depth assessment of the plan's success in shifting behavior both in terms of travel time and use of E-ZPass is provided in Chapters II through VII of this report.)

However, in other ways, the results appear to have been more mixed. E-ZPass penetration, for example, is still not as high as the PANYNJ would like to see. Overall, according to Mark Muriello, E-ZPass market penetration is roughly 67 percent, though it can be as high as 80 percent on certain facilities at certain times of day. With respect to the political acceptability of the plan, and long-term thoughts, Mr. Muriello shared that this initiative was "like taking the first baby steps toward something much different." Moving forward, he would like to see more ways to add value to various stakeholders. One way might be to work with other agencies to establish priority treatment at the approaches to the PANYNJ's facilities. Another way might be with creative use of existing lanes at different time periods throughout the day. (140)

With respect to lessons learned, Mr. Muriello shared several from the perspective of the PANYNJ:

- Obtaining the political support of key leaders within the organization and at the State level was critical. The New Jersey Department of Transportation leadership, for example, was effective in communicating the new toll plan and its alternatives to the Governor's Office.
- Education of the media and the public was important. This helped to generate an open and public debate so nobody was surprised when the final plan was implemented.

- Integration of stakeholders at the beginning and during the process is key. By having a process where stakeholders were involved early on and discussions were held throughout the debate, plans could be modified and language could be changed as needed to gain additional support.

Additional Lessons Learned from the Broader Perspective Taken in This Chapter Are As Follows:

- Consistency in language and goals is important. As Mr. Muriello conceded, much of the value pricing concept was lost in the print news media as they focused on the toll hikes alone. Then, possibly because the PANYNJ began to change its own language, there was additional lack of consistency when referring to the plan.
- Ongoing discussion and follow up is important. Several people noted their surprise that it had taken so long for any type of follow up on the new toll scheme. For the groups that had opposed the plan, this has translated into ongoing distrust that any of their concerns will be eventually integrated as the PANYNJ moves ahead.
- Finding value is still important. Because opposition remains to the plan, any modifications of the initiative may meet with resistance. One way to move beyond this is to look for effective ways of adding value for both commercial and passenger traffic.

Applicability for Gauging Acceptability of Other Value Pricing Initiatives

The purpose of this chapter was to gauge the acceptability of value pricing to opinion leaders and decision-makers before and after implementation of the new toll schedule. An initial assessment is that thus far those who were supportive of value pricing have remained so and those who opposed value pricing in this region have not changed their stance. Thus, additional attempts at value pricing in this region are likely to meet with similar resistance. However, this statement is tempered by the fact that the ability of the PANYNJ to implement the new toll schedule is likely to add leverage to other attempts, especially if the data demonstrate a positive impact.

As to gauging acceptability of value pricing initiatives outside this region, the PANYNJ example cannot easily be extrapolated. In different regions where value pricing is introduced, the politics, economics, and social framework are different. Further, the way value pricing is accomplished can vary from place to place. What likely made the California projects more acceptable, for example, was the existence of non-tolled alternatives as well as the added capacity or opening up of previous unutilized capacity, something that did not exist with the PANYNJ example.

CHAPTER X

PASSENGERS' AND CARRIERS' OPINIONS ABOUT THE TIME OF DAY PRICING INITIATIVE

Introduction

The main objective of this chapter is to assess the users' opinions about various aspects pertaining to the time of day pricing initiative. The analyses are based on a set of questions that were included in the corresponding surveys to capture users' opinions. As done before, the original responses in the public opinion sections were expanded so that they represent the behavior of the entire set of trips (rather than individuals) made by the interviewed passengers and carriers. This was accomplished by using the trip frequencies reported by the passengers and carriers as expansion factors for the individual observations. Therefore, the following findings represent results that are weighted based on the usage of toll facilities instead of the individual responses.

Passengers' Opinions

The passenger survey collected 505 complete observations, among which 392 respondents (77.6 percent) reside in New Jersey while 113 respondents are in New York, specifically in Staten Island (22.4 percent). The corresponding weighted responses are 4294 for the entire sample, which includes 3297 for New York users, and 997 for Staten Island users. All of these respondents were asked the public opinion questions. The data provide insight into their opinions about different toll related issues:

- The perceived impact of the time of day pricing on traffic.
- The inherent fairness of the time of day pricing, discounts for frequent users, and use of toll revenues to finance public transit, and,
- Willingness to pay more for better services.

Perceived Impact of the Time of Day Pricing on Traffic

The survey asked those who have used the PANYNJ toll facilities over three years and could recall when time of day pricing took effect (2462 weighted responses), if they think the toll increase had any effect on traffic across the Hudson River bridges and tunnels or not. Only a very small proportion of respondents (15.2 percent) reported that they thought the time of day pricing had an effect on traffic. Moreover, among those who indicated that the time of day pricing initiative had an impact on traffic, little less than half (44.0 percent) thought the traffic is now a lot worse, which accounts for 6.7 percent of the valid responses (Figure 68).

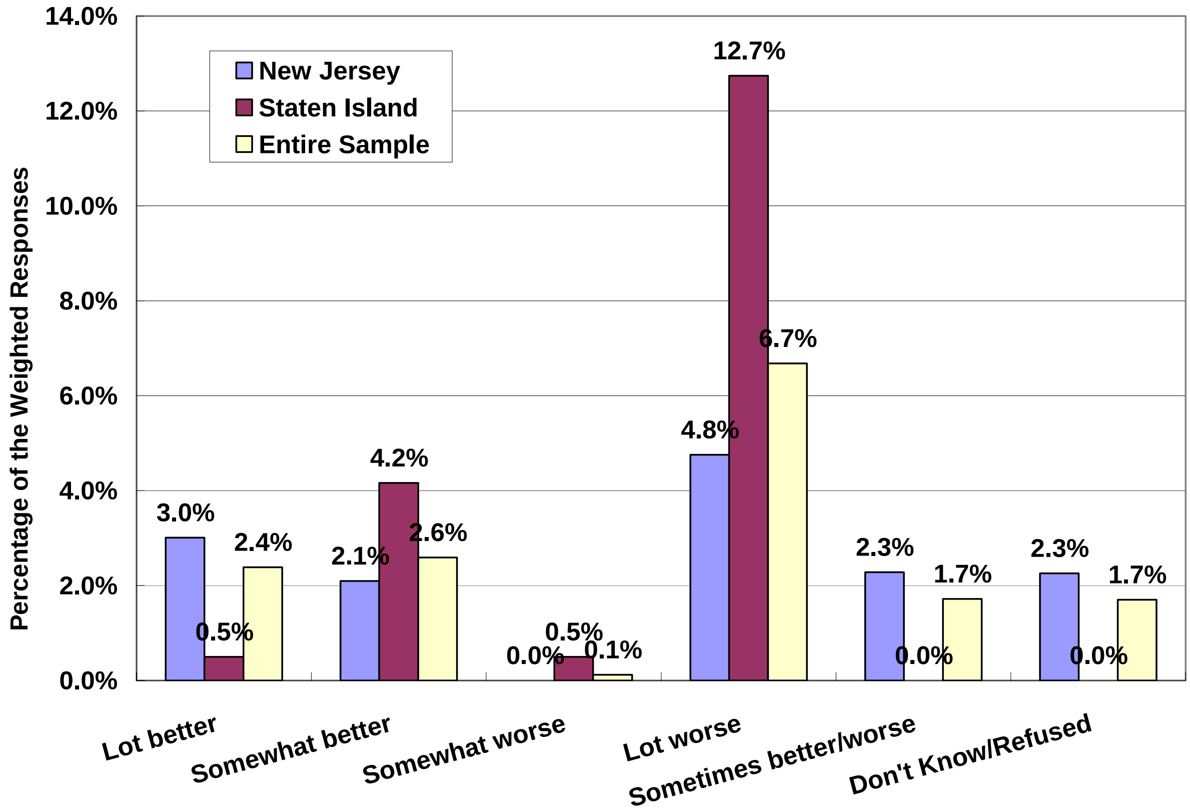

Figure 68. Perceived impact on traffic

<u>About the Perceived Fairness of the Time of Day Pricing</u>

Three questions were included to gauge passengers' opinions about the fairness of the time of day pricing: is it fair to give discounts to E-ZPass passenger users?, is it a good idea to vary toll rates during different time of day to help improve traffic congestion?, and is it fair to charge higher bridge and tunnel tolls during peak travel periods?

Figure 69 through Figure 71 show the breakdown of trip based weighted responses. The vast majority of respondents (84.6 percent) either strongly agreed (67.6 percent) or somewhat agreed (17.0 percent) that it would be fair to give discounts to E-ZPass users (Figure 69). This is consistent with the high usage of E-ZPass among the sample: 78.3 percent of respondents are E-ZPass users. Meanwhile, given that cash users cannot take advantage of toll discounts, it is interesting to find that almost two-thirds of cash users (65.7 percent) also approve this notion, which indicates passengers' acceptance of a key feature of the time of day pricing program, e.g., the toll discounts provided to E-ZPass users.

When asked if it is a good idea to vary toll rates during different time of day to help improve traffic congestion (Figure 70), a significant number of respondents strongly agreed (38.3 percent) or somewhat agreed (20.4 percent). However, when the idea of "charging more" was included in the statement, i.e., is it fair to charge higher bridge and tunnel tolls during peak travel periods?, only 26.4 percent of respondents strongly agreed (13.2 percent) or somewhat agreed (13.2 percent); while more than half of them (54.4 percent) strongly disagreed with it (Figure 71). This contradiction may be caused by the different wording used in the two questions, since most respondents do not like words such as "charge higher" or "higher tolls".

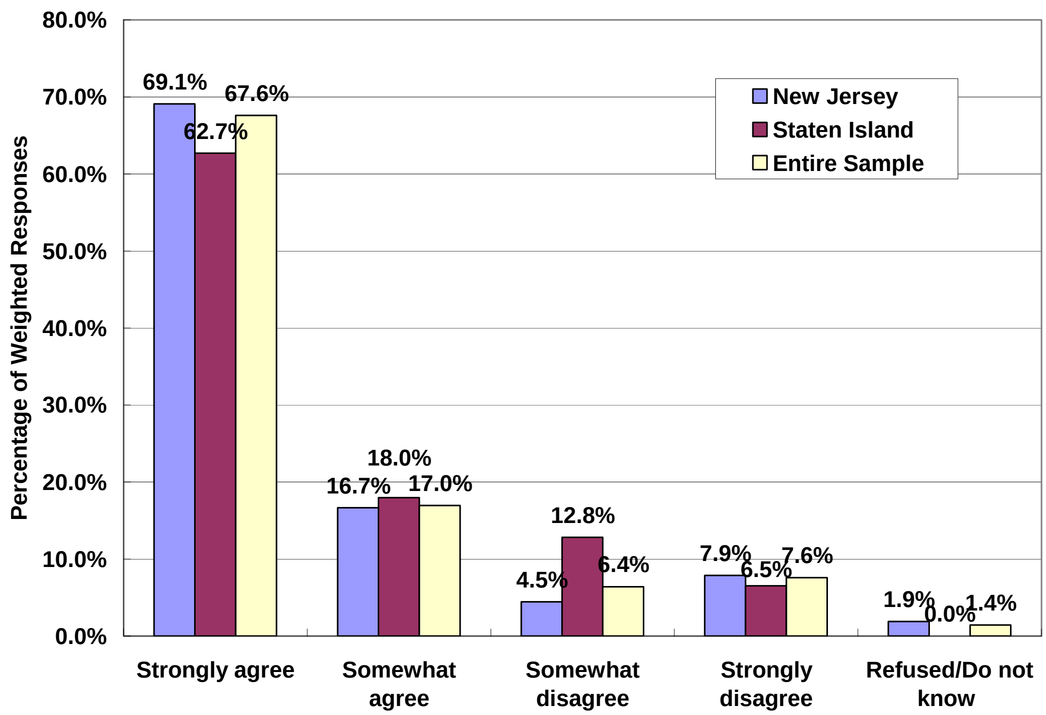

Figure 69. Is it fair to give discounts to E-ZPass users?

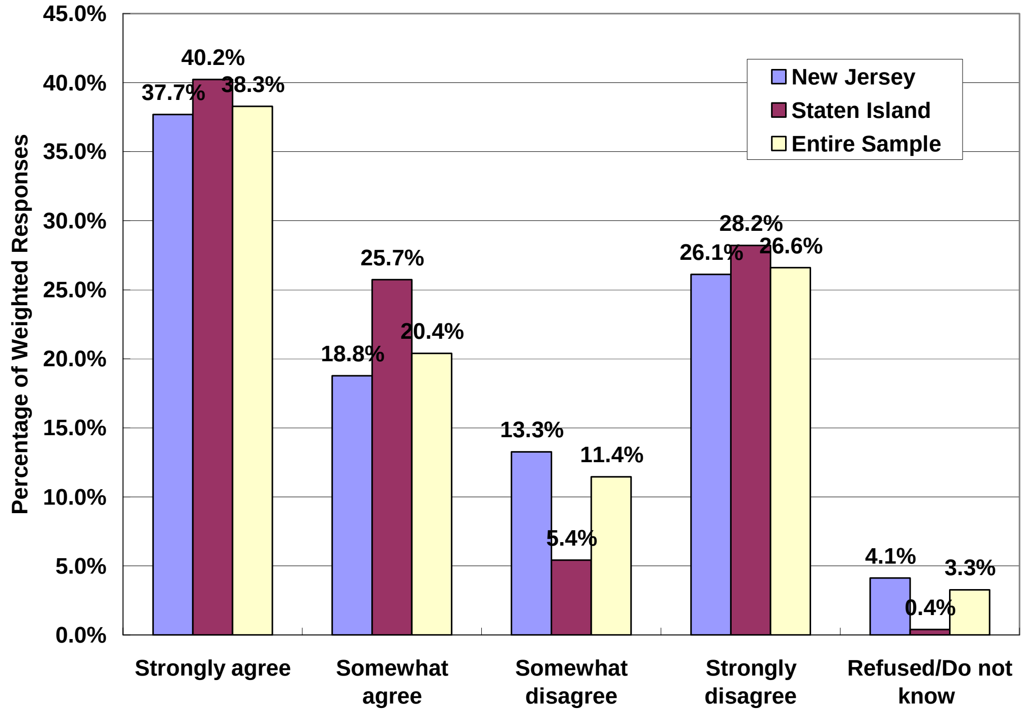

Figure 70. Is it fair to vary toll rates during different time of day?

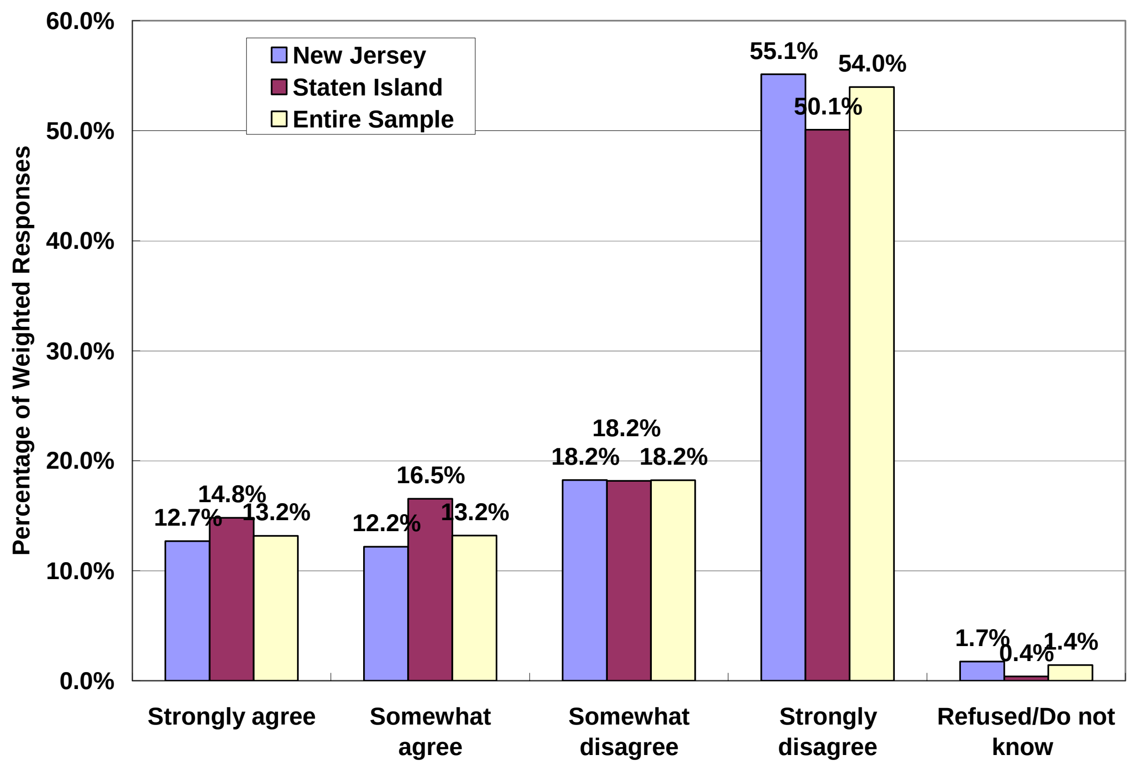

Figure 71. Is it fair to charge higher tolls during peak hours?

About the Fairness of Providing Discounts for Frequent Users

Respondents were also asked whether or not it is fair to provide discounts to frequent users traveling during the peak hours (Figure 72). The majority of respondents strongly agreed (61.7 percent) or somewhat agreed (20.7 percent). This could be explained by the fact that approximately 54 percent of current regular users travel through the toll facilities during peak hours, and therefore they may be the direct beneficiaries. Meanwhile, as noted earlier, this may also be due to the strong willingness to accept any kind of discounts.

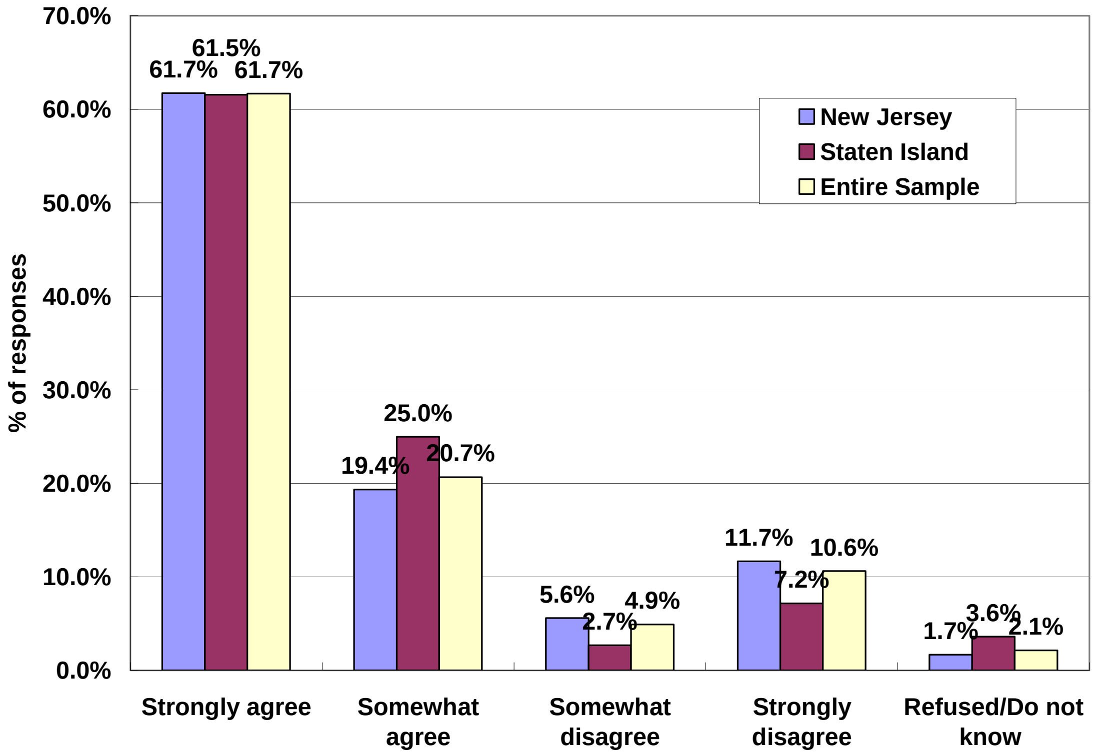

Figure 72. Is it fair to give discounts to peak-hour frequent commuters?

About the Fairness of Using Toll Revenues to Support Public Transit

In general, respondents indicated it is fair to use the toll revenues to support public transit (Figure 73). Almost two-thirds of respondents strongly agreed (36.6 percent) or somewhat agreed (28.1 percent) with the opinion that bridge and tunnel toll revenues should be used to support public transit. The responses vary by geography. The proportion of Staten Island respondents who strongly disagreed (26.8 percent) is relatively higher than the one of New Jersey respondents (19.7 percent). These differences may be induced by Staten Island users' strong dependence on cars. Nevertheless, the majority of Staten Island residents surveyed (64.1 percent) still approved the notion.

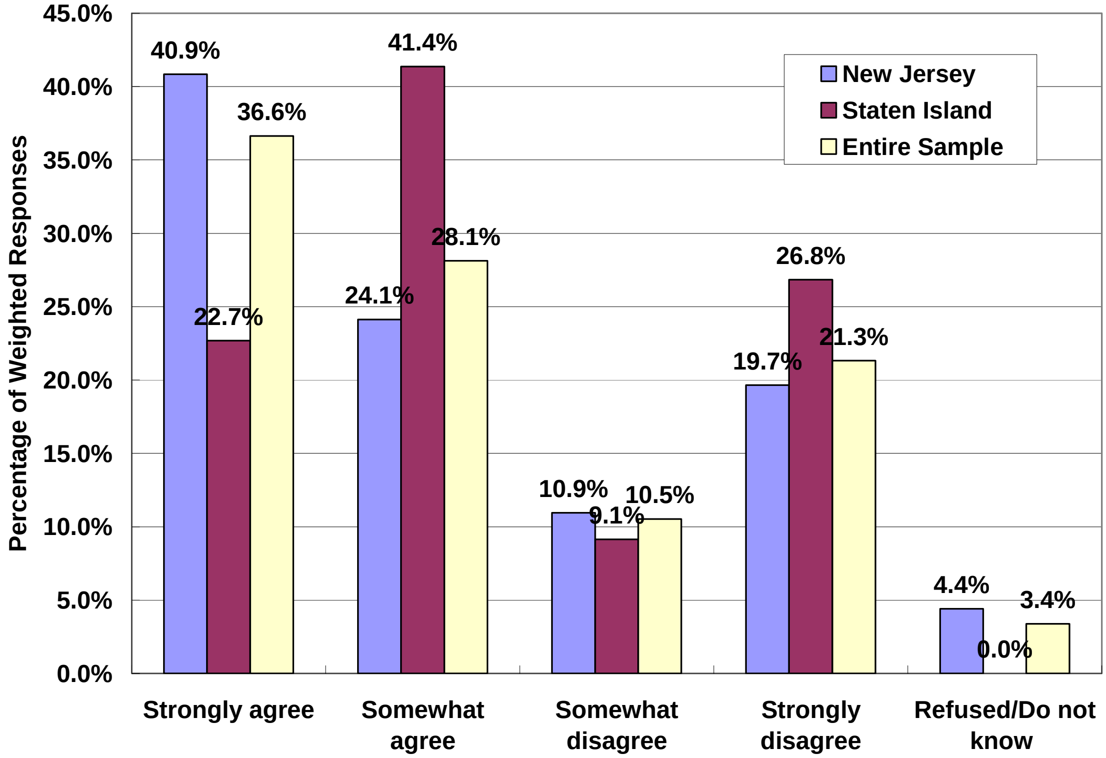

Figure 73. Is it fair to use toll revenues to support public transit?

Willingness to Pay More for Better Services

As shown by Figure 74 and Figure 75, 42.2 percent of respondents are willing to pay more for a faster trip and 36.8 percent of respondents said they would pay more for for a more reliable trip. A notable portion of respondents is willing to pay a higher toll for improved services.

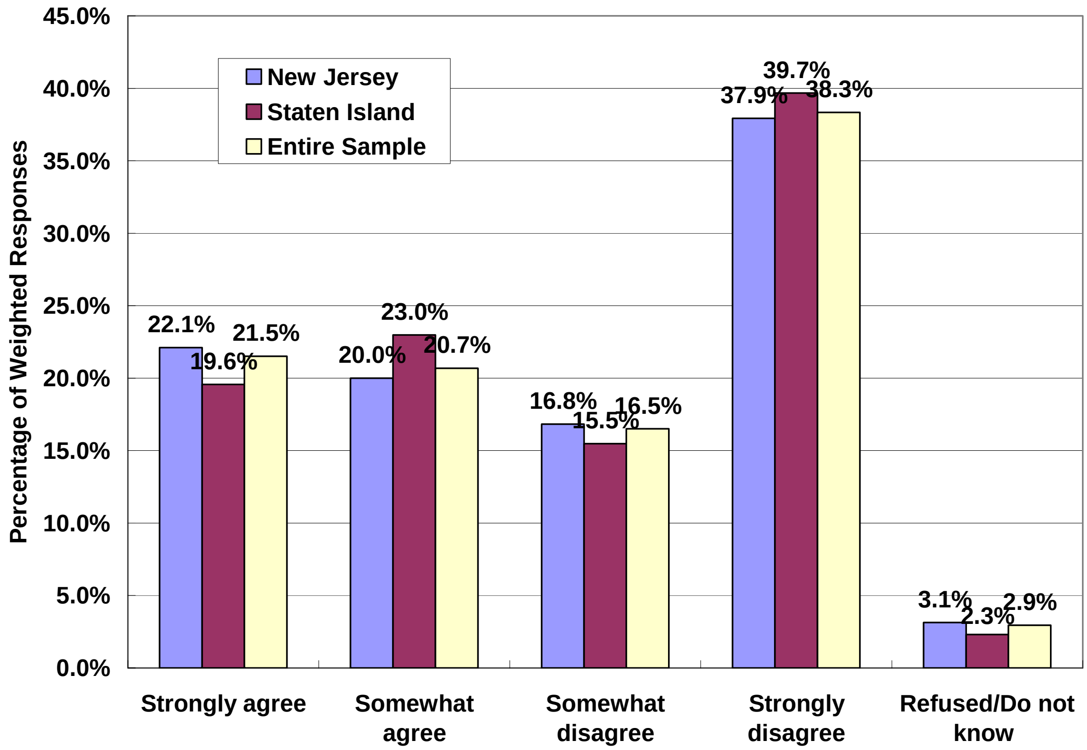

Figure 74. Would you be willing to pay a higher toll for a faster trip?

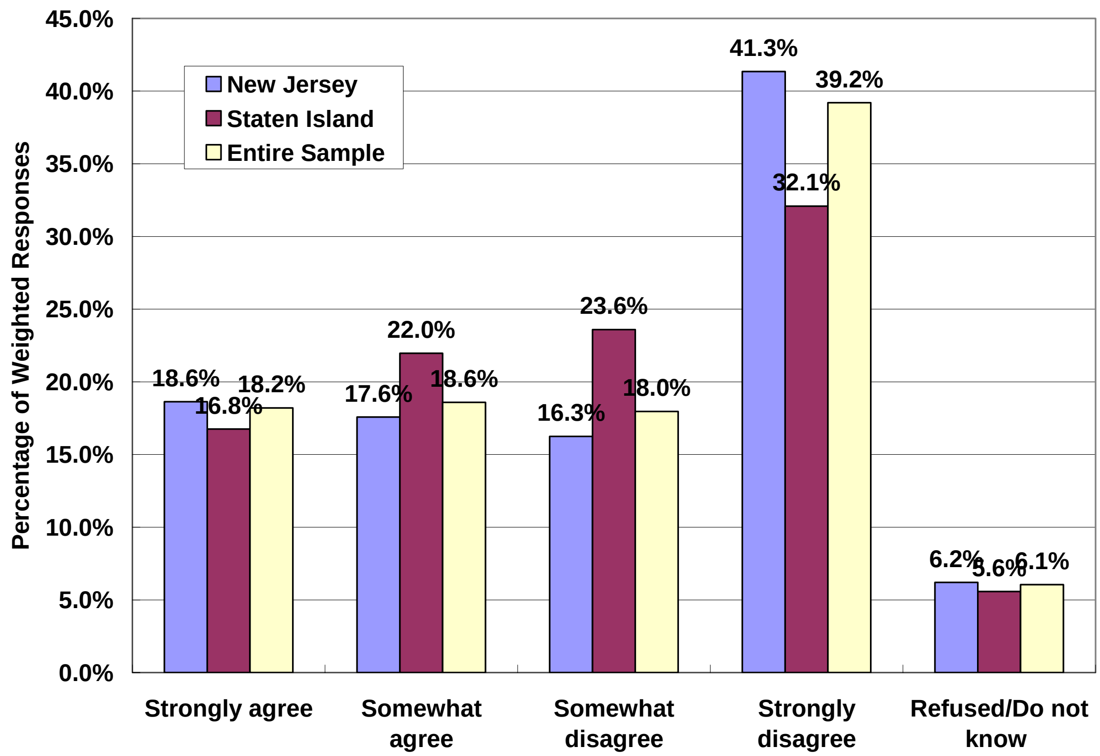

Figure 75. Would you be willing to pay a higher toll for a more reliable trip?

Carriers' Opinions

The carrier survey gathered information from 200 carriers, from which 103 were private carriers, and 97 were for-hire carriers (common carriers and contract carriers). All carriers provided their opinions about fairness of tolls and related issues. Figure 76 through Figure 80 show the distributions of their responses to the different questions asked. The percentages and analyses are based on 1271 trip based weighted responses (819 trip based weighted responses of for-hire carriers and 452 trip based weighted responses of private carriers) unless otherwise specified. The opinions focus on three major issues: (1) perceived impact of the time of day pricing on traffic, (2) fairness of the time of day pricing and (3) fairness of using toll revenues to support public transit.

Perceived Impact of the Time of Day Pricing Initiative on Traffic

Carriers that have used the PANYNJ toll facilities for at least three years and could recall the 2001 toll increase were asked if they thought the time of day pricing had any impact on traffic between New York City and New Jersey bridges and tunnels. Only 12.8 percent think that the time of day pricing had any effect on traffic. Table 101 shows that among this small group of respondents, 42.3 percent think that the traffic congestion is a *lot worse* than before, and similar percentage (43.6 percent) think the traffic congestion is somewhat better or lot better.

Table 101. Perceived change of traffic congestion after the time of day pricing

Change of traffic congestion between New York City and New Jersey bridges and tunnels after the time of day pricing	Weighted Responses	Percentage (1)	Percentage (2)
Lot worse	69	42.3%	5.4%
Lot better	38	23.4%	3.0%
Somewhat better	33	20.2%	2.6%
Somewhat worse	3	1.8%	0.2%
Combination, sometimes better/sometimes worse	4	2.5%	0.3%
Do not know/Refused	16	9.8%	1.3%
Total	163	100.0%	12.8%

Note: (1) Percentages were calculated based on 163 trip based weighted responses that think the toll increase had effect on traffic between New York City and New Jersey bridges and tunnels;

(2) Percentages were calculated based on 1271 trip based weighted responses that have used the PANYNJ toll facilities for at least three years and could recall the 2001 toll increase.

About the Fairness of the Time of Day Pricing

Carriers were asked about the fairness of some features of the time of day pricing, such as general E-ZPass discounts, cheaper tolls for trucks with fewer axles, higher tolls for commercial vehicles during peak and lower tolls during overnight hours.

As shown in Figure 76, most respondents (91.6 percent) agree that it is fair to give discounts to E-ZPass users. It seems that private carriers are more likely to strongly agree (89.9 percent vs. 75.3 percent for for-hire carriers). It is also interesting to note that, although cash users receive no discounts, the percentages of strongly agree or somewhat agree among E-ZPass and cash users are very similar (92.4 percent vs. 91.6 percent).

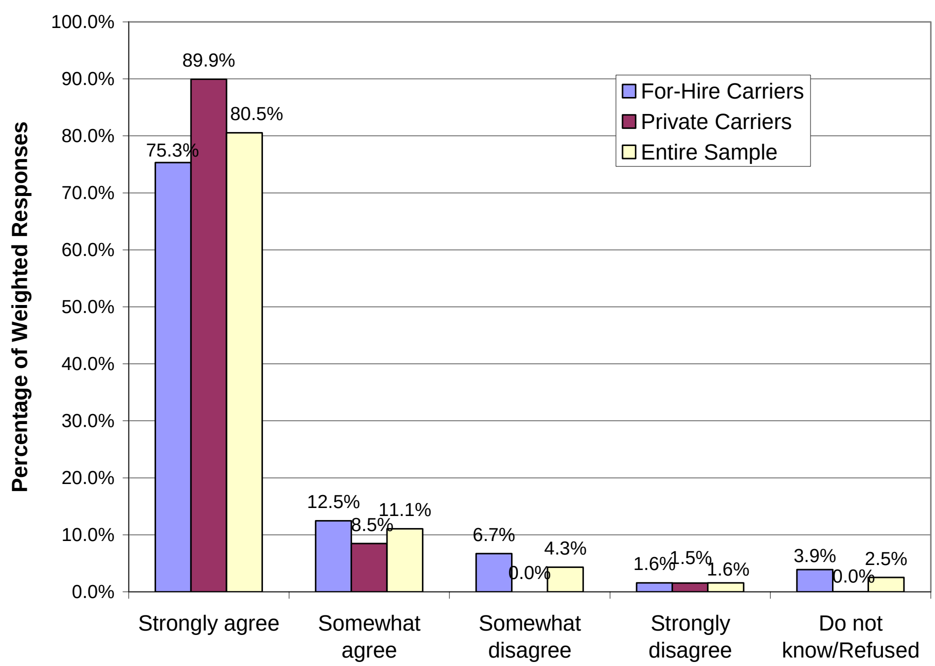

Figure 76. Is it fair to give discounts to E-ZPass users?

As shown in Figure 77, most respondents (84.9 percent) agree that it is fair to charge lower tolls for trucks with fewer axles, while 14.6 percent disagree. Private and for-hire carriers seem to have similar opinions.

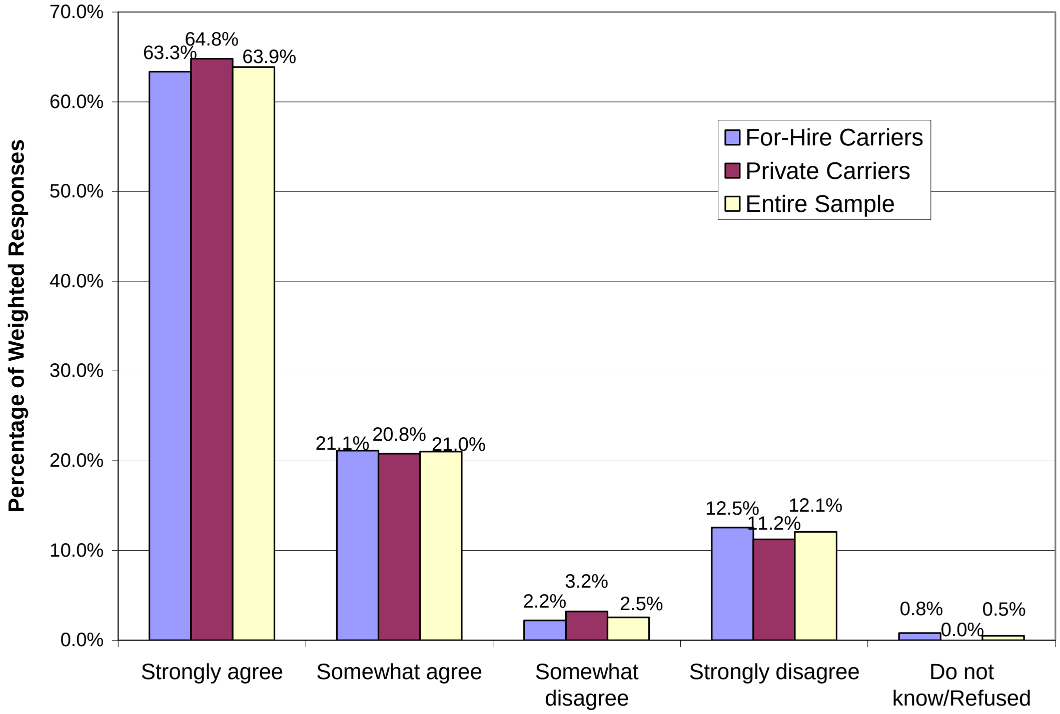

Figure 77. Is it fair to charge lower tolls for trucks with fewer axles?

Respondents were also asked whether or not it is fair to charge commercial users higher tolls during peak hours and lower tolls during off-peak hours. Comparison of these two opinions indicates that most carriers like the idea of paying less during the overnight hours, though they do not like paying more during the peak hours (which is a contradiction in itself, since one implies the other). As shown in Figure 78, most respondents (80.1 percent) disagree with charging commercial users higher tolls during peak hours. Private carriers are more likely to strongly agree (20.5 percent vs.12.0 percent for for-hire carriers). On the other hand, when asked about fairness of charging commercial users lower tolls during overnight hours, as shown in Figure 79, most respondents agree (88.4 percent). Private carriers are more likely to agree (95.4

percent vs. 84.4 percent for for-hire carriers), while for-hire carriers are more likely to strongly disagree (11.8 percent vs. 1.5 percent of private carriers).

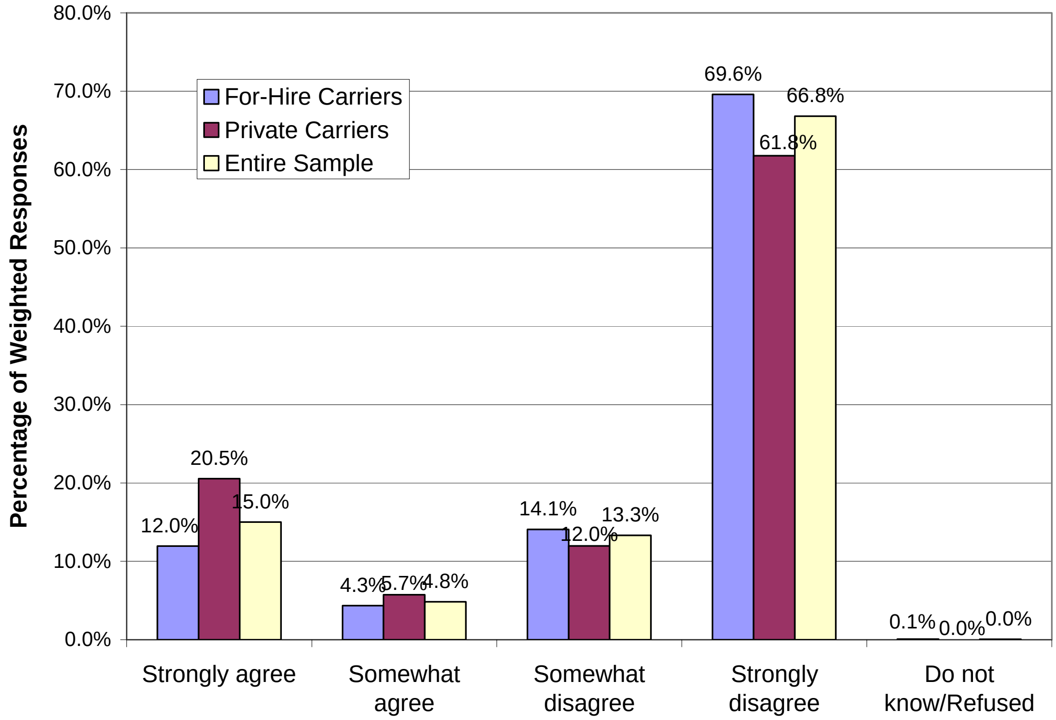

Figure 78. Is it fair to charge commercial users higher tolls during peak?

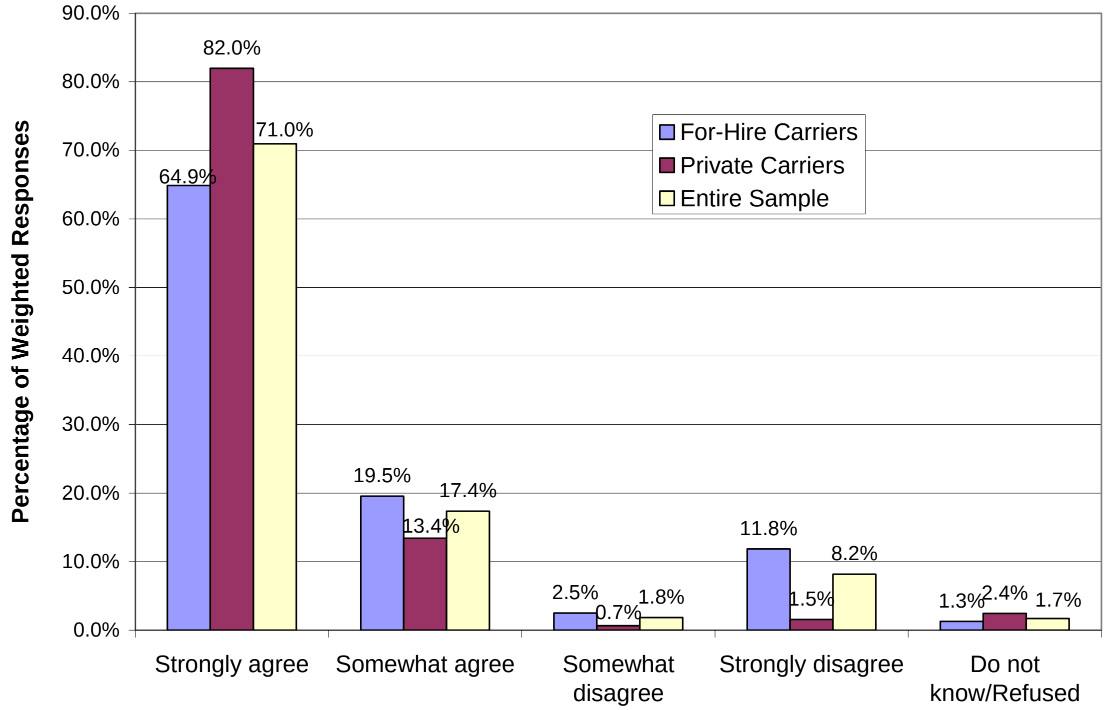

Figure 79. Is it fair to charge commercial users lower tolls during overnight?

Fairness of Using Toll Revenues to Support Public Transit

In terms of fairness of using toll revenues to support public transit, as shown in Figure 80, the majority (58.4 percent) of respondents agree. Private carriers are more likely to strongly agree (45.4 percent vs. 25.5 percent of for-hire carriers), while for-hire carriers are more likely to strongly disagree (36.6 percent vs.17.9 percent of private carriers).

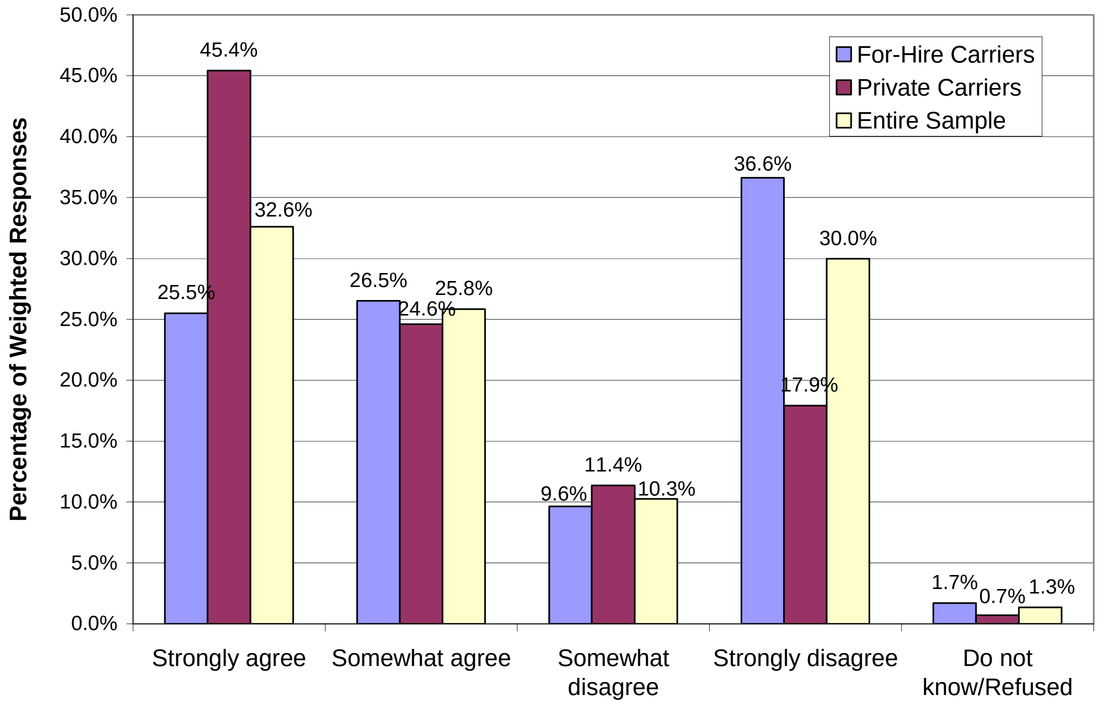

Figure 80. Is it fair to use toll revenues to support public transit?

Conclusions

This chapter examined public opinions on the time of day pricing initiative. Two surveys, one for passenger vehicle travellers and the other for freight carriers, were used to collect data to provide user insight about toll related issues, such as: the perceived impact of the time of day pricing on traffic, the inherent fairness of the time of day pricing, of providing discounts for frequent users, of using toll revenues to finance public transit, and, finally, their willingness to pay more for better services.

As indicated by passenger vehicle travelers, the perceived impact of the initiative was not favorable, as most respondents felt there was little change due to time of day pricing. When prompted about E-ZPass, the majority of respondents felt it would be fair to give E-ZPass users discounts. However, when asked if it is fair to charge more tolls to easy traffic congestion, the vast majority of respondents were against such a measure. In regards to other survey questions, respondents indicated that frequent users of PANYNJ toll facilities should receive a discount. Furthermore, respondents felt strongly that toll revenues should be used to support public transit. However, a majority of respondents are not willing to pay more for a faster or a more reliable trip. These results may seem contradictory but is illustrative of the fact that users feel that they are paying a high enough price for use of the toll roads but do not mind paying if there tolls are used for transportation services.

In addition to passenger vehicle travellers, for-hire carriers and private carriers were surveyed as well. Those carriers that could remember the 2001 toll increase felt that the time of day initiative had little, if any, impact on traffic conditions. In fact, most felt that traffic congestion has actually gotten worse. Like their passenger vehicle counterparts, most carriers also felt that it would be fair to give E-ZPass users a discount. There was also consensus that trucks with fewer axles should receive a toll discount. Furthermore, most carriers were in favor of charging less in tolls during off-peak hours and most were against charging more during peak hours.

The survey results of both these stakeholder groups indicate that E-ZPass could be a possible tool that policy-makers could use as a way to alter travel behaviour. Both stakeholder groups strongly agreed that it would be fair to give E-ZPass users a discount. Furthermore, both groups favored paying fewer tolls during off-peak hours and not paying more during peak hours. This indicates that a possible policy measure could be to keep toll prices the same during peak hours, while lowering toll prices during off-peak hours. This option may be a plausible way of getting those with more elastic travel demand to shift to off-peak hours.

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APPENDICES

Appendix 1. Two-way ANOVA Results for Seasonal Variation at each PANYNJ Crossing

Table 102. Seasonal variation analysis for Bayonne Bridge

time period	Case	Type of Variation	MS	F	F crit	significance
A.M. peak	**Case 1 (Before VP)**	among months	2.741E-05	139.5556	161.4462	No
		among years	7.182E-07	3.6568	161.4462	No
		random error	1.964E-07			
	Case 2 (Before VP)	within seasons	5.128E-07	0.0090	5.1432	No
		among seasons	8.975E-05	1.5777	4.7571	No
		random error	5.689E-05			
	Case 3 (After VP)	within seasons	9.78E-06	1.4696	19.0000	No
		among seasons	1.917E-05	2.8810	18.5128	No
		random error	6.655E-06			
P.M. peak	**Case 1 (Before VP)**	among months	6.997E-05	3.8069	161.4462	No
		among years	7.483E-07	0.0407	161.4462	No
		random error	1.838E-05			
	Case 2 (Before VP)	within seasons	2.232E-06	0.1244	5.1432	No
		among seasons	0.0001278	7.1217	4.7571	**Yes**
		random error	1.794E-05			
	Case 3 (After VP)	within seasons	1.727E-05	7.6752	19.0000	No
		among seasons	7.827E-06	3.4791	18.5128	No
		random error	2.25E-06			
off-peak	**Case 1 (Before VP)**	among months	9.793E-06	0.6628	161.4462	No
		among years	3.105E-10	0.0000	161.4462	No
		random error	1.478E-05			
	Case 2 (Before VP)	within seasons	4.852E-06	0.0886	5.1432	No
		among seasons	0.000108	1.9726	4.7571	No
		random error	5.474E-05			
	Case 3 (After VP)	within seasons	1.606E-06	1.3763	19.0000	No
		among seasons	2.499E-06	2.1412	18.5128	No
		random error	1.167E-06			

Table 103. Seasonal variation analysis for Goethals Bridge

time period	Case	Source of Variation	MS	F	F crit	significance
A.M. peak	Case 1 (Before VP)	among months	1.54E-06	3.4879	161.4462	No
		among years	5.17E-06	11.7104	161.4462	No
		random error	4.415E-07			
	Case 2 (Before VP)	within seasons	2.691E-05	1.0082	5.1432	No
		among seasons	7.985E-05	2.9912	4.7571	No
		random error	2.67E-05			
	Case 3 (After VP)	within seasons	0.0001094	4.2837	19.0000	No
		among seasons	0.0002858	11.1919	18.5128	No
		random error	2.554E-05			
P.M. peak	Case 1 (Before VP)	among months	3.325E-07	0.3822	161.4462	No
		among years	2.412E-06	2.7717	161.4462	No
		random error	8.701E-07			
	Case 2 (Before VP)	within seasons	7.165E-06	0.2524	5.1432	No
		among seasons	0.0001891	6.6618	4.7571	**Yes**
		random error	2.838E-05			
	Case 3 (After VP)	within seasons	2.41E-06	1.1595	19.0000	No
		among seasons	0.0001314	63.2101	18.5128	**Yes**
		random error	2.078E-06			
off-peak	Case 1 (Before VP)	among months	4.413E-07	0.1730	161.4462	No
		among years	5.197E-07	0.2037	161.4462	No
		random error	2.551E-06			
	Case 2 (Before VP)	within seasons	5.362E-05	0.7111	5.1432	No
		among seasons	0.000422	5.5969	4.7571	**Yes**
		random error	7.54E-05			
	Case 3 (After VP)	within seasons	0.0001271	5.1031	19.0000	No
		among seasons	0.0008047	32.3083	18.5128	**Yes**
		random error	2.491E-05			

Table 104. Seasonal variation analysis for GW Bridge, lower level

time period	Case	Source of Variation	MS	F	F crit	significance
A.M. peak	Case 1 (Before VP)	among months	1.82E-06	0.0277	161.4462	No
		among years	0.0002142	3.2575	161.4462	No
		random error	6.575E-05			
	Case 2 (Before VP)	within seasons	6.265E-05	0.3715	5.1432	No
		among seasons	0.0001798	1.0659	4.7571	No
		random error	0.0001686			
	Case 3 (After VP)	within seasons	0.0001252	0.5588	19.0000	No
		among seasons	0.000145	0.6471	18.5128	No
		random error	0.0002241			
P.M. peak	Case 1 (Before VP)	among months	2.919E-06	0.0620	161.4462	No
		among years	1.73E-05	0.3677	161.4462	No
		random error	4.704E-05			
	Case 2 (Before VP)	within seasons	1.727E-06	0.0463	5.1432	No
		among seasons	8.499E-05	2.2805	4.7571	No
		random error	3.727E-05			
	Case 3 (After VP)	within seasons	3.599E-05	1.7075	19.0000	No
		among seasons	0.000236	11.1972	18.5128	No
		random error	2.107E-05			
off-peak	Case 1 (Before VP)	among months	1.293E-07	0.0006	161.4462	No
		among years	0.0003532	1.5767	161.4462	No
		random error	0.000224			
	Case 2 (Before VP)	within seasons	6.995E-05	0.2355	5.1432	No
		among seasons	0.0004165	1.4025	4.7571	No
		random error	0.000297			
	Case 3 (After VP)	within seasons	9.322E-05	0.3387	19.0000	No
		among seasons	1.102E-05	0.0400	18.5128	No
		random error	0.0002752			

Table 105. Seasonal variation analysis for GW Bridge, upper level

time period	Case	Source of Variation	MS	F	F crit	significance
A.M. peak	Case 1 (Before VP)	among months	1.756E-07	0.0086	161.4462	No
		among years	0.0001737	8.4638	161.4462	No
		random error	2.052E-05			
	Case 2 (Before VP)	within seasons	1.76E-05	0.1337	5.1432	No
		among seasons	0.000317	2.4079	4.7571	No
		random error	0.0001316			
	Case 3 (After VP)	within seasons	6.202E-05	0.2373	19.0000	No
		among seasons	0.0014276	5.4633	18.5128	No
		random error	0.0002613			
P.M. peak	Case 1 (Before VP)	among months	7.426E-06	1.1697	161.4462	No
		among years	6.351E-05	10.0041	161.4462	No
		random error	6.348E-06			
	Case 2 (Before VP)	within seasons	1.721E-05	0.1795	5.1432	No
		among seasons	3.705E-05	0.3863	4.7571	No
		random error	9.591E-05			
	Case 3 (After VP)	within seasons	6.084E-05	0.7498	19.0000	No
		among seasons	0.0001014	1.2501	18.5128	No
		random error	8.115E-05			
off-peak	Case 1 (Before VP)	among months	5.318E-06	0.1070	161.4462	No
		among years	0.0004472	8.9995	161.4462	No
		random error	4.97E-05			
	Case 2 (Before VP)	within seasons	3.866E-05	0.0866	5.1432	No
		among seasons	0.0005656	1.2668	4.7571	No
		random error	0.0004465			
	Case 3 (After VP)	within seasons	0.0002203	1.0664	19.0000	No
		among seasons	0.0022901	11.0882	18.5128	No
		random error	0.0002065			

Table 106. Seasonal variation analysis for Holland Tunnel

time period	Case	Source of Variation	MS	F	F crit	significance
A.M. peak	Case 1 (Before VP)	among months	2.95E-05	3.9598	161.4462	No
		among years	7.321E-06	0.9828	161.4462	No
		random error	7.449E-06			
	Case 2 (Before VP)	within seasons	5.911E-05	3.1019	5.1432	No
		among seasons	5.39E-05	2.8286	4.7571	No
		random error	1.906E-05			
	Case 3 (After VP)	within seasons	5.868E-06	0.8251	19.0000	No
		among seasons	3.502E-05	4.9249	18.5128	No
		random error	7.112E-06			
P.M. peak	Case 1 (Before VP)	among months	2.365E-06	0.0617	161.4462	No
		among years	8.728E-06	0.2279	161.4462	No
		random error	3.83E-05			
	Case 2 (Before VP)	within seasons	1.104E-05	0.4053	5.1432	No
		among seasons	6.584E-05	2.4170	4.7571	No
		random error	2.724E-05			
	Case 3 (After VP)	within seasons	3.269E-07	0.0383	19.0000	No
		among seasons	6.363E-06	0.7448	18.5128	No
		random error	8.543E-06			
off-peak	Case 1 (Before VP)	among months	4.856E-05	0.6107	161.4462	No
		among years	3.204E-05	0.4028	161.4462	No
		random error	7.953E-05			
	Case 2 (Before VP)	within seasons	0.0001174	1.4250	5.1432	No
		among seasons	0.0002378	2.8871	4.7571	No
		random error	8.238E-05			
	Case 3 (After VP)	within seasons	8.801E-06	0.2847	19.0000	No
		among seasons	7.124E-05	2.3047	18.5128	No
		random error	3.091E-05			

Table 107. Seasonal variation analysis for Lincoln Tunnel

time period	Case	Source of Variation	MS	F	F crit	significance
A.M. peak	Case 1 (Before VP)	among months	9.208E-06	5.9240	161.4462	No
		among years	2.403E-06	1.5463	161.4462	No
		random error	1.554E-06			
	Case 2 (Before VP)	within seasons	2.881E-05	0.4862	5.1432	No
		among seasons	7.825E-05	1.3205	4.7571	No
		random error	5.926E-05			
	Case 3 (After VP)	within seasons	5.988E-06	0.2388	19.0000	No
		among seasons	6.266E-05	2.4986	18.5128	No
		random error	2.508E-05			
P.M. peak	Case 1 (Before VP)	among months	2.048E-05	2.3224	161.4462	No
		among years	1.469E-06	0.1666	161.4462	No
		random error	8.82E-06			
	Case 2 (Before VP)	within seasons	1.599E-06	0.1009	5.1432	No
		among seasons	0.00011	6.9363	4.7571	**Yes**
		random error	1.585E-05			
	Case 3 (After VP)	within seasons	7.758E-06	0.9969	19.0000	No
		among seasons	6.959E-05	8.9427	18.5128	No
		random error	7.782E-06			
off-peak	Case 1 (Before VP)	among months	5.716E-05	19.2524	161.4462	No
		among years	7.631E-06	2.5704	161.4462	No
		random error	2.969E-06			
	Case 2 (Before VP)	within seasons	4.133E-05	0.3743	5.1432	No
		among seasons	0.000356	3.2237	4.7571	No
		random error	0.0001104			
	Case 3 (After VP)	within seasons	1.457E-05	0.4855	19.0000	No
		among seasons	0.0002643	8.8046	18.5128	No
		random error	3.002E-05			

Table 108. Seasonal variation analysis for Outerbridge Crossing

time period	Case	Source of Variation	MS	F	F crit	significance
A.M. peak	Case 1 (Before VP)	among months	5.985E-05	3.3942	161.4462	No
		among years	6.669E-07	0.0378	161.4462	No
		random error	1.763E-05			
	Case 2 (Before VP)	within seasons	1.898E-05	0.1059	5.1432	No
		among seasons	0.0004039	2.2544	4.7571	No
		random error	0.0001791			
	Case 3 (After VP)	within seasons	0.0002068	8.4792	19.0000	No
		among seasons	0.0008364	34.2978	18.5128	**Yes**
		random error	2.439E-05			
P.M. peak	Case 1 (Before VP)	among months	7.649E-06	22.1811	161.4462	No
		among years	3.283E-06	9.5184	161.4462	No
		random error	3.449E-07			
	Case 2 (Before VP)	within seasons	3.493E-06	0.3843	5.1432	No
		among seasons	4.817E-06	0.5299	4.7571	No
		random error	9.091E-06			
	Case 3 (After VP)	within seasons	4.19E-07	0.1016	19.0000	No
		among seasons	8.819E-06	2.1387	18.5128	No
		random error	4.124E-06			
off-peak	Case 1 (Before VP)	among months	2.471E-05	1.8938	161.4462	No
		among years	9.904E-07	0.0759	161.4462	No
		random error	1.305E-05			
	Case 2 (Before VP)	within seasons	1.406E-05	0.0804	5.1432	No
		among seasons	0.0003693	2.1115	4.7571	No
		random error	0.0001749			
	Case 3 (After VP)	within seasons	0.0001893	14.5988	19.0000	No
		among seasons	0.0006735	51.9269	18.5128	**Yes**
		random error	1.297E-05			

Appendix 2. E-ZPASS Usage as a Function of Time of Day for Each PANYNJ Crossing

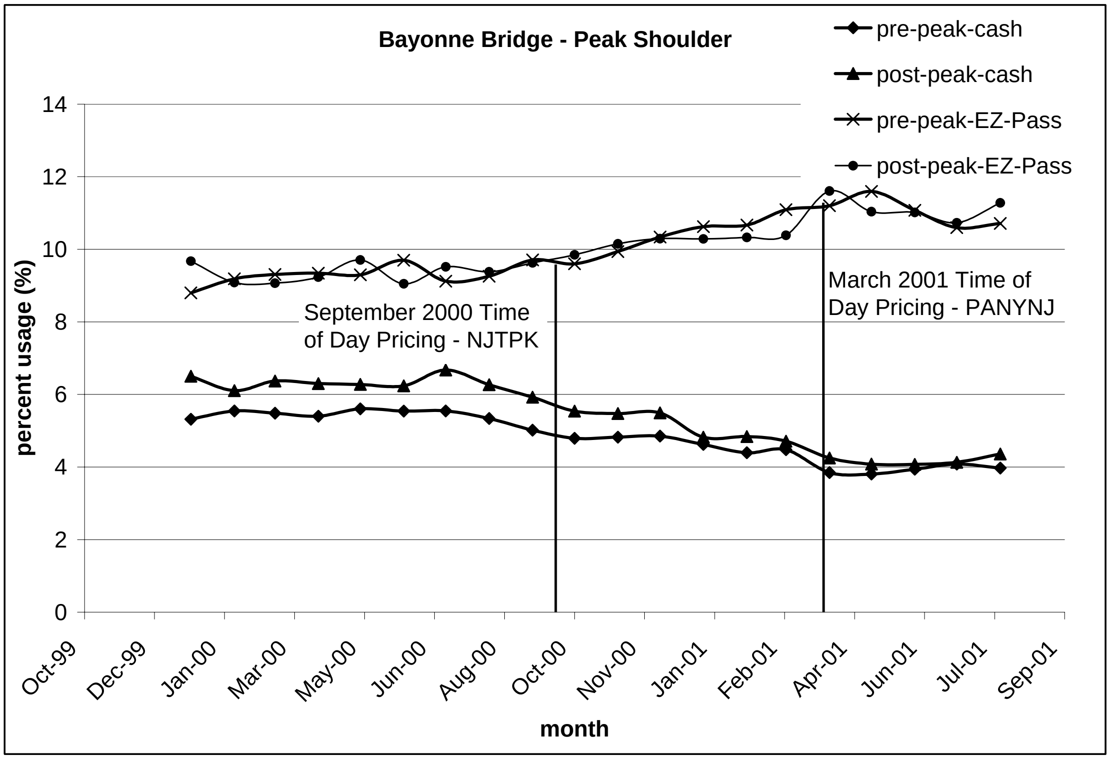


Figure 81. Cash versus E-ZPass usage over time - Bayonne Bridge, peak shoulders

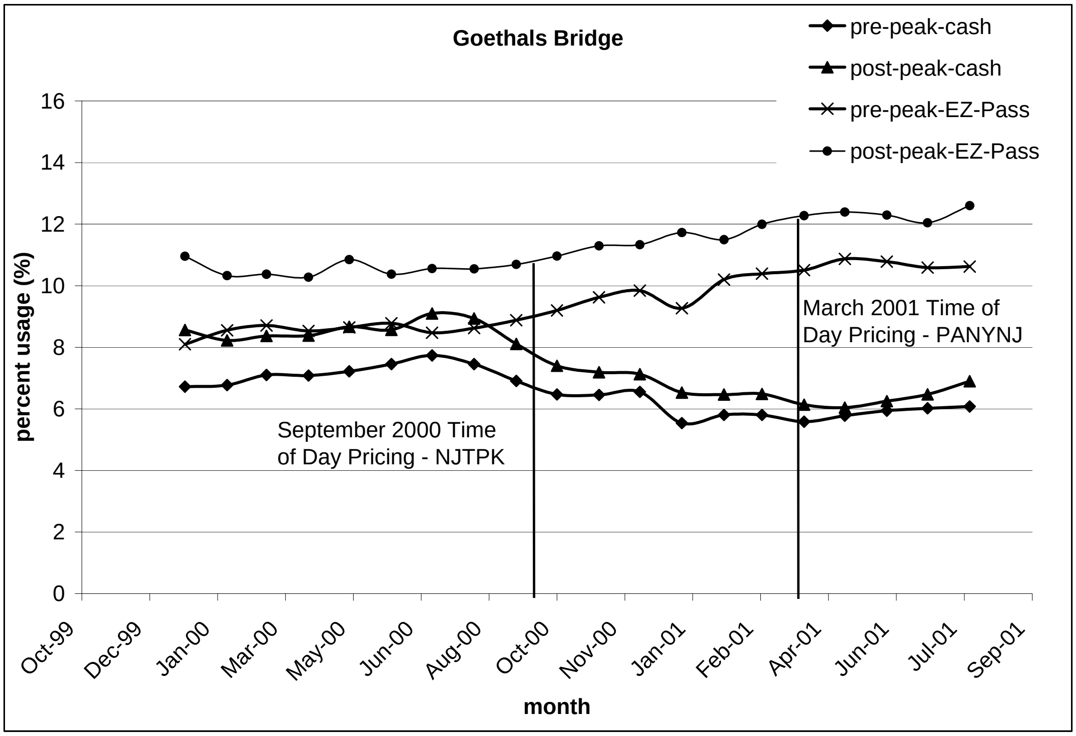


Figure 82. Cash versus E-ZPass usage over time - Goethals Bridge, peak shoulders

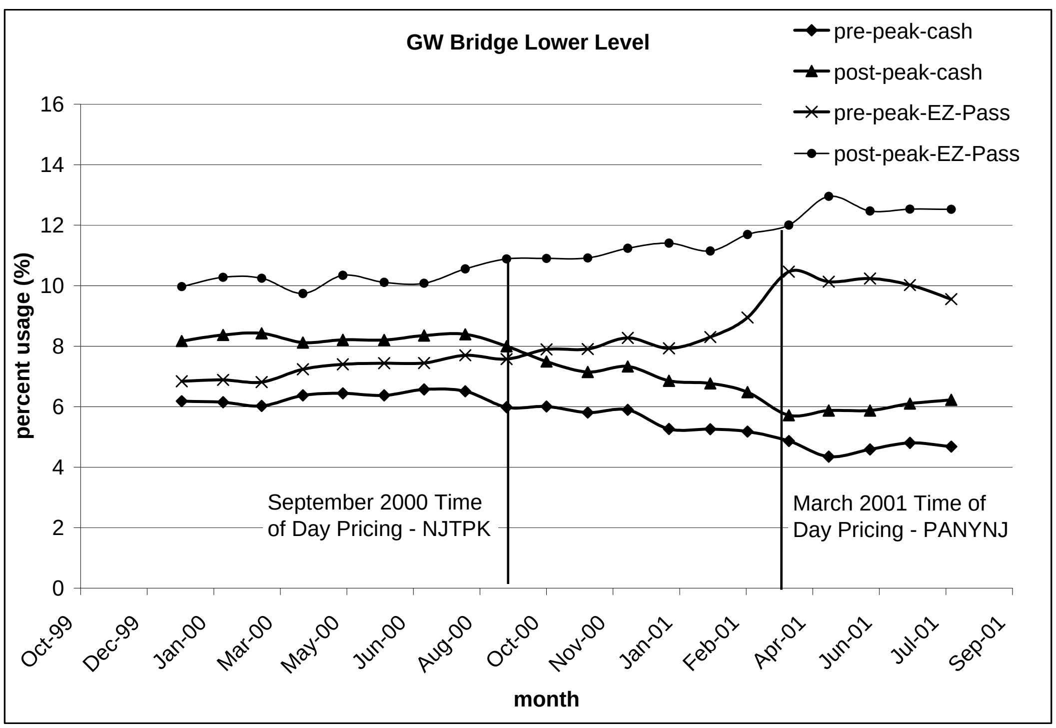


Figure 83. Cash versus E-ZPass usage over time – GWB lower level, peak shoulders

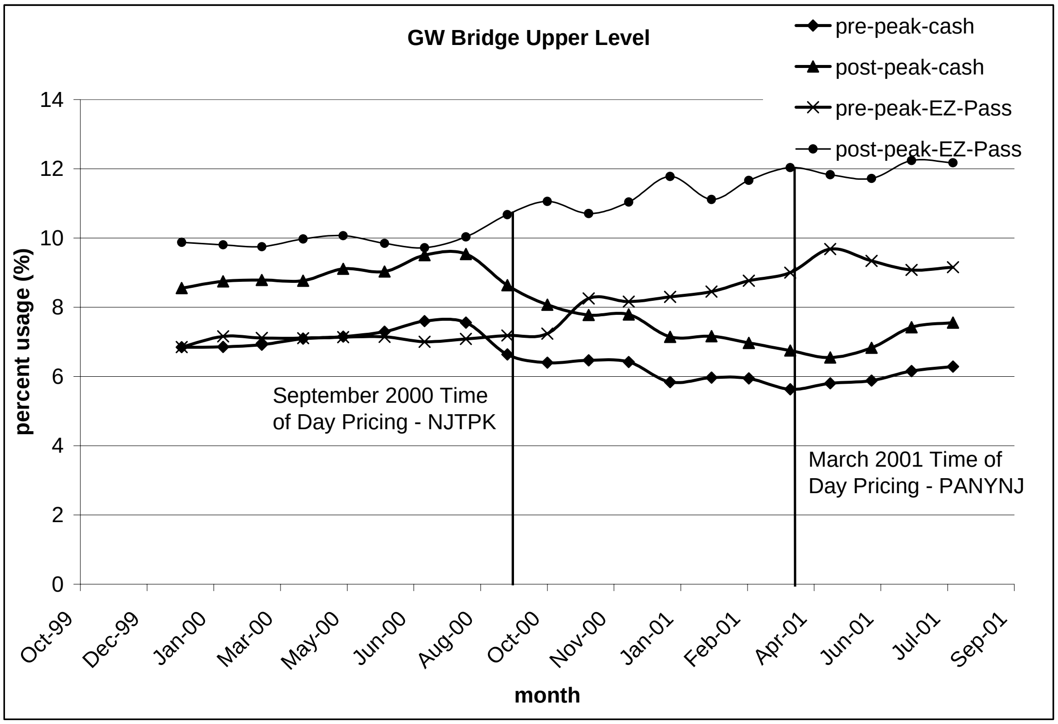


Figure 84. Cash versus E-ZPass usage over time – GWB upper level, peak shoulders

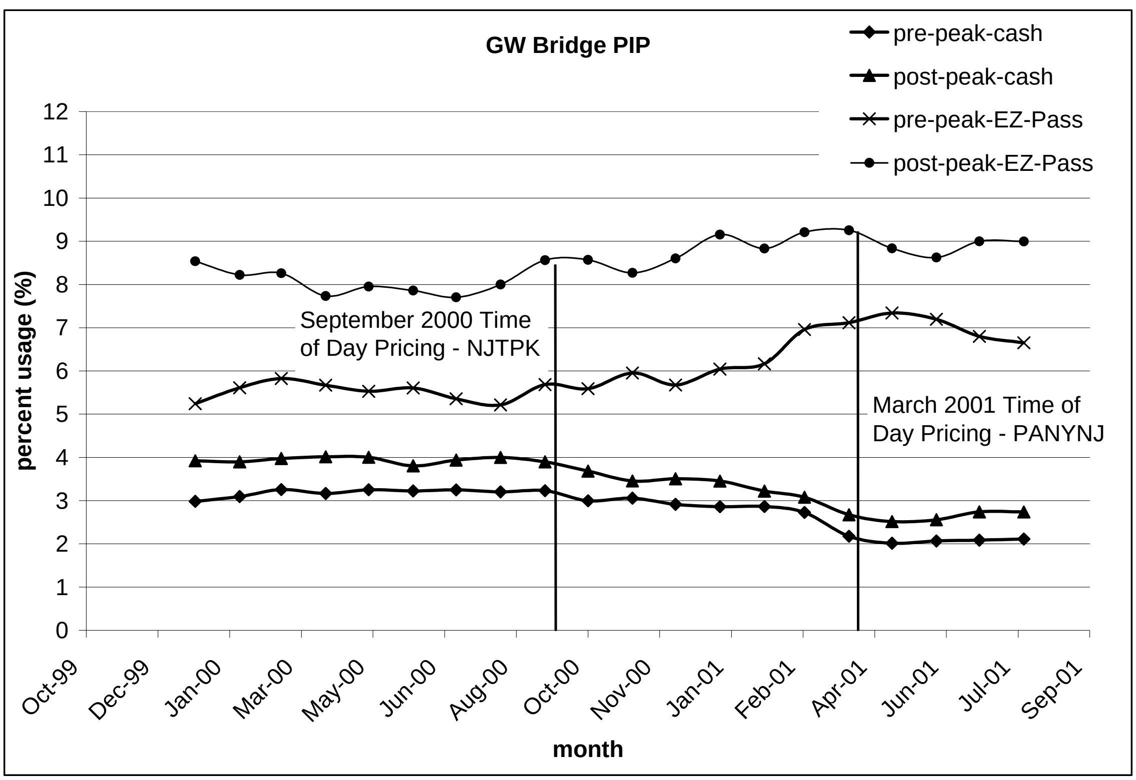


Figure 85. Cash versus E-ZPass usage over time – GWB PIP, peak shoulders

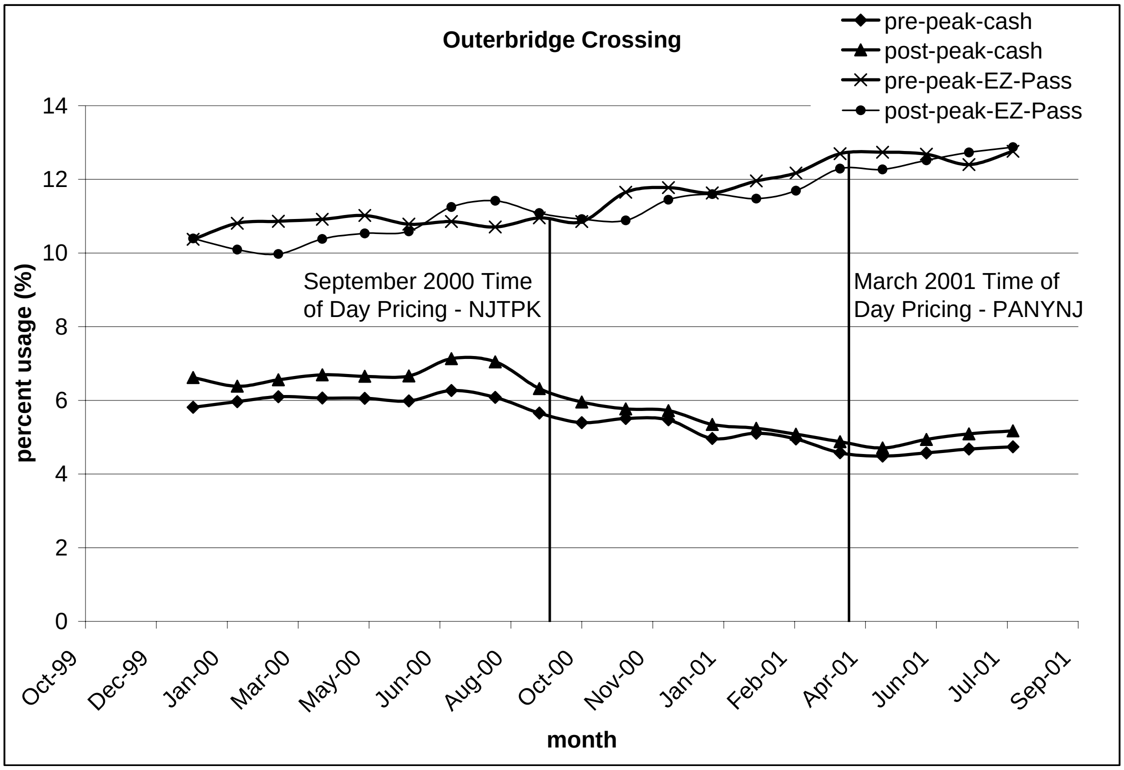


Figure 86. Cash versus E-ZPass usage over time – Outerbridge Crossing, peak shoulders

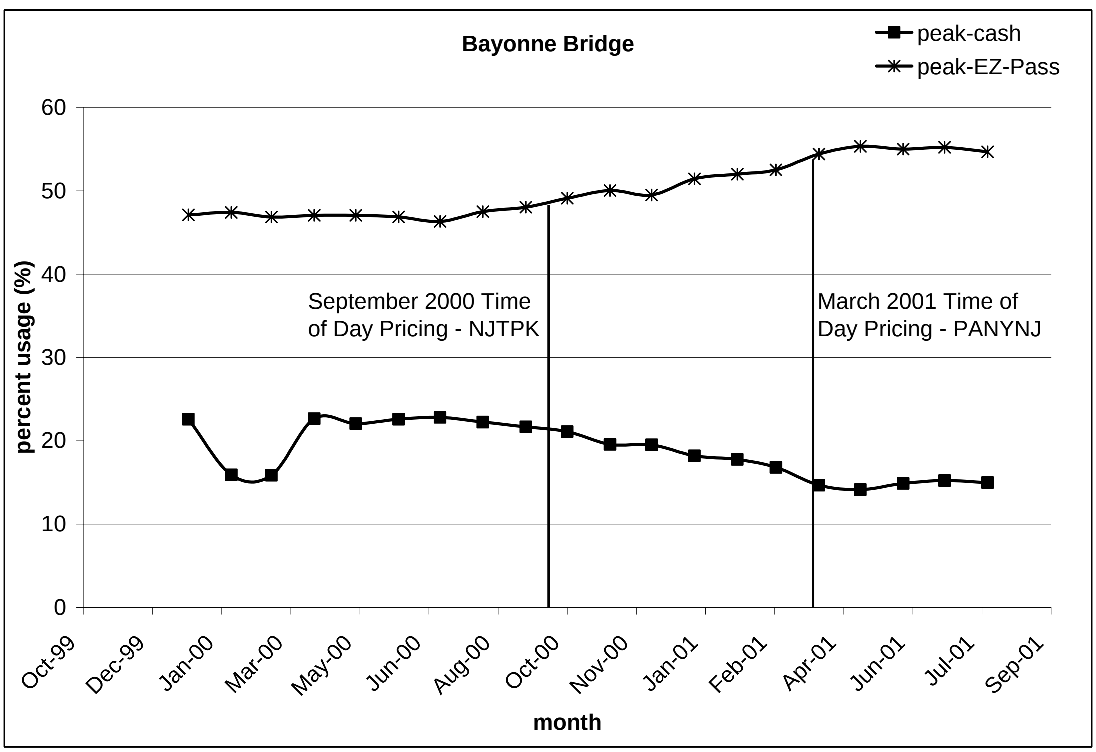


Figure 87. Cash versus E-ZPass usage over time - Bayonne Bridge, peak

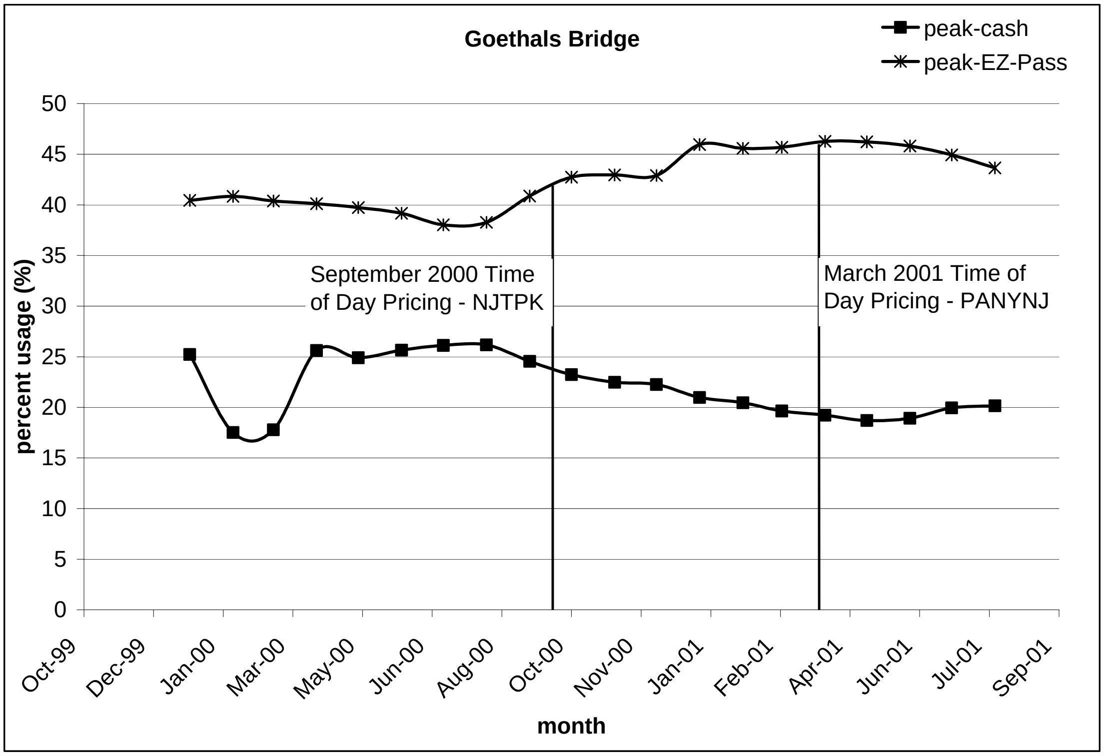


Figure 88. Cash versus E-ZPass usage over time - Goethals Bridge, peak

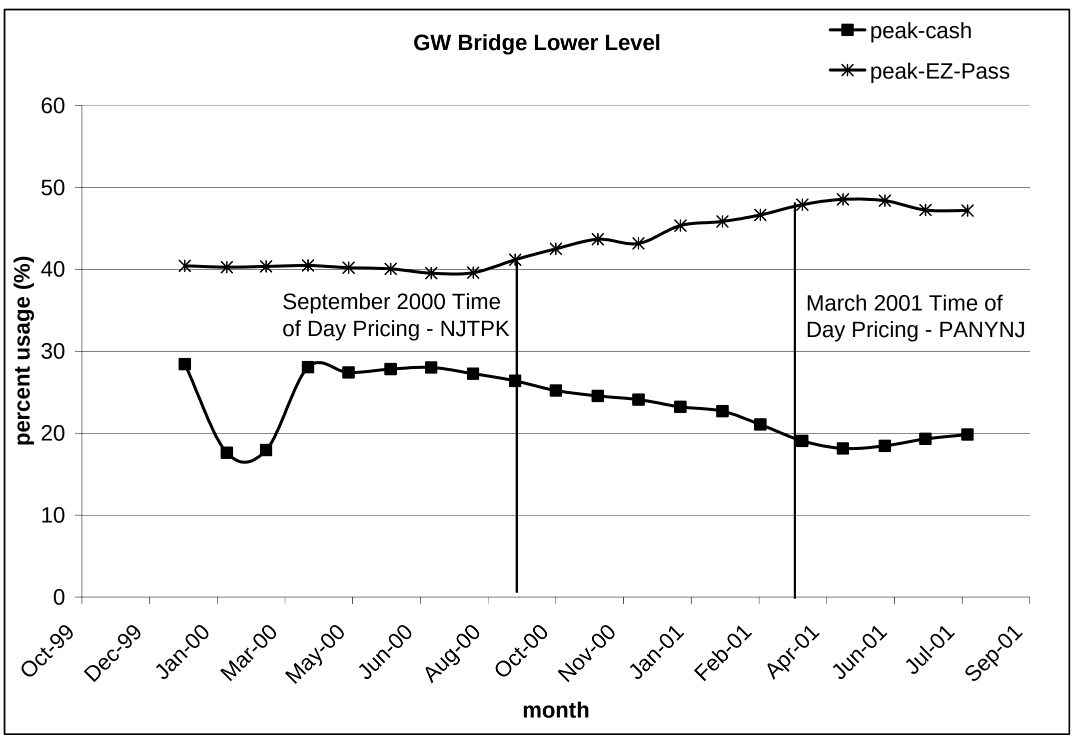


Figure 89. Cash versus E-ZPass usage over time – GWB, lower level, peak

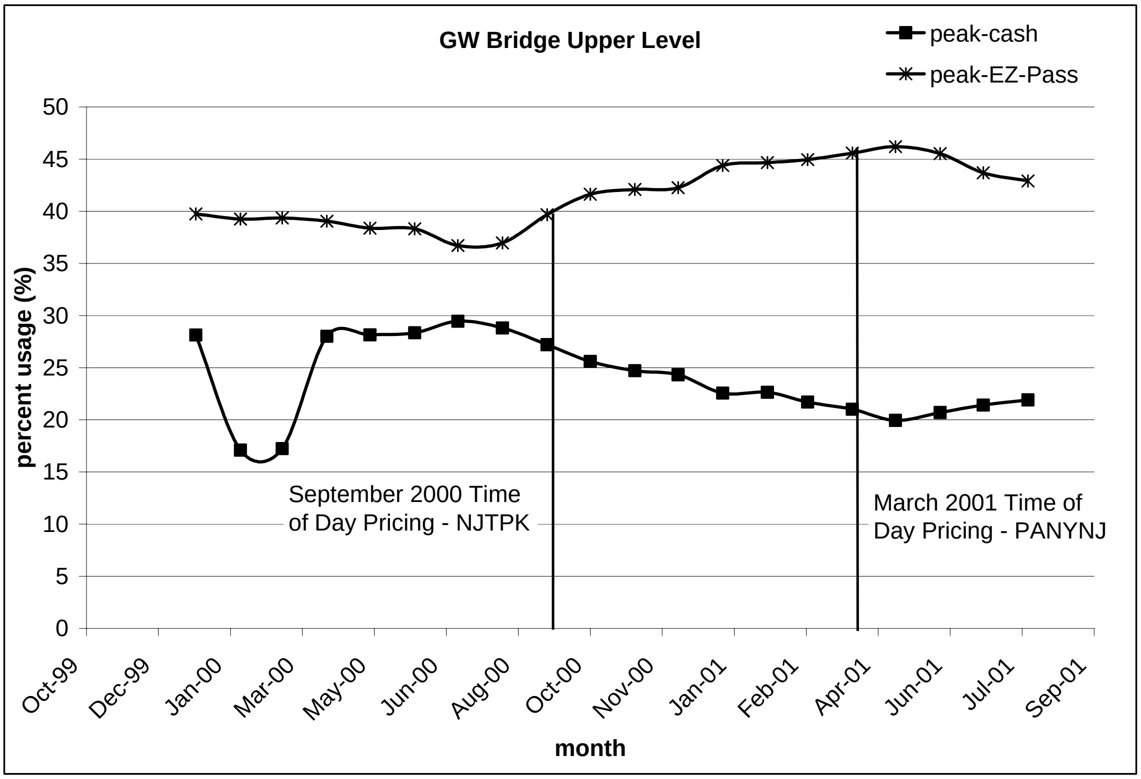


Figure 90. Cash versus E-ZPass usage over time – GWB, upper level, peak

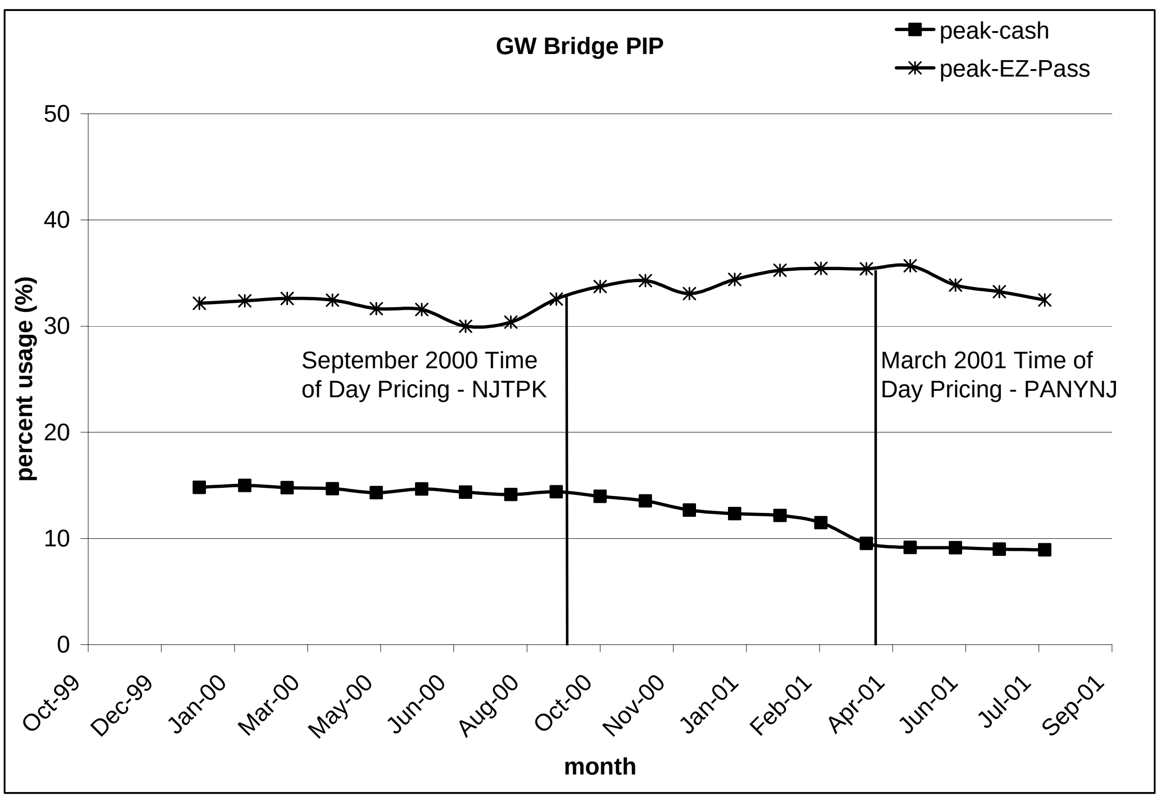


Figure 91. Cash versus E-ZPass usage over time – GWB PIP, peak

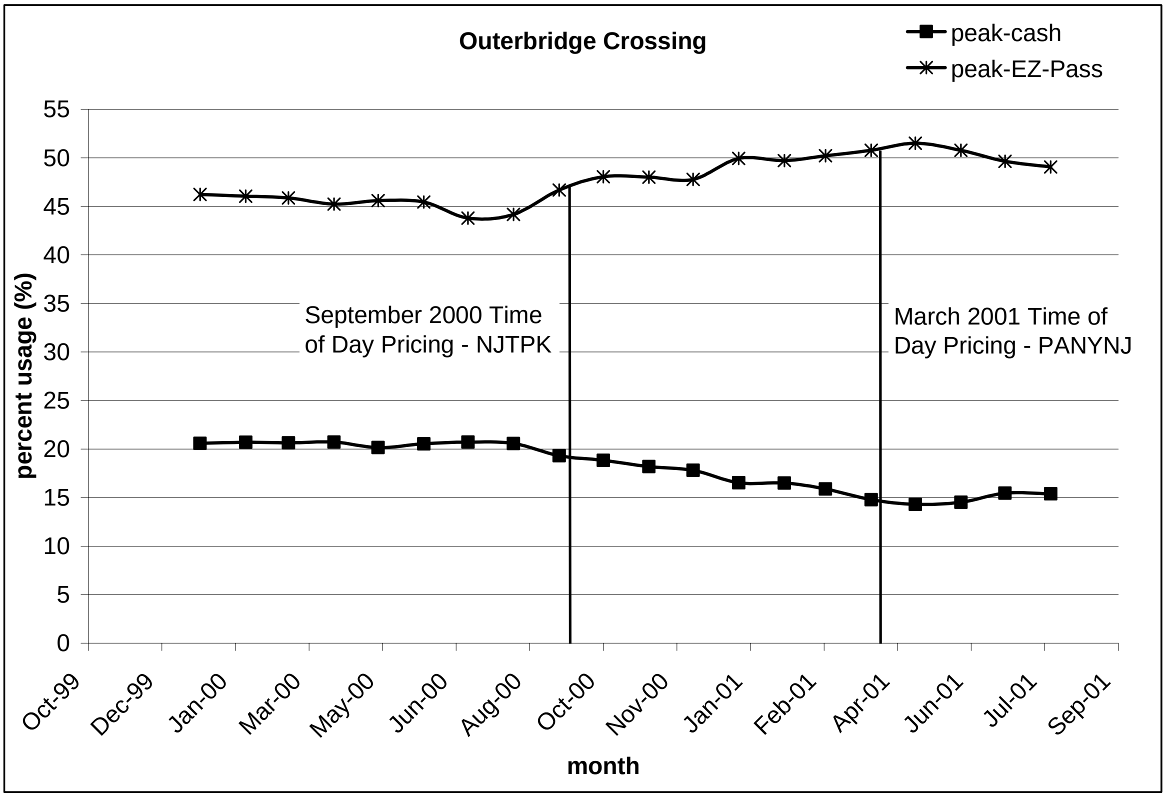


Figure 92. Cash versus E-ZPass usage over time – Outerbridge Crossing

Appendix 3. Detailed Findings Phase I - Passenger Car Groups

<u>Composition</u>

The first two groups which were conducted on the same evening, had a balance of females and males, and a wide spread of age range and college education. Group one had income that clustered at the higher end of the range than Group two. There was a mix of people that traveled peak weekday, off-peak weekday, peak weekend and off-peak weekend.

Groups three and four were conducted the night of a sudden snowstorm that somewhat impacted attendance. Group three had slightly more females than males in the group. The age range for these latter groups was slightly older than for the first two groups but education and household income spanned the same broad range as with the other two groups. Group three participants had a mix of those who traveled peak versus off-peak and weekday versus weekend. Group four traveled mostly during the weekdays both peak and off-peak. Many of the respondents of the first three groups had children at home but members of Group four did not.

Group 1 Demographics : 5 travel peak periods and 5 travel off peak. Within each group three travel weekdays and two travel weekends. 4 females, 6 males. I Respondent 18-25 age, 6 in the 26-35 range, 3 in the 36-45 range. 4 College grads, 6 with some college ; income under 24k –1, 36-45k –1, 46-55k-1, 56-65k-2, 66-75k-2 96-105k- 1, 106k-115k-2 respondents.

Group 2 Demographics:5 males and 5 females, age 18-25- 1R, 26-35-<u>5R</u>s, 36-45 –1R, 45-55- 1R, 56-65-1R, 66-75-1R; hs grad –1r, college grad –5r, some coll 2r, post grad 2r; hh income 25-36k-1r, 36-45-2r, 46-55-1r, 56-65-2r, 66-75-1r, 116-125-3r. 7r travel peak time and 3 off peak. Half peak travel weekdays and half travel peak weekends.

Group 3 *** Rs came in a massive snow storm that virtually stopped city traffic Demographics 3 males and 5 females. 3 travel off peak weekday, 3 peak weekend, 2 peak weekday. 3 coll grad, 3 some coll, 1 hs grad, 1 post graduate. Age 36-45 –3, 46-55- 2, 56-65-3. HHI –36k-45k-4, 46-55k-2; 56-65k-4; 66-75k-2; 126-135k –1.

Group 4 *** The same massive snow storm impeded attendance. Results of this group may be less representative of all cash users. Five people showed of which three were female and two were male. Two traveled over the GW bridge, two traveled the Holland tunnel and one traveled over the Staten Island bridges. Two traveled peak weekday, two traveled off peak weekday, and one traveled off peak weekends. Two were in the 26-35 age range, one respondent was in the 46-55 age range, and two were in the 56-65 age range. Two respondents had some college, two were college students, and one was post graduate. Most traveled between 1-3 times a week. Household income ranged from one respondent in the 36k-45k range, two in the 46k-55k, one in the 76k-85k, and one respondent in the 96k to105k range. None of these respondents had children at home.

Warm-Up & First Memory Stimulation

The warm-up was successful in terms of engaging participants and helping to form them into a working group. They cooperated with discussing their past as well as their present life. For example, when asked how they went about remembering their first home, some indicated they used visual images of their old home and school. Typical of New Yorkers, they described fairly busy work and personal lives.

Guided Memory Recall of Year 2001: Almost all group members could remember what they did for the 1999-2000 Millennium New Year celebration. Nonverbally, most seemed comfortable with describing what they did. A small number of people in each group expressed that they had some anxiety about Y2K at that time. When next asked about New Year’s for the 2000-2001 year they had more difficulty remembering what they did and verbalized less about their activity.

When asked about memories of the spring of 2001 and the fall of 2001 many became subtly but visibly uncomfortable and verbalized less. As a result, in Groups three and four the moderator changed the design and asked that each person first write down three positive things and negative things that happened during the year, starting with the spring of 2001, then the summer of 2001, the fall of 2001, and winter of 2001. The concreteness of this task was to anchor them in 2001 prior to 9/11 and to have them respond uninfluenced by other group members.

Group three proved to be the most vocal of the four groups. The female participants were a little more verbal about their experiences on this topic. Respondents offered positive experiences of 2001 that related to personal experiences such as the arrival of a baby, a graduation, and an increase in salary. Almost all the negative experiences of 2001 referred to the impact of 9/11 on them and on New York. While quite poignant, after acknowledging the trauma and allowing a respectful period of time to pass, the moderator did refocus the participants to other parts of the year. No one spontaneously made mention of time of day pricing or anything happening on the date March 25, 2001. Respondents were asked any travel change on their part, then as of March 2001 and then informed it was the start of time of day pricing and did they now recall any reactions to that event.

When asked how traveling and commuting were like in the spring of 2001, very few responded. They did not seem to remember anything remarkable about it. Several people's recollection of 2001 was about the fall and 9/11 and the traffic problems it caused, which seemed to eclipse all but a few other meaningful personal memories.

E-ZPass and the Awareness of the Introduction of Variable Tolls

When the groups were asked if they remembered any changes in their commuting around March of 2001, extremely few people spontaneously remembered anything about it. Even less remembered E-Z Pass announcements in the newspapers. After some discussion some thought it might have to do with the start of E-ZPass, or greater applicability of E-ZPass to more areas, or related to greater security searches on the road due to 9/11.

<u>"But it's always happening that tolls get increased"</u>

After the moderator explained the introduction of variable priced tolls with their discounts etc., several more people seemed to acknowledge that there had been some change in the system. Mostly, participants assumed March 25, 2001 inaugurated higher tolls. There were no differences among the E-ZPass groups or between these groups and the cash users group in terms of their awareness of the introduction of time of day pricing. Even when participants were told the event Be specific about questions and prompts.]had something to do with E-ZPass there was little recollection of the event.

Reference to E-ZPass: Most respondents were unsure when E-ZPass was created and sometimes confused it with the start of time of day pricing. Their associations to E-ZPass included the following: it was convenient; it was quicker; you drove through when others had to wait in line; and, it was a tracking system.

Most were unsure why E-ZPass was created. Respondents offered that perhaps it was to control traffic; to relieve congestion; to save costs by cutting jobs; the E-ZPass prepayment system created income from the float of the money. Very few participants felt it was created to improve the environment. Only after some probing from the moderator did some participants agree that tolls could help reduce congestion.

<u>"Just the fact of having a car go through and not stop and start, and not back up with traffic is a definite plus for the environment" Quote from Group two</u>

A small number of people had frustrations and concerns about E-ZPass having to do with billing errors that were hard to redress. A few felt it was a device to track people. A good portion of people were frustrated at the cash users driving in their lanes and causing congestion in them.

The cash users had the same number and kinds of associations to the concept of E-ZPass but they seemed to be more explicit about how E-ZPass was designed to stop people from coming into the city – connoting something more negative. One got the impression from cash users that they thought E-ZPass was a good idea but also thought they did not come into the city often enough to warrant its adoption. However, the cash users traveled into the city about as often as the E-ZPass users.

Initial Time of Day Pricing Awareness

Very few people knew about the time of day pricing program when it was initiated. Very few people were aware of the program now or understood its features. A good number of participants reluctantly indicated that they paid E-ZPass by credit card and rarely scrutinized their bills so they had little awareness of any toll programs. Most of these respondents trusted that they were being billed accurately.

They mostly associate E-ZPass to fares and fare changes with fare increases. The minority that were aware of toll changes since 2001 felt resigned that they could not do anything about it. A few remembered that they had frequent user discounts that may have been eliminated by E-ZPass. It was aggravating that it was eliminated but again they felt resigned and impotent to change the situation. The cash users were less likely to know about the variable price initiative than E-ZPass users.

When time of day pricing was explained and some respondents began to recall a little of their initial reactions they expressed that it was nice to have a little discount but it wasn't enough to alter their driving decisions.

"It's a non-event for me… raising the tolls or giving me a discount… its not going to alter my life." Quote from Group one

"10 Percent discount isn't that much." Quote from Group one

General Reactions to Tolls: Paying tolls frustrated almost all the respondents. Some of the reasons had to do with how time consuming it was to wait on lines. Many felt that the roads were not maintained well. This made them skeptical that the tolls were actually being used to pay for roadwork. A few perceived that tolls in New York were high and road repair took years while in other states repairs took months. Many resented having to pay tolls just to get from one borough to the next. Several people complained that there were too many cars on the road. Cash users and E-ZPass users were similar in their complaints about tolls. When probed, almost none of the respondents could articulate what value they did get or could get for their toll dollars.

Stated Reactions to Variable Tolls in General: All four groups, including the cash users group, were fairly consistent in their negative responses to varying tolls and offering off-peak discounts. They did not focus on the benefits of going off-peak (cost is less, positive environmental impact, reduced traffic congestion). Rather, the respondents felt that they were being punished for traveling peak times. Several felt it was unfair to charge more for peak times since many believed that they had no choice as to when they traveled. They did not have control over their time, especially regarding work. However, even when they were asked if their bosses could offer flexible time which would allow them to travel off-peak most didn't know or did not respond. The amount of the discount was not worth altering their travel plans even when they did have some flexibility.

Group one tended to use more of a mix of car travel and mass transit to get into the city during weekday peak time than the other groups.. However, the time of day pricing plan did not alter when they traveled or what travel mode they used.

A few respondents felt that varying the tolls by time of day was confusing. Some respondents were skeptical that traveling off-peak would reduce traffic congestion and help the environment in any substantial way. A few respondents saw varying tolls as another device to extract more money from the car driver.

Travel Behavior Reactions to the Introduction of Time of Day Pricing

None of the group members believed that they changed their travel strategy or path as a result of time of day pricing. What they remember is what changes they made regarding 9/11. Several remembered altering their departure time and route into the city as a result of 9/11 but many have reverted back to their previous schedule. Some people stopped using mass transit as a result of 9/11.

"…A creature of habit." Quote from Group two

A few more people in Group two and Group three attempted to make some changes in their route into the city to avoid higher fares and a few tried off-peak. All respondents were looking for the fastest way into the city. When mass transit was suggested as an option it was discounted quickly in terms of saving money; it was not convenient and did not go where they wanted to go. A few tried carpooling but it did not work out because they had to modify their schedule. Thus, shifting to off-peak or carpooling did not save much and people had to change their patterns too much to be worth it to them. Almost none brought up concerns about the environment and the role of the car. Most admitted that New York City road capacity was too small for the number of cars on the road.

"You get upset with it for a little bit but …it is just like the gas prices… you got to pay it." Quote from Group four

A few expressed great concerns about the idea of tolls on the East river bridges. Then a few would use mass transportation more. They also chose their route for the quickest way around. All preferred the car for the convenience and ability to make various stops along the way home. Almost all found mass transit inconvenient unless it went directly to where they wanted to go. Even if a respondent had flexible time at work they still wanted to travel when they wanted to travel.

Why pay by cash now?

Several group four members were concerned that the computer would over-bill them and it would be very difficult to correct. It was simpler to use cash and be more in control of the process. They would know what was going on if they handed money over themselves to a toll taker. A few indicated that the amount of money saved would not offset their billing concerns especially since they did not feel they would use E-ZPass very often. A few told of negative stories of someone unfairly getting ticketed as a result of E-ZPass and of transponder battery problems. There was concern over E-ZPass invading their privacy. A few noted that E-ZPass lanes did not always move quickly as one was lead to believe.

<u>Travel Patterns Today</u>

The major reasons that these respondents make their trips are the same today as before March 25, 2001. They travel mostly for work, visiting family and friends, shopping, and for recreation. The amount of the toll does not strongly influence when they travel unless there is a choice of traveling free or paying a toll. Most aren't even able to state the correct amount of tolls they pay regularly. Most of the respondents like to come into the city during weekends when the traffic is lighter and they are able to get parking.

Groups one and two tended to follow the same travel path for work and recreation without much variation. The Staten Island bridge users tend to listen more to traffic conditions and use a combination of modes of travel that are least congested. That would include using PATH, ferry, express bus, and car. Almost all the group members reiterated that the toll discounts were too small to warrant their making any major travel changes. Several felt they would consider it more for when they traveled recreationally. The discount would have to be quite deep, approaching 50 percent in group four, to be considered. But even then, most were unwilling to alter their route unless it was convenient for them and fit into their time schedule and agenda.

Several considered switching to mass transit at times but only if public transportation was cleaner, safer and more reliable to them. Respondents had no response to variable tolls for HOV lanes though some in Group two knew of the bus lane in the Lincoln tunnel.

PANYNJ Awareness and Suggestions

Group one was the most aware that the PANYNJ ran the facilities discussed in the focus group. About one-third to one-half identified them. Group two, three, and four, in descending order, had less recognition of who ran the facilities. Most often people confused the PANYNJ facilities with those of the MTA. This was in contrast the awareness in the truck dispatcher groups for the PANYNJ.

When members of group three were informed about which agency ran their facilities they began to talk about possible misuse of funds by agencies that ran facilities. When asked to compare the facilities of the PANYNJ and its E-ZPass system to others around the country, few were able to do so. This was especially true of group four. Group one felt this system compared well to the ones in New Jersey and Delaware in terms of ease of use but they preferred the other systems where the car did not have to slow down as much.. Group two felt this system was not as fast as the one in Boston.

Suggestions for improving the PANYNJ system included:

- Allow the cars to travel through toll area without slowing.
- Have E-ZPass lanes conveniently and consistently placed at each part of the roadway;
- Be alerted earlier as to where the E-ZPass lanes start, and;
- Reinstate discounts for frequent usage.

To address traffic congestion, respondents traveling over the George Washington Bridge suggested:

- Filling in the potholes on the Cross Bronx Expressway;
- Ticketing cash users who remain in the E-ZPass lanes;
- Make E-ZPass more available and easier to obtain;
- Eliminate the tolls;
- Improve and reduce the cost of rail and mass transit; and
- Vary tolls based on the size of the car, or the mpg of the car.

Appendix 4. Detailed Findings Phase II - The Commercial Groups

Composition

Both groups were mostly males with two to three women in each group. The for-hire carrier group had a preponderance of small company dispatchers to medium/large company dispatchers while the private truck group had more of an equal balance of those from small companies and those from medium/large sized companies.

There were few large companies in either group. The facilities most traveled were the George Washington Bridge, followed by the Lincoln and Holland Tunnels followed by the Staten Island Bridges.

Most of the for-hire carrier truckers paid tolls by E-ZPass while the private carriers were equally divided in terms of paying tolls by E-ZPass or cash. Most truckers from both groups were traveling during peak weekdays. The ages of the dispatchers varied across the full range with a preponderance in both groups of those in the 36 years to 45 years age range. In both groups about half had some college education while almost all of the others were college graduates. Most of both groups carried goods.

The two truck dispatcher groups expressed very similar attitudes and stated dispatching behavior. No significant differences were found in terms of size of the company.

Warm-Up and First Memory Stimulation

As with all of the passenger car groups the warm-up did successfully “break the ice” and helped the respondents begin to form into a cohesive, working group. All groups were able to remember where they first lived and how they got their first name. Two members of the for-hire carrier group were planning career changes.

Assisted memories of 2001 - Almost all participants of both groups remembered New Year’s 1999-2000. A few were anxious about Y2K problems anticipated. It was harder for most to remember New Year's 2001. Good and bad personal memories of 2001 were difficult for them to attempt to itemize. With some encouragement they said comments like:

" … I can't think of anything positive…I took a big hit in the stock market…" "I gained custody of my son"; "My son little league won the championship." Quote from Group five

One member's business was growing tremendously but the bad news was that it was destroyed by 9/11. The private carrier group members were able to recall more positive and negative events from 2001 than the for-hire carrier group.

For members of both commercial groups 9/11 colored most memories of 2001. In contrast to the passenger car groups they seemed more uncomfortable acknowledging it and discussing it.

During the spring of 2001 several reported business going well or better, while others indicated business was usual. The fall of 2001 was disastrous for most. However, a third of the private carriers indicated business picked up as a direct result of 9/11. Most agreed that 9/11 did eclipse a lot of memories of 2001. It was a sad, frightening time. It disrupted most of their businesses with re-routing, security related backups, other traffic delays, and tension. Truckers had to leave two hours earlier. Private carriers indicated that during 9/11 they sent fewer trucks to New Jersey or condensed trucks to New Jersey.

Most of their businesses were just coming back by January 2004 to what they were before 9/11. Business was slowly picking up but not great. A few reported a little new business but some said the customer bid-competition was more intense. This implied that they had to get more competitive on their prices thereby reducing their profit margins. Gas and oil had gone up as well suggesting that while business may have picked up the cost of doing business had gone up at least as much.

E-ZPass and the Awareness of the Introduction of Variable Tolls

Consistent with the findings of the passenger car groups, the dispatchers had no initial reactions to the date of March 25, 2001. They had neither initial awareness nor recall of the introduction of time of day pricing. When they were told it had something to do with E-ZPass, some thought the date related to when E-ZPass was initiated in New York, or when it was expanded into other regions adjacent to New York, or when it was expanded to commercial vehicles. Others guessed that it had to do with a fuel tax increase, or something related to single occupancy cars and activities of the DOT.

Associations to E-ZPass: The initial reactions of the for-hire carrier dispatchers were about how E-ZPass made paying tolls more convenient. A few voiced concern about being tracked. The initial reactions of the private carrier dispatchers were negative stories (some second and third hand) about double billing nightmares, and scanning malfunctions of the transponders. However, both groups elaborated most on the advantage of being able to drive through and have the tolls made electronically.

"No more sitting at the toll booths for twenty minutes." Quote from Group five

Almost none knew when E-ZPass was created, though many had been dispatchers at the time it started in New York. Most of the respondents thought that E-ZPass was created to save time, and speed up the flow of traffic. No one mentioned it was a possible anti-congestion measure. And they did not think it was an important environmental step since cars got pulled over anyhow and caused pollution.

The benefits of E-ZPass: Both groups agreed that it did speed up the flow of traffic at toll areas. It made tracking of drivers possible thereby providing greater accountability. Now drivers did not have to carry cash. It made billing easier too and reduced some paper work. Some felt it provided greater security because of its tracking potential.

"… (E-ZPass) increased productivity, definitely, we don't have to pay cash on trips anymore, there are no more expenses, an expense report is filled out…" Quote from Group six

Perceived Problems with E-ZPass: The problems associated with E-ZPass were varied. One got the impression that what disturbed them was that E-ZPass made them feel less in control of their life on the road. Several dispatchers disliked the concept of anyone being able to track them. Those from small companies who drove their own trucks felt that E-ZPass could tell when they were speeding above the limits but those truckers felt that they needed to speed in order to make deadlines. Some other respondents reiterated their concern about potential billing errors or being ticketed in error. A few people in Group five felt that in the long term the advantage of E-ZPass would be lost because as everyone migrated to it, the lanes would be clogged once more.

A few people complained that it was confusing for drivers to have the speed limit entering the toll area vary from location to location. Instead they preferred that there be no slow down as you entered the toll area. A few complained of battery failures in the transponders.

In addition it was suggested that E-ZPass put up a website where dispatchers could look up traffic flow and traffic problems in real time.

Time of Day Pricing

Very few people indicated an awareness of time of day pricing. For the few who acknowledged an awareness of the program at the time it came out time of day pricing was a non-event.

"Oh yeah, I remember reading about it. It did not mean very much." Quote from Group five

Only one person remembered reading in the papers about the concept of variable priced tolls to discourage people from coming at peak times.

"It was just something I read and discounted." Quote from Group five

When given more of an explanation of the date March 25, 2001 and time of day pricing, most of the respondents still had only partial awareness and understanding of it. A few wondered if that was when the tolls got raised and ignored references to toll discounts. None felt they made any changes in their dispatching after March 25, 2001 whether or not they were aware of the March toll changes.

“I don’t think there is a major incentive there to … hold up one hour just to take the off hour peak toll there …” Quote from Group five

Variable tolls are not of much interest to these dispatchers. They want to save time and not wait till off-peak or avoid toll roads. If they save substantial time, for example, 15-20 minutes, they will make up more money than the discount offers.

“If I can save a half hour on a job, I’m on to my next job and my next delivery making up that $3 to $5 (discount) much quicker than eating it and saying I’ll go the long way around.” Quote from Group six

The other major stated reason for their lack of interest in time of day pricing and variable tolls was that they did not feel they had much control over when they delivered their goods in relation to their clients.

“We are in a time-sensitive business.” Quote from Group six

“It’s great to get a discount but…we are in the service business we have to get there when our customer s need it.” Quote from Group five

No value in time of day pricing: Consistent with the passenger car drivers, most of the dispatchers did not seem to know what the tolls were in 2001 or now. They were unaware and / or confused about when the toll discounts were in effect and the amount of the discounts. However, even when the dispatchers were recited the difference in tolls peak and off-peak for a three-axle truck, for example, the dollar amount wasn’t impressive to them. The amount of the current discounts was not going to alter the time of day their trucks traveled or their route.

Reactions to tolls in general: "Tolls are just a fact of life**"** when they factor in all the expenses of a trucking company. But many resent having to pay tolls from borough to borough. The benefits of tolls were unclear to these respondents. They were skeptical that tolls actually went to roadway enhancement and repair. There were also some feelings expressed by a few participants that they were treated poorly as an industry. Almost all expressed a wish for tolls to be eliminated. A few suggested alternatives such as adding on more tax to gasoline to cover the tolls.

Awareness of greater usage of lighter trucks:
When asked about changes in the number or ratio of light to heavy trucks on the road, most members of the private carrier group were unclear or mixed as to whether there were more light trucks on the road now.

They guessed that there might be more of them because of possible fuel savings, or because of security restrictions on larger trucks, or because heavier trucks might be traveling off-peak more often.

Some members of the for-hire carrier group believed they saw more heavy trucks on the road, not less. Others believed because of the economy there were fewer trucks on the road in general. After further discussion, several believed that because of less volume that probably more light trucks are being used.

Dynamics between Shippers - Truckers - Receivers

Both private carrier dispatchers and for-hire carrier dispatchers felt initially that the shipper feels the impact of toll changes the most. They benefit from discounts and are impacted by toll increases. Most felt that the truckers would be affected by the shippers need to squeeze the truckers for an even more competitive price. However, truckers may, in some cases re-bill the increases so that they may even benefit by toll increases, especially if they are taking two loads at once from two different clients. [Explain] Ultimately, they described how toll changes, usually toll increases, were passed along from the shipper to the receiver to the customer. Therefore, the truckers were not as disturbed by toll changes. If tolls were discounted they indicated that, where possible, they would probably not pass along the discount.

Dispatchers believed that the biggest concerns of shippers in moving freight in and out of New York City were the following: time (caused by traffic), fuel costs, concern about the labor since they pay by time, and space concerns, i.e., are they putting goods in the most efficient space (truck size). They believed that the receiver was basically concerned about getting the goods safely to them and on time. The truckers' main concerns were over time and traffic.

Truckers wanted receivers and shippers to better understand their problems related to the traffic and time delays and found that shippers and receivers were inflexible and ignorant about New York City traffic and security issues, especially if the receivers came from out of state.

When asked which subgroup had the most control over the trip time, many dispatchers felt that the driver has the most control over the trip time followed by the dispatcher. They did not see much flexibility in choice of route, time of day. They often picked a route by map quest software and knew the hot traffic spots and restricted areas to avoid. The bottom line is that truckers want to pick the quickest route. Some members in the for-hire carrier group felt they had a little flexibility of using non-union drivers at times which may reduce costs.

They were very skeptical that they could influence the receiver to accept goods off-peak if that was not the receiver's typical schedule. They believed that receivers would only do it if the receiver got a big benefit from it and the trucker benefited from going at night. Otherwise, the receiver would have to put on more personnel to accomplish the same task with no apparent incentive. After discussing it, some entertained the idea of getting some clients to accept goods off-peak, such as Home Depot already does. But others added that it depended on when the goods had to be there, what kind of material was being delivered (perishable or not), on union regulations, and on trucks cueing to deliver freight. If trucks had to wait in a queue then they may end up leaving during peak time causing them to be delayed and thereby losing the off-peak advantage.

The truckers reiterated that the amount of tolls did not strongly affect the choice of route. Toll discounts did not have much impact right now. For some private carrier participants the discount would need to be well over 20-30 percent to influence their route at all. It was suggested that those in the larger companies would be more interested in the current off-peak toll discount but those few in the group from the larger companies did not confirm this.

Some restrictions, such as size of truck, mirrors, and HAZMAT did affect the route and they knew the restrictions on each facility. The receiver and end-user paid for the tolls eventually, which, like fuel surcharges, were added on. Midnight to 6 AM discounts would be used when it fit their schedule but they wouldn’t alter their schedule to get the toll discount.

Group Suggestions for Improving the Time of Day Pricing Toll System

- Be consistent about where the E-ZPass lanes are placed.
- Prevent cash users from clogging up E-ZPass lanes.
- Improve the system by making the upper level of the George Washington Bridge E-ZPass only.
- Make the lanes wider.
- Don’t allow construction during congested times.
- Have all the agencies responsible for the roads and traffic coordinate their efforts.
- Give deep toll discounts during off-peak hours.

When suggested to them, the participants liked the following ideas in descending order:: high speed free flow lanes, volume discounts for frequent users, fleet discount, and free transponders. While the for-hire carrier participants liked the idea of pre-approved security clearance, the private carrier participants felt that, as a result of 9/11 security concerns, pre-approved security clearance was not a good idea.

PANYNJ Awareness and Suggestions

PANYNJ Recognition: Half of the for-hire carrier group identified the PANYNJ as running the facilities discussed in the group while almost all the private carriers correctly identified the PANYNJ. When asked if they avoid any of the PANYNJ facilities, the most often mentioned was the George Washington Bridge because traffic congestion was worse there and on the Cross Bronx Expressway leading up to it.

Comparison of the PANYNJ to Other Facilities: When the for-hire carrier group compared the PANYNJ facilities to others around the country they were somewhat negative. Several felt the PANYNJ was behind the times in their toll system that seemed cobbled together.

The private carrier group started out a little more circumspect regarding electronic toll collections systems but became concerned over threats to their autonomy. They initially compared the PANYNJ facilities to other E-ZPass types and indicated that it was better than the NJ system. Maryland and Delaware facilities were comparable to the PANYNJ. But, they added, even if the PANYNJ did a good job at the tolls. The experience of driving through a congested urban traffic was frustrating. For that reason they liked the Thruway even more.

"You never have to stop." Quote from Group six

Suggestions for Dealing with Congestion: The truckers suggested getting rid of the traffic and construction delays and build more tunnels and bridges, i.e**., "**truckers – only bridges" They then discussed the lack of use of the air train at the airport (referencing the under use of mass transit)**.** "New York is very different than any where else; "They all want their independence." Some then asked if E-ZPass would be mandatory and then expressed some resentment about that possibility. That led to concern about their being tracked and ticketed (one respondent got a ticket in the mail and others “heard” that people could be mailed tickets for speeding , unbeknownst to them) through all toll devices such as Metro cards and E-ZPass.

Appendix 5. Current Regular Users' Most Recent Car Trips

This section discusses the findings pertaining to current regular users' most recent trip. Current regular users are individuals who have driven on any of the toll facilities on a regular basis since the time of day pricing initiative. The data collected include trip purpose, travel time frequency, the day of travel, departure and arrival times, time of travel flexibility, payment technology, among other variables. The analyses concerning former regular users' were included in Appendix 8.

There are 467 current regular users in the sample, which account for 3930 trips as weighted responses. The following analysis is based on trip-based weighted responses instead of individual observations. It is important to highlight that the survey focused on the most recent trip made by users in the toll paying direction (eastbound) direction from New Jersey to New York.

Characteristics of Current Regular Users

Similar as the characteristics of the entire weighted sample, current regular users tend to be white, middle-aged men with an above average level of education and household income. This was expected since current regular users account for 91.5 percent of the entire weighted sample. As found in the survey, the majority of current regular users (74.8 percent) used E-ZPass to pay tolls for their most recent car trips. This result is consistent with the data collected by the PANYNJ at the time, which showed that 74 percent of passenger cars used E-ZPass to cross the Hudson River on daily basis. (1)

The survey also asked what bridge or tunnel they used on their most recent trips to get to New York from New Jersey. As expected, New Jersey and Staten Island users exhibited different usage patterns as shown in Figure 93. For New Jersey users, the most frequently used facility is the George Washington Bridge (33.1 percent), followed by the Lincoln Tunnel (32.7 percent) and the Holland Tunnel (20.1 percent), which are three main facilities that connect New Jersey and New York City. On the other hand, the majority of Staten Island users used Goethals Bridge (30.3 percent), the Outerbridge

Crossing (13.7 percent), and the Bayonne Bridge (15.6 percent), which are the tree facilities that enable them to reach areas outside Staten Island.

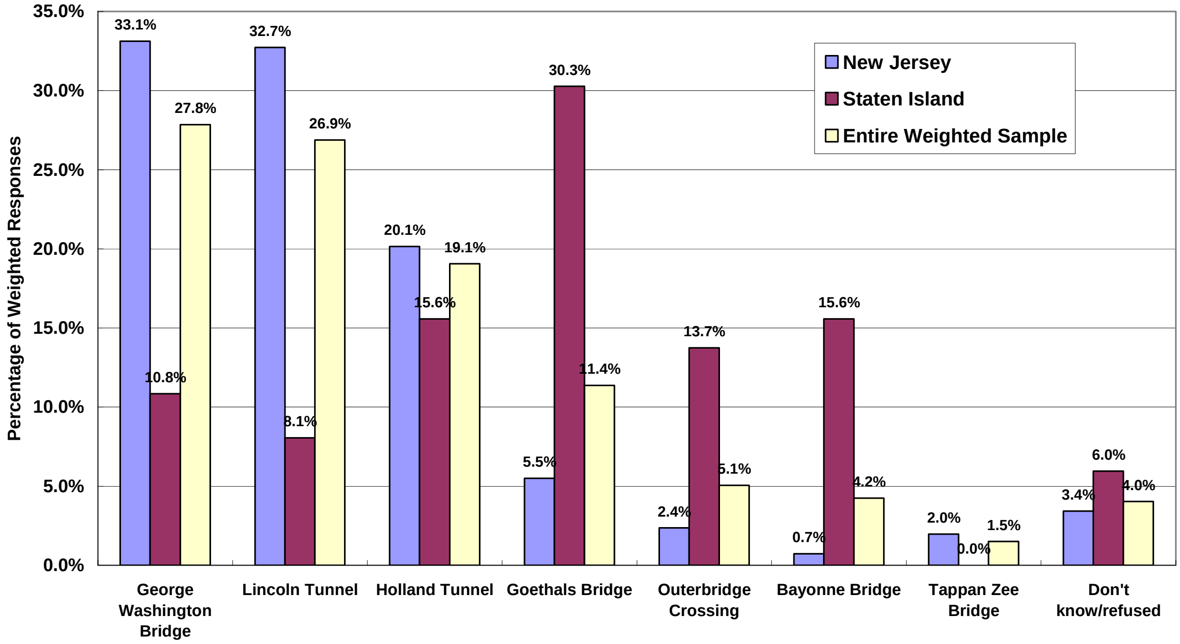


Figure 93. Toll facilities used for on the most recent trip

About 33.5 percent of current regular users said that they also used other toll facilities during their most recent trip. The vast majority of them took the New Jersey Turnpike (21.4 percent or car trips) or the Garden State Parkway (9.8 percent). Others reported using the Verrazano Bridge (1.8 percent), Queens-Midtown Tunnel (1.6 percent), the Triboro Bridge (1.5 percent), the Throgs Neck Bridge (0.2 percent), and/or the Whitestone Bridge (0.1 percent).

Trip Attributes

Trip attributes play an important role in shaping users' responses towards time of day pricing. Among other things, trip attributes determine the toll elasticity and provide the set of constraints in which travel decisions are made. This subsection discusses the attributes of most recent trips made by current regular users. The analyses discuss trip purposes, time of travel, time of travel flexibility, among other attributes.

(1) Trips purposes vs. time of travel

Most of current regular users (94.0 percent) made their most recent trip less than a month before the survey was conducted, and 84.1 percent made the trip just a week before. There are 6.0 percent of current regular users who reported *the past year* as the time when they made their most recent trips, though they said in the screening section that they use the toll facilities on a regular basis. Since it is not clear if this is due to misreporting, their responses are included in the analysis. As shown in Figure 94, the majority of most recent trips (61.5 percent) passing through the PANYNJ facilities were made for work purposes, either commuting to work (46.3 percent) or traveling for job (15.2 percent). The next significant category is the group of recreation/shopping trips, which accounts for 23.9 percent of the most recent trips. Other trip purposes include school trips (4.4 percent), family/friend visits (2.9 percent), and doctor appointments (2.3 percent).

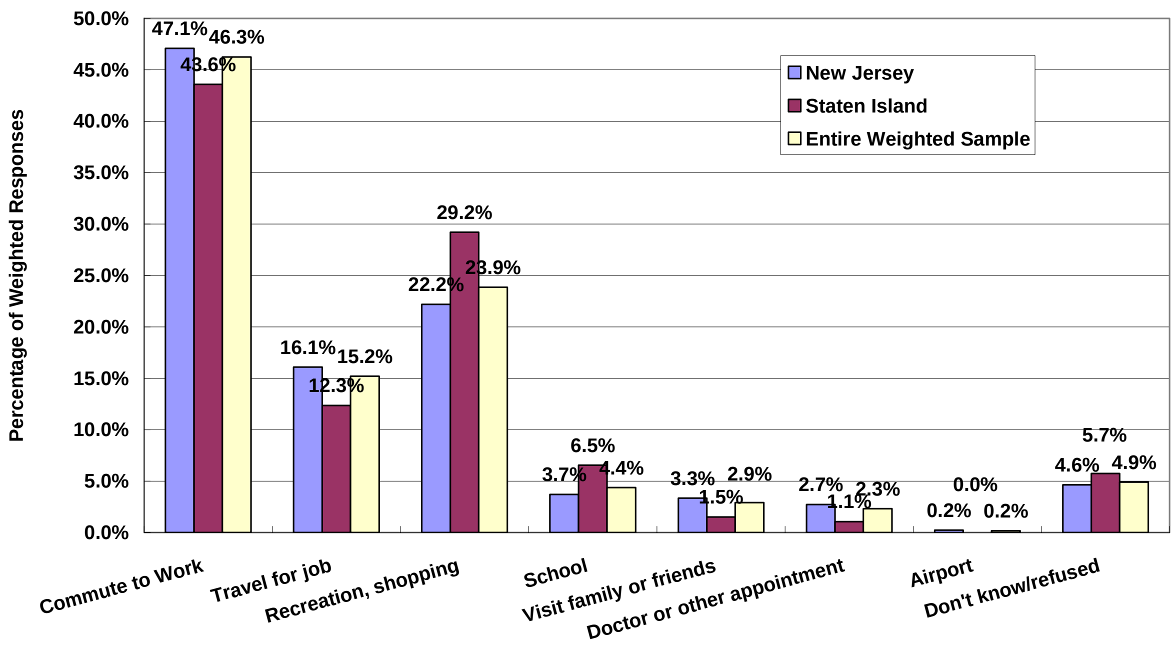


Figure 94. Trip purposes of the most recent car trips (current regular users)

Figure 95 through Figure 97 show the breakdown of the most recent trips by day of the week. As can be seen from Figure 95, traffic across the toll booths in the east bound direction is lopsided towards weekdays, Fridays being the busiest days, followed by

Thursdays and Wednesdays. It also shows that work related trips are the dominant ones on weekdays while recreational/shopping trips account for most of weekend trips, which coincides with most people's travel habits.

New Jersey users and Staten Island users follow similar patterns in their trip purpose distributions by day of week (Figure 96 and Figure 97). This pattern is obvious especially among the most recent trips made by Staten Island users of which 84.0 percent of the current regular users from this area made their trips during weekdays in contrast to 79.3 percent among New Jersey users. Besides this, the two groups of current regular users also exhibit some differences in the distributions of weekday trips. For Staten Island users, the busiest day is Thursday followed by Tuesday while it is Friday followed by Wednesday for New Jersey users.

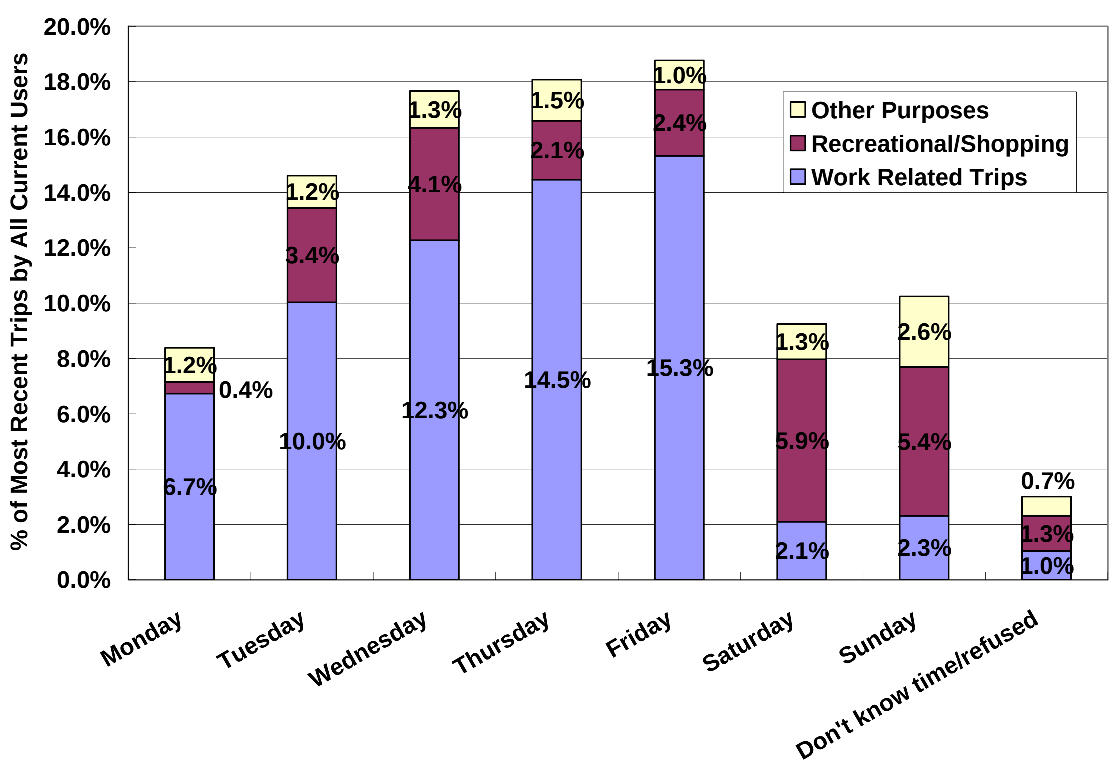


Figure 95. Trip purposes vs. day of week among all current regular users

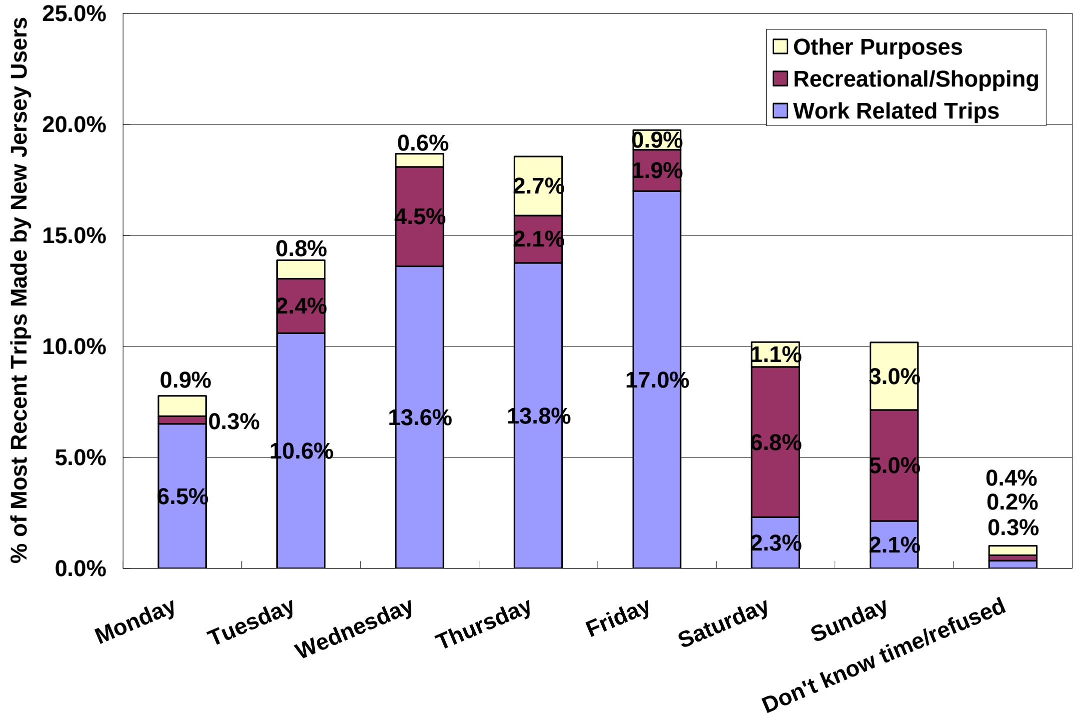


Figure 96. Trip purposes vs. day of week among New Jersey users

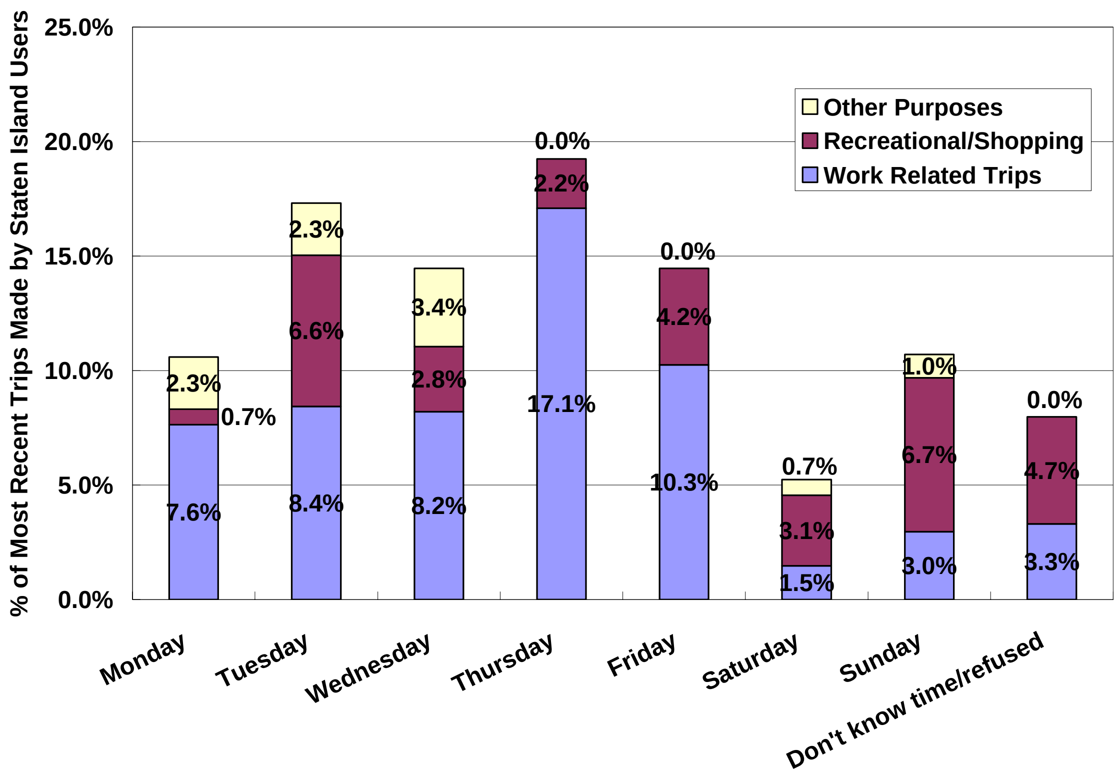


Figure 97. Trip purposes vs. day of week among Staten Island users

Current regular users were asked what time of day they went through the toll booth. Table 109 and Figure 98 show the trip distribution by time of day. Using the toll schedule from PANYNJ (Peak hours: Weekdays 6-9 AM & 4-7 PM, Weekends Noon-8 PM), [12] it was found that approximately 54 percent of current regular users traveled across toll booths in the peak periods, among which the weekday AM peak trips (33.9 percent) are the dominant ones followed by weekday PM peak trips (13.0 percent) and weekend peak trips (7.1 percent). The respondents that are making peak-hour trips are the target of the time of day pricing program, though they may not want to (or be able to) shift their current time of travel to take advantage of the off-peak toll discounts.

Table 109. Trip breakdown by time of travel (current users)

Time of travel	AM Peak	PM Peak	Off-Peak
Weekdays	33.9%	13.0%	34.5%
Weekends		7.1%	11.4%
Combined		54.1%	45.9%

Note: The percentages were calculated on the basis of the valid responses to both questions.

Figure 98 shows the breakdown of most recent trips by time of travel and trip purpose. In general, work related trips were more likely to be made during weekday peak hours (29.9 percent) than trips with other purposes, though weekday off-peak trips for work related purposes are also significant (25.1 percent). On the other hand, trips for recreational/ shopping purpose were more likely to happen in the less congested time periods, i.e., weekday off-peak hours (6.4 percent), or weekends (11.9 percent).

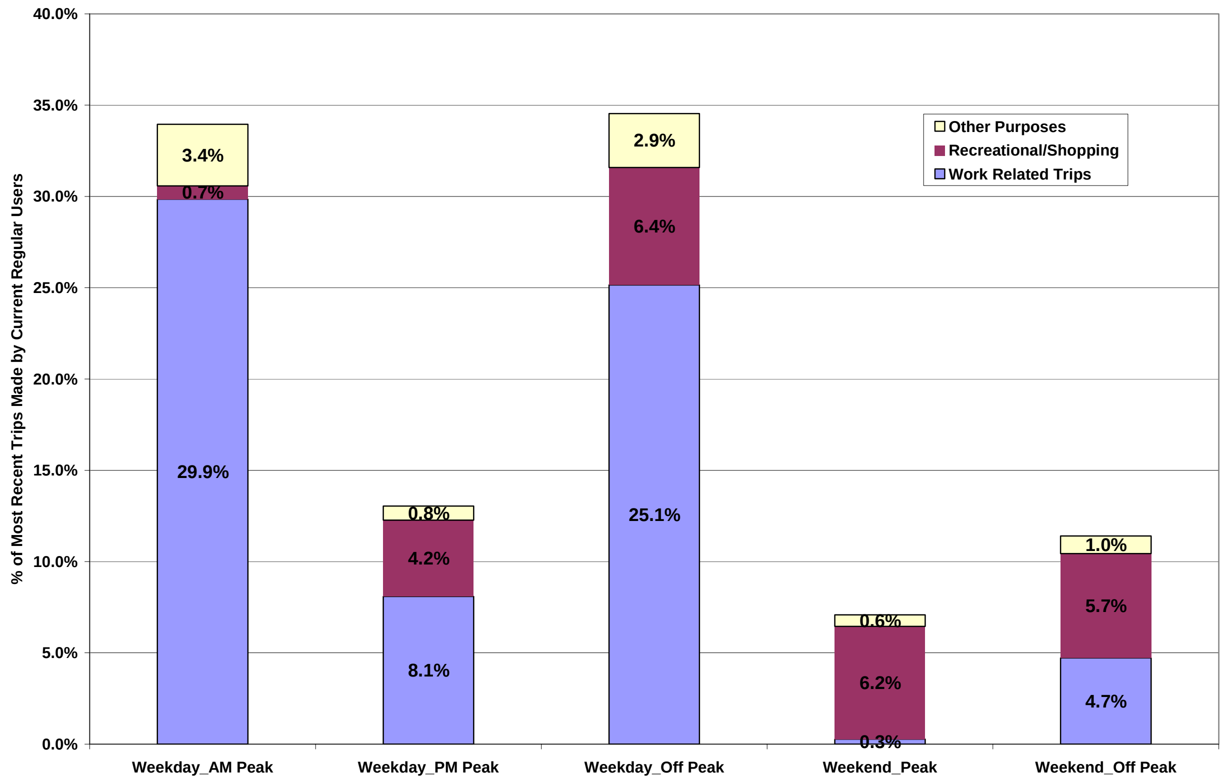


Figure 98. Trip purposes vs. time of travel among all current regular users

When these current regular users were asked why they traveled at that time (Table 110), approximately 70.0 percent of current regular users said it is because of their *work schedule* (48.4 percent), or *to make an appointment* (22.3 percent). Only 0.3 percent of current regular users traveled at the stated time to take advantage of toll discounts. This seems to suggest that off-peak discounts are working among a marginal number of trips that can be influenced in users' travel decisions.

Table 110. Reasons for traveling at the stated time (current users)

Reasons for Traveling At Stated Time	**% of Weighted Responses**
Work schedule	48.4%
To avoid congestion	22.3%
To make an appointment/meet people	15.1%
Out of habit / what I usually do	4.3%
So I could return at a certain time	2.0%
Easier or cheaper parking availability	1.3%
Don't know time/refused	6.4%
Cheaper toll	0.3%
Total	100.0%
Based on weighted responses of	**3930**

(2) Time of travel flexibility

The survey collected information of time of travel flexibility, i.e., how much later/earlier than the typical departure or arrival time current regular users would be able to depart or arrive and still meet their schedules. Table 111 shows the mean values of time of travel flexibility for current regular users. The analyses are based on 3930 trip-based weighted responses from 467 current regular users. Among them, 2415 weighted responses correspond to work related trips, 937 were recreation/shopping trips, and 384 were other trips, while the rest did not provide information of trip purpose. In general, the flexibility is within 20 minutes, on average, for all trips. The relatively small flexibility indicates that current regular users have constraints that make it difficult to shift to their time of travel regardless of trip purpose.

Figure 99 thru Figure 102 show the distributions of late/early departure flexibility and late/early arrival by trip purpose. It could be seen that current users reported more flexibility of being early than being late, which indicates that people usually prefer traveling earlier rather than later. For departure flexibility, as shown in Figure 99 and Figure 100, current regular users exhibit similar flexibilities for work related trips and recreation/shopping trips. For late arrival flexibility (Figure 101), a higher percentage of work related trips have no flexibility than recreation/shopping trips and vice versa for early arrival (Figure 102). For early arrival flexibility, work related trips seem to have more flexibility than recreation/shopping trips. Interestingly enough, regardless of trip type, the percentage trips reporting flexibility of 30 minutes or more is roughly 10 percent. This group of current users could be the target of the time of day pricing initiative since they have the flexibility to shift their current time of travel.

Table 111. Travel flexibility for current regular users (unit: minutes)

Mean	Trip Type			
	Work related	Recreation/shopping	Other	All
Late departure	14.7	13.8	14.4	14.4
Early departure	19.0	16.4	15.3	18.0
Late arrival	12.3	13.4	9.7	12.2
Early arrival	20.4	16.0	24.2	19.6

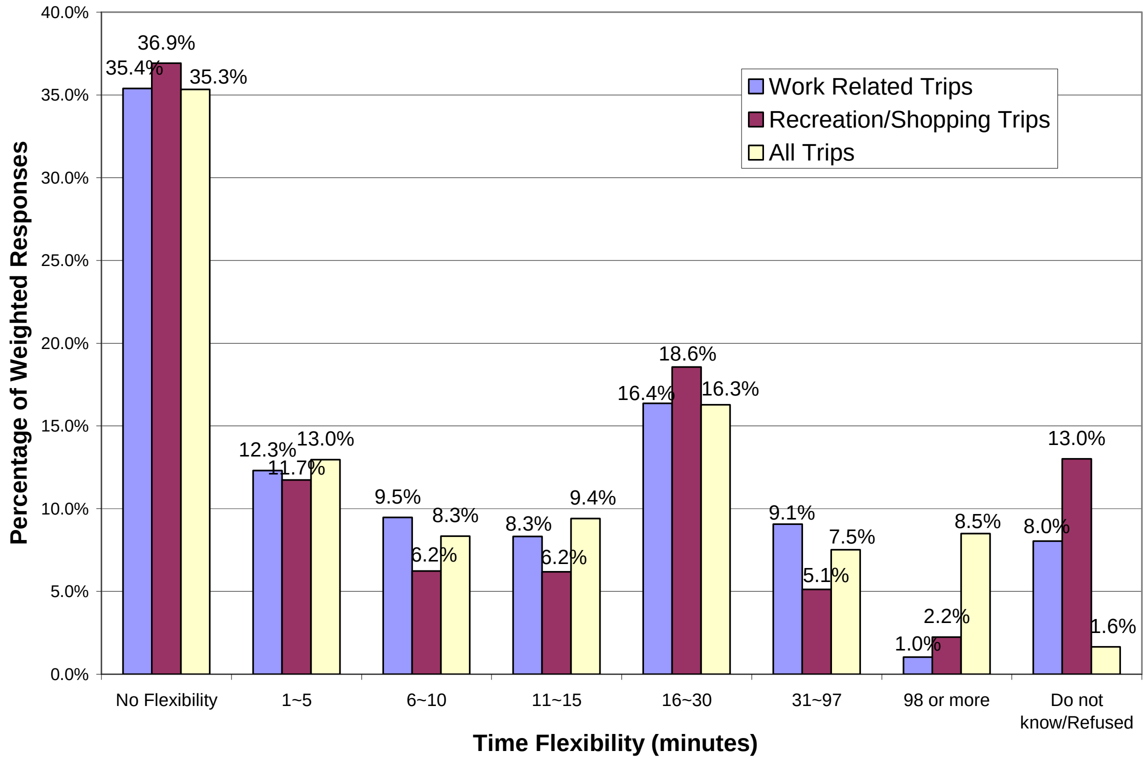


Figure 99. Departure flexibility for current users (late departure)

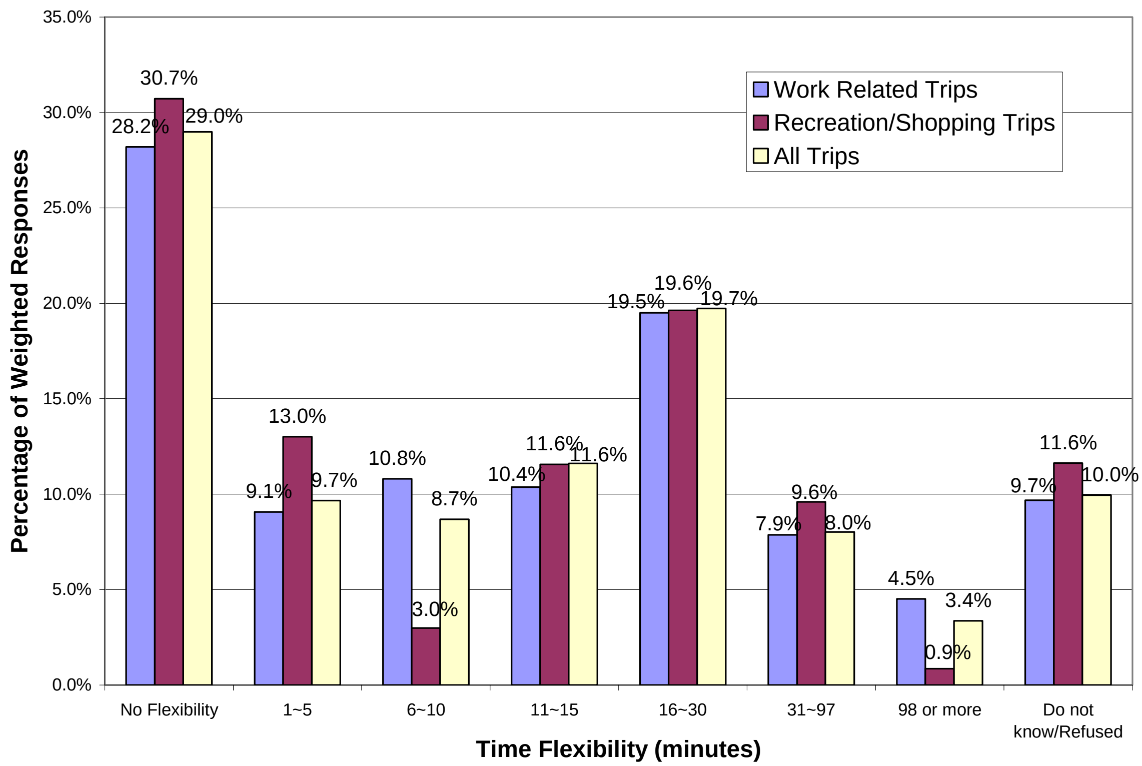


Figure 100. Departure flexibility for current users (early departure)

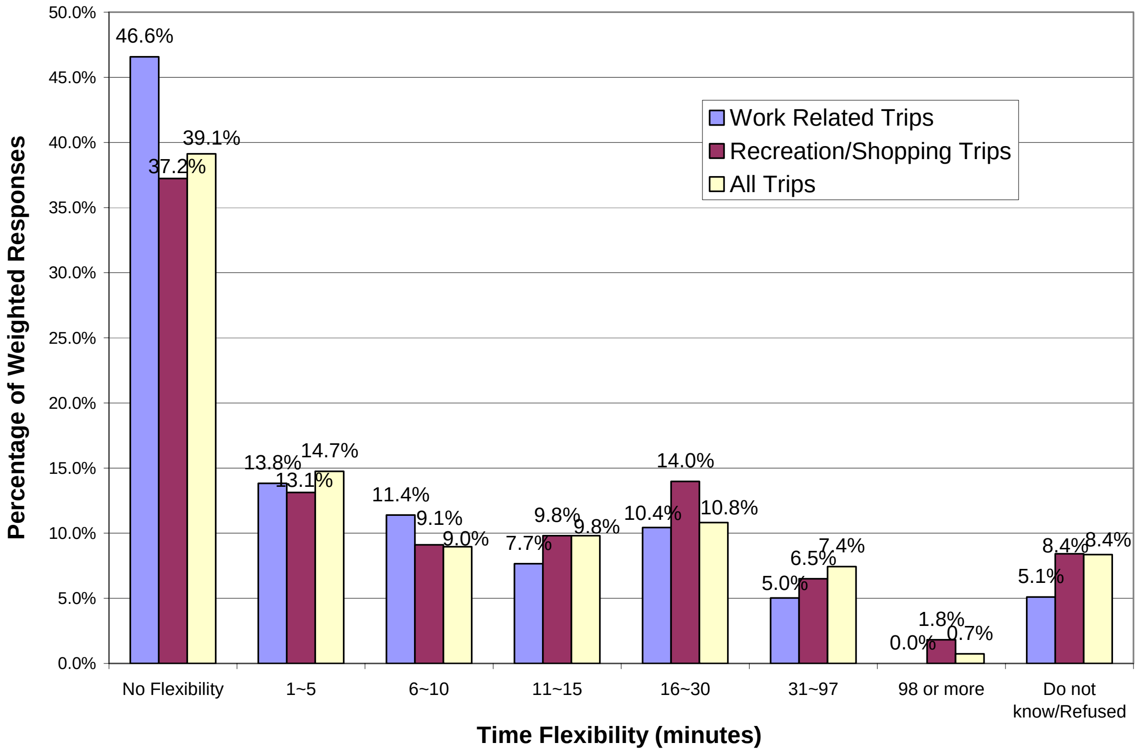


Figure 101. Arrival flexibility for current users (late arrival)

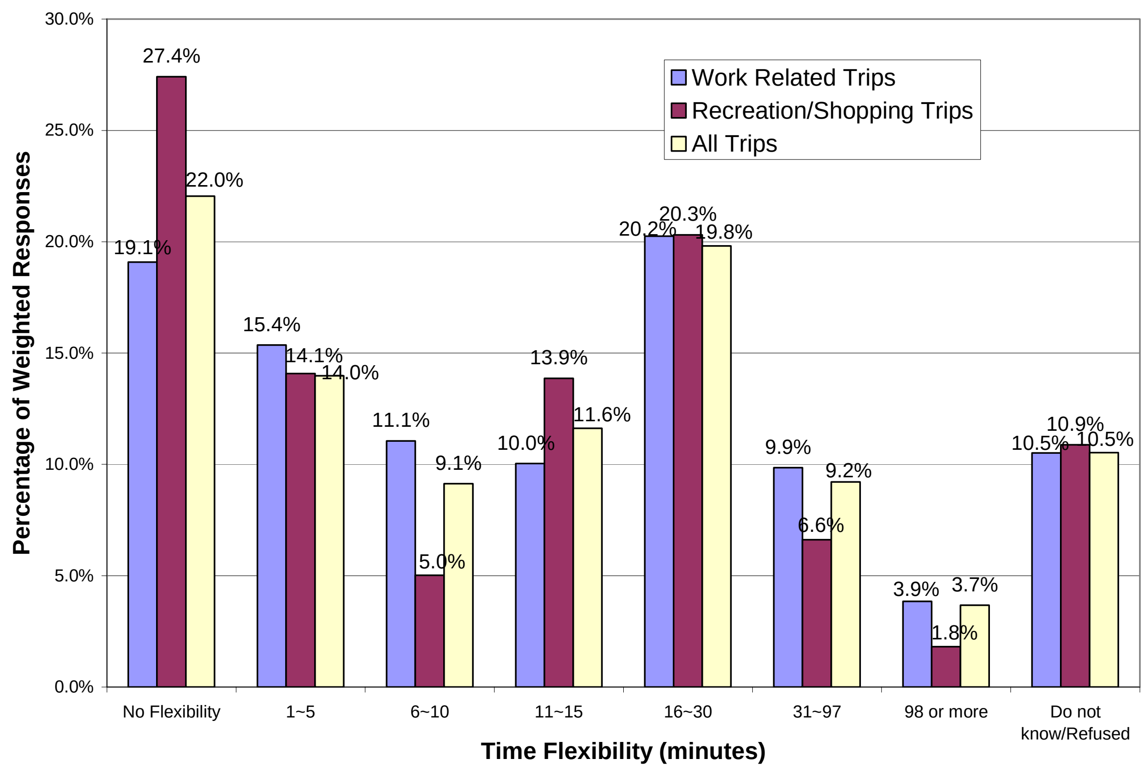


Figure 102. Arrival flexibility for current users (early arrival)

Travel Costs

This subsection discusses the data about travel costs collected by the survey. Among other things, the analyses focus on: (1) assessing the respondents' awareness of the actual tolls they paid; (2) understanding the relative importance of parking fees.

(1) Tolls paid for the most recent trip

61.8 percent of current E-ZPass users reported how much they paid at the toll facilities; while 82.4 percent of cash users did so. Figure 103 shows the distributions of the difference between the respondents' stated tolls and the actual tolls for New Jersey users. Responses from Staten Island users were not included because it as not possible to determine with certainty the actual tolls they pay (some users are part of the frequent user discount; while other pay regular tolls). The research team could also not conclude how many New Jersey respondents participated in the Staten Island Bridges discount program from the survey questions. While about 50 percent of the Staten Island Bridges discount program users are from New Jersey, for simplicity of analysis it was assumed that none of the New Jersey respondents took advantage of the Staten Island Bridges discount program.

In the case of New Jersey users, the actual tolls are $6.00 for cash users, $5.00 during peak hours and $4.00 during off-peak hours for E-ZPass users. The analyses in this figure are based on 2891 trip-based weighted responses from New Jersey current regular users (2216 weighted responses of E-ZPass users and 681 weighted responses of cash users, 101 weighted responses were excluded from this analysis because they did not specify if they paid by E-ZPass or cash).

As shown in Figure 103, more E-ZPass users' trips (38.1 percent) reported "do not know" or "refused" than cash users (20.3 percent). This includes the following cases: (1) did not know, or (2) refused to answer, or (3) did not specify time of day and/or day of week. This suggests that compared with cash users, E-ZPass users are much less aware of the actual amount of tolls they paid, which is probably true since people tend not to pay attention to the toll signs when they through the toll booths. Furthermore, while the majority of cash users' trips (60.5 percent) correctly reported the tolls, only 17.4 percent of those paying E-ZPass did so. Both types of users' trips underestimated tolls in similar proportions: E-ZPass users' trips (10.6 percent) and cash users' trips (14.4 percent). However, the amounts of overestimations are vastly different: while 33.9 percent of E-ZPass users overreported tolls, only 4.8 percent for cash tolls did so.

The mean value and the standard deviation of the misreported tolls confirms that, as a group, cash users have a more precise idea about how much they paid in tolls. The mean value of the misreported toll for E-ZPass users is $0.4 (positive sign means overreported) with a standard deviation of $1.7; while the mean value for cash users is -$0.1 (negative sign means underreported) with a smaller standard deviation ($1.3).   It must be noted that the tendency to overreport tolls for E-ZPass trips may be slightly biased toward over-reporting since those New Jersey users who pay a Staten Island Bridge discount toll were not factored into these calculations.

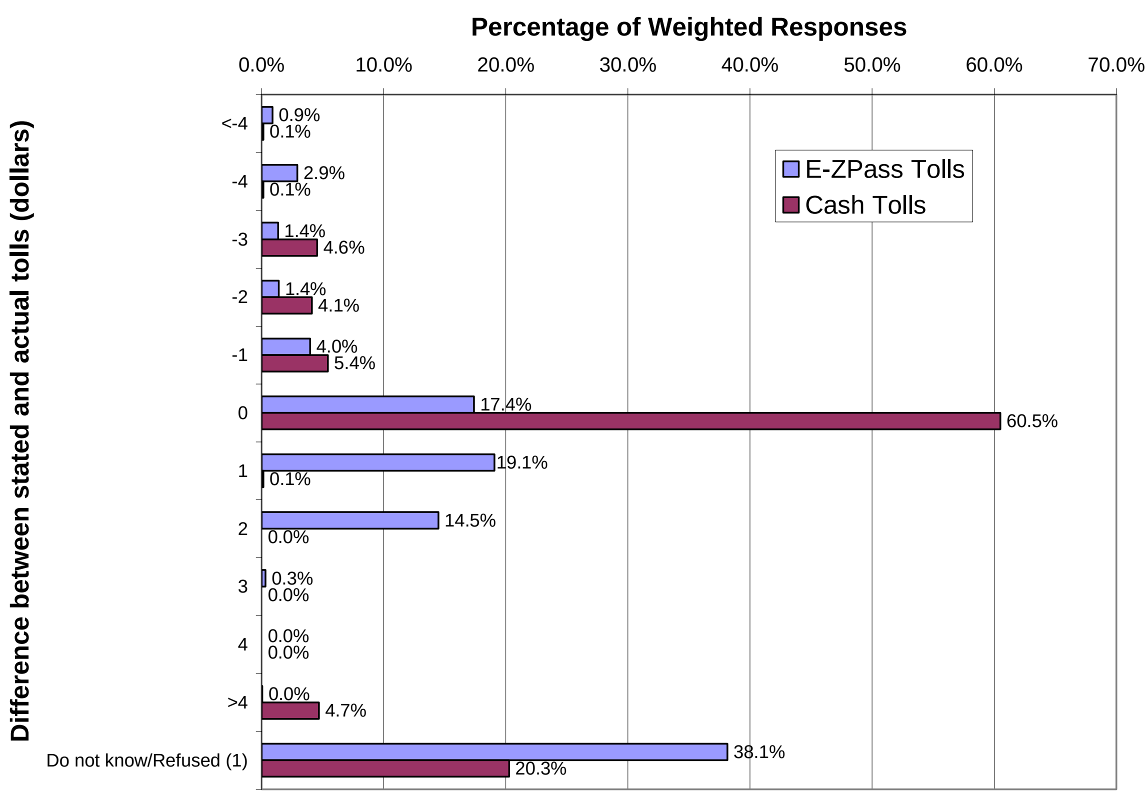


Figure 103. Difference between stated and actual tolls –New Jersey– (dollars)

Note: For E-ZPass users, the category of “Do not know/Refused” includes respondents whose actual tolls are unknown because they either did not report time at the toll plaza and/or day of travel, since E-ZPass has different toll rates during different times of day and day of week.

(2) Parking fees

The survey collected data amount the parking fees. The data show that the majority of participants do not pay for parking. Approximately a quarter of current regular users (26.3 percent) paid for parking, either by themselves (23.4 percent) or sharing with others (3.0 percent), while others *park for free* (60.1 percent), *the employer paid* (9.3 percent) or *other passengers paid* (1.1 percent). The average fee, for those who paid for parking, was $16.40, which is more than three times higher than the average tolls paid.

(3) Estimated cost by transit

The survey also asked current regular users to estimate the travel cost for their most recent trips (one-way trip from New Jersey to New York) if they would have made by transit. Current regular users estimated the travel cost by transit as $9.60 per trip on average. This amount is lower than the average parking fees for those who paid parking by themselves.

Appendix 6. Characteristics of the Individuals that Changed Behavior

The analysis in this appendix is based on 35 passengers who changed their travel behavior because of time of day pricing, which account for 316 weighted responses and 7.4 percent of the entire weighted sample (Table 40). Compared with those who did not change behavior, the 35 individuals who changed travel behavior are similar in race and employment status, but different in most of other socio-economic attributes such as gender, age, education levels, household structure and car ownership. The following analysis summarizes the main distinctions of the trips made by these 35 individuals. Again, the reader is warned that—because of the very small sample size—the conclusions must be interpreted with great caution. At best, they only provide a qualitative idea about the characteristics of the individuals that changed behavior.

It is interesting to find that more trips were changed by females because of the time of day pricing initiative than by males as shown in Table 112. Females account for 57.6 percent of the trips that changed by the individuals who indicated that they changed behavior in contrast to only 40.2 percent of the trips among those who did not change behavior.

Table 112. Gender (changed vs. not change)

Gender	Respondents who changed behavior	Respondents who did not change behavior
Male	42.4%	59.8%
Female	57.6%	40.2%
Total	100.0%	100.0%
Based on weighted responses of	**316**	**3977**

The analysis of the age distribution suggests that the 35 individuals who changed behavior are relatively younger than those who did not change. As shown in Figure 104, when the respondents are younger than 50.0 years, the percentages of the individuals who changed their behavior are generally higher than those who did not change; it is exactly the opposite when the range of age is greater than 50.0 years old. What is more, the average age of these individuals is 38.3 years, which is about seven years younger than those who did not change (45.2 years).

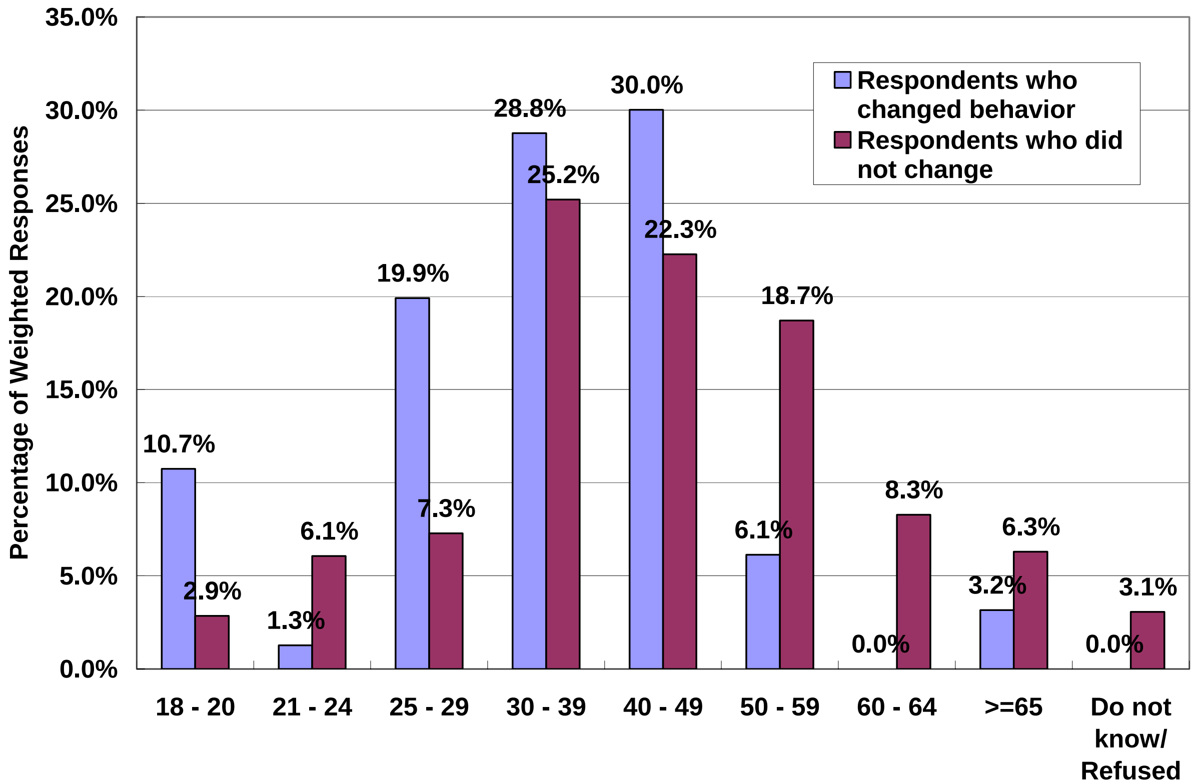


Figure 104. Comparison of age distribution

The 35 individuals who changed their behaviors have a relative lower education level than those who did not change. As shown in Figure 105, these who changed behavior tend to have level of education of vocational or technical school, some college, and junior college graduates levels. Those with a four-year college degree are overwhelmingly less likely to change behavior. It also suggests that individuals who have some levels of education above high school complete and below four-year college graduate level are more sensitive to the changes of the toll structure.

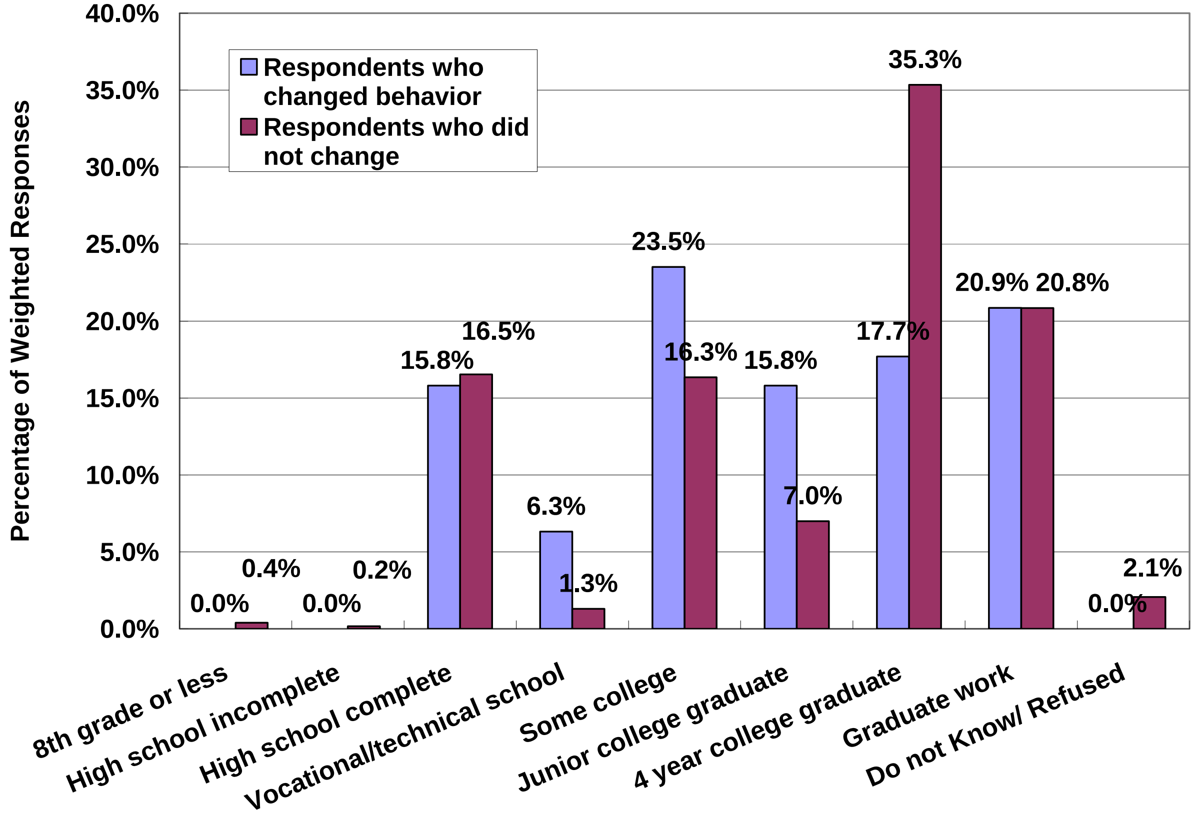


Figure 105. Comparison of education level distributions

The previous findings pertaining to age and education level could be further explained by the analyses of their household income, since people who are younger and have relatively lower education levels generally earn less than those who are older and well-educated. The median income for these 35 survey respondents who changed behavior ($86,450) is lower than the one for those who did not change ($93,458). As shown in Figure 106, the largest group among these who changed behavior is the one with household income ranging from $75,000 to $100,000 (35.4 percent), while the most significant one for those who did not change earned more than $100,000 per year (36.2 percent). Meanwhile, the proportion of these individuals who earned less than $ 25,000 per year among these who changed behavior (12.6 percent) is about three times higher than the one among those who did not change (3.5 percent).

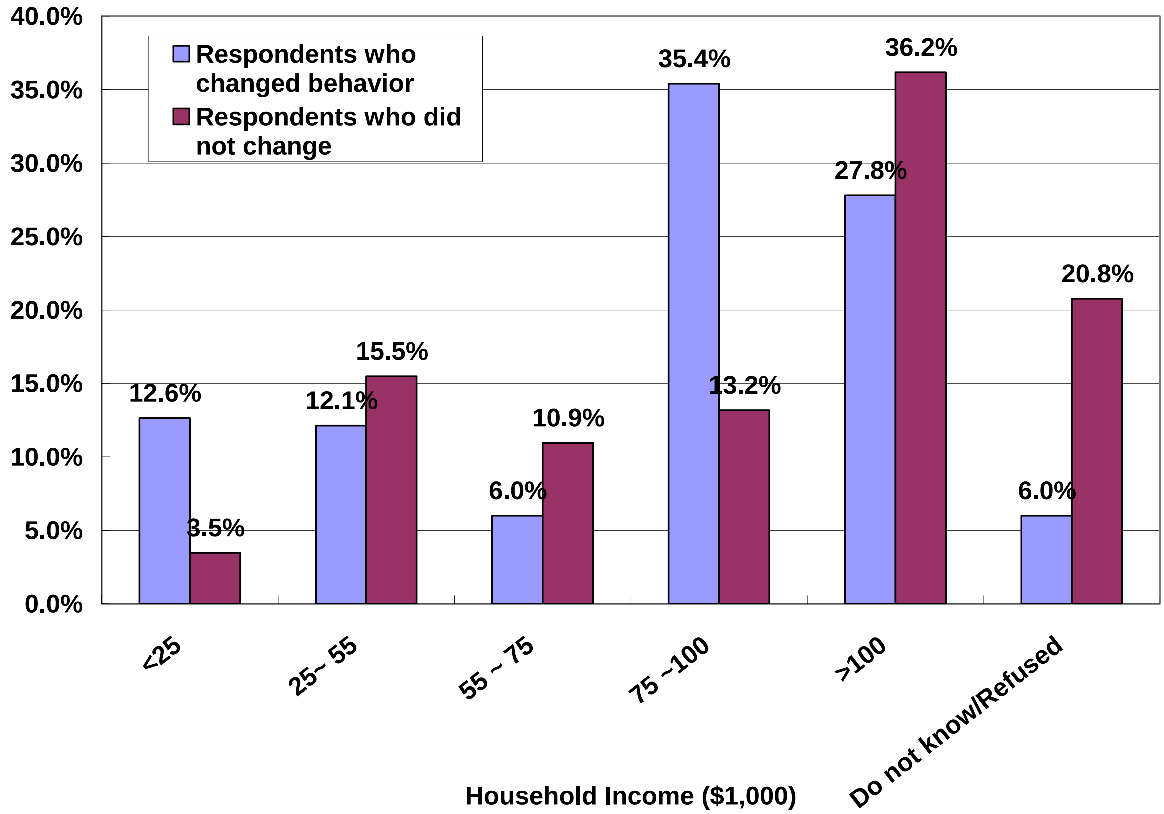


Figure 106. Comparison of household income distributions

Consistent with the age distribution, the 35 individuals who changed behaviors tend to have smaller families with less adults but almost the same number of children compared with those who did not change. The number of licensed drivers and cars in the household follow the similar pattern as the number of adults. The detailed comparisons are listed in Table 113 and Table 114.

Table 113. Comparison of household structure

Household Structure	Respondents who changed behavior	Respondents who did not change
Adults in household (average)	**2.1 adults**	**2.5 adults**
1	33.3%	18.8%
2	51.5%	48.3%
3+	12.0%	29.7%
Do not know/Refused	3.2%	3.2%
Total	100.0%	100.0%
Licensed drivers in household (average)	**2.0 drivers**	**2.3 drivers**
1	33.6%	23.0%
2	54.7%	48.8%
3+	8.5%	25.7%
Do not know/Refused	3.2%	2.5%
Total	100.0%	100.0%
Children in household (average)	**1.2 children**	**1.1 children**
0	50.7%	53.9%
1	17.4%	19.3%
2	19.0%	13.1%
3+	9.8%	10.5%
Do not know/Refused	3.2%	3.2%
Total	100.0%	100.0%
Based on weighted responses of	**316**	**3977**

Table 114. Comparison of car ownership

Car ownership	Respondents who changed behavior	Respondents who did not change
Number of cars in household	**1.8 cars**	**2.3 cars**
0	0.0%	4.4%
1	37.7%	25.0%
2	44.2%	40.1%
3+	18.0%	26.5%
Do not know/Refused	0.0%	3.9%
Total	100.0%	100.0%
Based on weighted responses	**316**	**3977**
Among the respondents reporting car ownership:		
Fewer cars than licensed drivers	10.4%	23.7%
Cars >= licensed drivers	89.6%	76.3%
Total	100.0%	100.0%
Based on weighted responses	**274 (1)**	**2914**

Note: (1) Some participants did not report either the number of cars owned or the number of licensed drivers in household.

Appendix 7. Behavior Change Patterns

The analysis in this appendix is based on 35 passengers who changed their travel behavior because of time of day pricing, which account for 316 weighted responses and 7.4 percent of the entire weighted sample (Table 40). Table 115 shows the behavioral changes reported by the 35 participants that modified their travel patterns as a consequence of the time of day pricing initiative. The most obvious finding is the multidimensional nature of their responses, which frequently involved three to five different dimensions of change. As shown, the average number of changes is 2.97 changes/person.

In the following analysis, the breakdown of responses by each dimension of changes (Table 117) shows the most significant dimensions. Table 118 shows the major and minor two-dimension combinations of changes. Since most of the 35 passengers reported at least two types of behavioral changes, two-dimension combinations, instead of three or four-dimension combination, were used to summarize the behavioral findings. Because of the relatively low response rate, Table 115 is able to reflect the entire survey data set for the change dimension analysis for each individual respondent.

Table 115. Behavioral changes reported by passengers

User ID	Area	User type (current user or former user)	Transit use	Changes in car trips: Total number	Weekday peak	Weekday off-peak	Weekend peak	Weekend off-peak	Carpool	Switch to E-ZPass	Number of stops	Changes made	Trips / month
267	NJ	CU	I	D	D			D				4	8
715	NJ	CU	I	D	D	D			S			5	5
1035	NJ	CU	I	D	D	D	D	D	I			7	1
1221	NJ	CU	I	D	D		I	D	Q	Y		7	10
1733	NJ	CU	I	D	D	D	D	D	S		D	8	10
2821	NJ	CU	I	D	D	D	D	D		Y		7	10
1723	NJ	CU	I									1	20
2563	NJ	CU	I		D	D	D	D				5	5
2795	NJ	CU	I									1	10
3574	SI	CU	I						S	Y		3	3
4386	SI	CU	I									2	6
2818	NJ	CU	D		D	D						3	4
2637	SI	CU	D			D					I	3	1
883	NJ	CU		D			D					2	3
974	NJ	CU		D								2	5
1141	NJ	CU		D		D	D	D				4	3
1703	NJ	CU		D	D	I	D	I			D	6	2
1584	SI	CU		D		D		D			D	4	2
1171	NJ	CU										0	20
1442	NJ	CU					D		S			3	3
2431	NJ	CU								Y		1	1
2482	NJ	CU										0	4
3330	NJ	CU			D					Y		2	10
591	SI	CU				I	D					2	12
2167	SI	CU						I			D	2	10
100	NJ	FU	I	D	D	D	D	D				6	4
1142	NJ	FU	I	D	D	I						4	30
1449	SI	FU	I	D		I			S			4	30
1546	NJ	FU	I						S	Y		3	30
1721	NJ	FU	D	D	D	D	D	D	D			7	4
553	NJ	FU			D	I						3	20
5248	SI	FU	D						S			2	0
2759	NJ	CU	D	D	I							3	0
3368	NJ	CU										0	10
1707	NJ	CU										0	20
Average												2.97	

Note: Two individuals (5248 and 2759) do not make the reported trip frequently, which explains the values of trip/month equal to zero. The last two individuals (3368 and 1707) did not provide data about the nature of their behavioral changes. Notation: I: Increase, D: Decrease; S: Switch to; Q: Quit; Y: Yes.

Table 116 shows the summary of behavioral changes obtained after adding together the trip-based weighted responses for all the users listed in Table 115.

Table 116. Summary of behavioral changes

Direction of changes	Use of public transit	Number of car trips	Car trips made during weekday peak periods	Car tripsmade during weekday off-peak periods	Car trips made during weekend peak periods	Car trips made during weekend off-peak periods	Carpooling	Switching to E-ZPass	Stops made during a trip
I	182	0	0	94	10	12	1	0	1
D	9	127	123	49	57	57	4	0	24
S	0	0	0	0	0	0	81	0	0
Q	0	0	0	0	0	0	10	0	0
Y	0	0	0	0	0	0	0	64	0
Total	191	127	123	143	67	69	96	64	25

Notation: I: Increase, D: Decrease; S: Switch to; Q: Quit; Y: Yes

Note: The total numbers computed are based on the weighted responses.

Table 117 summarizes the dimensions of travel behavior changed by the 35 respondents who reported a change due to the time of day pricing initiative by geography. The typical reactions of the respondents towards time of day pricing include *a shift towards public transportation*, *a reduction in the frequency of trips made by car*, *a shift towards carpooling*, and *a decrease in the number of stops during the trip*. Among these strategies, the most widely used one was to *increase usage of public transportation* (4.2 percent of the entire trip-based weighted sample) followed by *decreasing the car-trip frequency across the tolled facilities* (3.0 percent of all trips reported by the 35 respondents).

In terms of time of day, only 2.9 percent of the 35 respondents reported decreasing the car trips during the weekday peak hours, while, 2.2 percent said they increased the car trips during the weekday off-peak hours. Of the trip-based weighted sample, 2.6 percent decreased their weekend car trips during either peak (1.3 percent) or off-peak periods (1.3 percent), while 1.9 percent *starting using carpooling,* 1.5 percent *switched to E-ZPass*, and 0.6 percent *decreased the number of stops during a trip*.

Table 117. Dimensions of change for travel behavior

Dimensions of Change	New Jersey		Staten Island		Entire Weighted Sample	
	% of Valid (1)	% of Sample (2)	% of Valid	% of Sample	% of Valid	% of Sample
1. Usage of public transportation						
Increased	56.8%	4.3%	60.9%	3.9%	57.9%	4.2%
Decreased	3.2%	0.2%	1.6%	0.1%	2.8%	0.2%
2. Frequency of using the toll facilities						
More	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Less	37.8%	2.9%	50.0%	3.2%	40.3%	3.0%
3. Number of trips during peak hours (weekdays) (3)						
Increased	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Decreased	48.9%	3.7%	0.0%	0.0%	39.0%	2.9%
4. Number of trips during off-peak hours (weekdays) (4)						
Increased	20.6%	1.6%	65.6%	4.2%	29.7%	2.2%
Decreased	18.2%	1.4%	4.7%	0.3%	15.5%	1.1%
5. Number of trips during peak hours (weekends) (5)						
Increased	4.0%	0.3%	0.0%	0.0%	3.2%	0.2%
Decreased	17.8%	1.4%	18.8%	1.2%	18.0%	1.3%
6. Number of trips during off-peak hours (weekends) (6)						
Increased	0.8%	0.1%	15.6%	1.0%	3.8%	0.3%
Decreased	22.0%	1.7%	3.1%	0.2%	18.1%	1.3%
7. Carpooling						
Start using	19.0%	1.5%	51.6%	3.3%	25.6%	1.9%
Increase using	0.4%	0.0%	0.0%	0.0%	0.3%	0.0%
Stop using	4.0%	0.3%	0.0%	0.0%	3.2%	0.2%
Decrease using	1.6%	0.1%	0.0%	0.0%	1.3%	0.1%
8. Switching to E-ZPass	24.2%	1.9%	4.7%	0.3%	20.2%	1.5%
9. Number of stops during the trip						
More	0.0%	0.0%	1.6%	0.1%	0.3%	0.0%
Less	4.8%	0.4%	18.8%	1.2%	7.6%	0.6%
Based on weighted responses of	**252**	**3297**	**64**	**997**	**316**	**4294**

Note: (1) Percentage among the respondents who reported change in the corresponding category;

(2) Percentage among all the respondents in the corresponding category;

(3) Weekday peak hours are between 6 and 9 AM or 4 PM and 7 PM;

(4) Weekday off-peak hours are between 9 AM and 4 PM or between 7 PM and 6 AM next day;

(5) Weekend peak hours are between noon and 8 PM;

(6) Weekend off-peak hours are before noon or after 8 PM.

Two-dimension combinations of changes are shown in Table 118. *Reducing car trips* + *increasing transit trips* + other changes (2.5 percent among the entire weighted sample) is the most cited combination of behavioral changes; followed by *increasing transit trips* + *increasing (or starting) carpoolin*g + other changes (1.8 percent). Some people chose *increasing the transit trips* + *switching to E-ZPass* (1.2 percent) + other changes as their strategy. A proportion of people who changed their number in weekdays tended to *decrease the trips in peak hours* but *increase the trips in off-peak hours* (1.2 percent). Also, a group of people decreased their car trips in both weekday peak and off-peak periods (1.0 percent). It is obvious that this pattern of time of travel switch is more significant during weekdays than during weekends. The possible reason is that this strategy is more cost efficient since most of car trips are made during weekdays. Other important combinations include: *decreasing car trips* + *switching to carpool* + other changes (1.1 percent), and *decreasing car trips during both weekend peak hours and weekend off peak hours* (0.9 percent).

Table 118. Cited combinations of behavioral changes

Combinations of behavior changes	New Jersey		Staten Island		Entire weighted Sample	
	% of Valid (1)	% of Sample (2)	% of Valid	% of Sample	% of Valid	% of sample
Major two-dimension combinations:						
Decrease car trips + increase transit trips + … (3)	31.1%	2.4%	46.9%	3.0%	34.3%	2.5%
Increase transit trips + increase/start carpooling + …	18.2%	1.4%	51.6%	3.3%	25.0%	1.8%
Increase transit trips + switch to E-ZPass + …	19.8%	1.5%	4.7%	0.3%	16.8%	1.2%
Decreae car trips during weekday peak + increase during weekday off peak + …	20.6%	1.6%	0.0%	0.0%	16.4%	1.2%
Decrease car trips + increase/start using carpools + …	6.3%	0.5%	46.9%	3.0%	14.5%	1.1%
Decrease car trips during both weekday peak and weekay off peak + …	17.0%	1.3%	0.0%	0.0%	13.6%	1.0%
Minor two-dimension combinations:						
Decrease car trips during both weekend peak and weekend off peak + …	14.7%	1.1%	0.0%	0.0%	11.7%	0.9%
Switch to E-ZPass + increase/start using carpools + …	11.9%	0.9%	4.7%	0.3%	10.4%	0.8%
Decrease weekday car trips + increase/ start using carpools + …	6.3%	0.5%	0.0%	0.0%	5.1%	0.4%
Decrease car trips + decrease the number of stops + …	4.8%	0.4%	3.1%	0.2%	4.4%	0.3%
Decrease car trips + decrease/stop carpooling + …	5.5%	0.4%	0.0%	0.0%	4.4%	0.3%
Decrease number of stops + increase/start carpooling + …	4.0%	0.3%	0.0%	0.0%	3.2%	0.2%
Increase the transit trips + decrease carpooling + …	4.0%	0.3%	0.0%	0.0%	3.2%	0.2%
Decrease car trips+ decrease transit trips + …	1.6%	0.1%	0.0%	0.0%	1.3%	0.1%
Decrease weekend trips + increase/start carpooling + …	1.2%	0.1%	0.0%	0.0%	0.9%	0.1%
Decreae car trips during weekend peak+increase during weekend off peak + …	0.8%	0.1%	0.0%	0.0%	0.6%	0.0%
Based on weighted responses of	**252**	**3297**	**64**	**997**	**316**	**4294**

Note: (1) Respondents who changed behavior in the corresponding category;

(2) Percentage among all the respondents in the corresponding category;

(3) The combinations tend to have more than two dimensions of changes, though only the two main ones were identified.

Appendix 8. Former Regular Users' Most Recent Transit Trip

The target respondents for this section are those who no longer travel through the toll facilities by car on a regular basis but instead use transit. This section discusses the key findings pertaining to this group of users. It is important to highlight that, because of the relatively small number of observation in this subgroup, the results in this section must be interpreted and used with caution. There are 38 respondents (7.5 percent among the entire sample) who reported as regular users in past three years and switched to transit sometime after the time of day pricing implementation (March 2001), among which 30 were from New Jersey and eight from Staten Island. These former regular users account for 364 weighted responses which are the basis of the following analysis. It needs to highlight that the results from this subsection should be interpreted and used carefully due to the small sample size of former regular users.

The analyses conducted are reported in three different subsections: the first discusses the socio-economic profile of respondents. The second subsection focuses on the characteristics of the most recent trip (e.g., trip purposes, time of travel and travel frequency). The third subsection analyzes travel costs.

The questions in this section are similar to those in the most recent car trip for current regular users. For comparison purposes, the analyses in this section follow the same outline as the previous section. Since former users now travel regularly by transit, the most recent trips mean the last transit trip for them made across the Hudson River. The time of day traveling was specified as the time for them to cross the Hudson River.

Characteristics of Former Regular Users

Among former regular users, 48.3 percent of are males, approximately 11 percent less than the percentage of males for current users. 77.9 percent of these respondents are white, 90.2 percent received some college education or above, and the average age is 38.7 years, about seven years younger than current users (45.8 years). The median household income is approximately $125, 000, even higher than the median income of current users ($100,000). Table 119 shows the comparisons in household structure and car ownership between former users and current users. On average, there are 2.1 adults, 0.7 children, 2.1 licensed drivers and 1.8 vehicles in the households. It seems that the households have smaller families and fewer vehicles. Also, different from current users, the households of former users have fewer cars than licensed drivers on average (1.8 cars vs. 2.3 cars for current users).

Table 119. Comparison of household structure and car ownership

Household Structure and Car Ownership	Former Users	Current Users
Average Number of Adults	2.1	2.5
Average Number of Licensed Drivers	2.1	2.3
Average Number of Children	0.7	1.1
Average Number of Cars	1.8	2.3

These respondents were asked to provide a reason for changing modes, and over half of former regular users said they did so because it reduced the stress of driving and parking (27.2 percent) or because transit is more convenient/easier (25.2 percent). In contrast, only 9.3 percent of former users (representing 0.4 percent of individuals and 0.8 percent of traffic) changed to transit because of time of day pricing initiative, which has been analyzed in the section of the impact of time of day pricing. The results also showed that these former car users now travel mostly by bus (56.0 percent), followed by train (28.5 percent), ferry (10.4 percent), taxi (3.5 percent), and PATH (1.3 percent).

Trip Attributes

The trip purpose distribution for transit users follows the same pattern as current regular users, as shown in Figure 107. The majority of transit trips in the sample were made for work purposes (83.8 percent), either commuting to work (73.4 percent) or traveling for job (10.4 percent). Recreation/shopping trips are more significant among Staten Island respondents than among the New Jersey's.

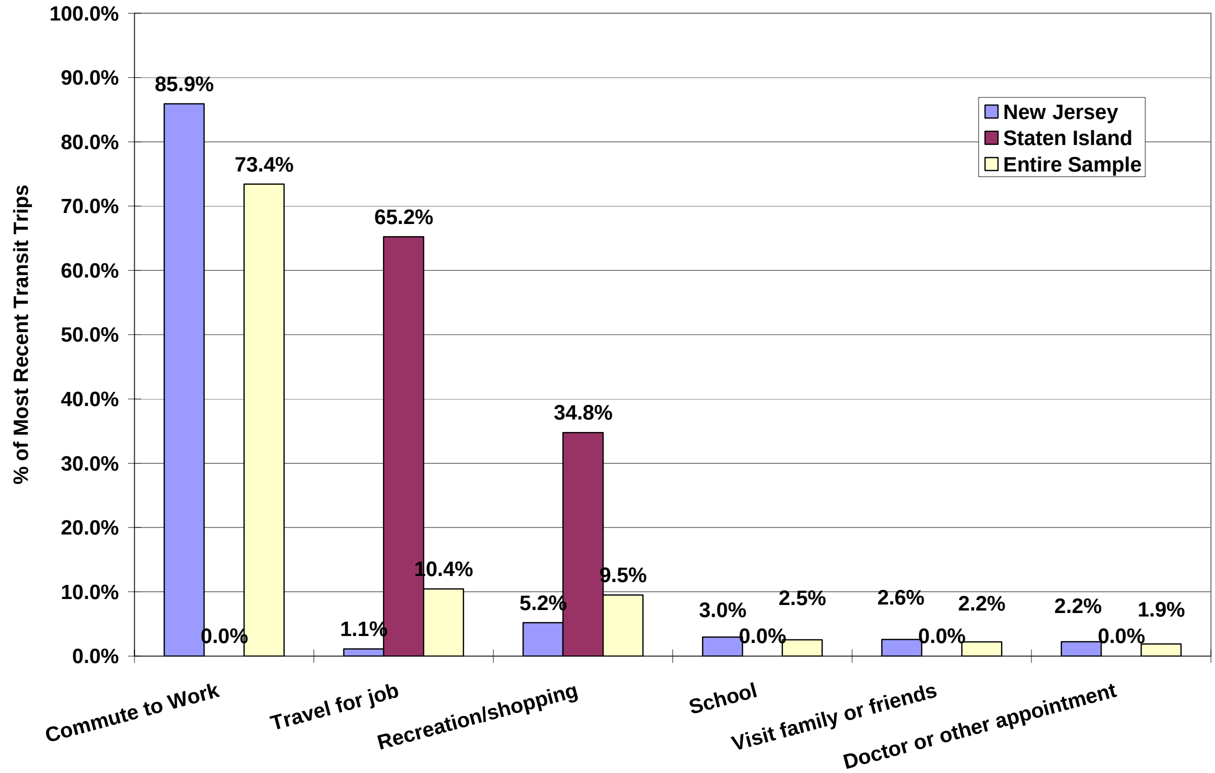


Figure 107. Trip purposes of the most recent transit trips (former regular users)

Temporal distributions of trips by trip purpose were also produced (see Figure 108). Similar to car trips, the vast majority of most recent transit trips were made during weekdays reflecting the significance of work related trips. The differences in this case are that: trips made during Tuesdays are much less than other weekdays; and that no recreation/shopping trips were made during weekdays. As noted earlier, these may be caused by the small size of the former-regular-users sample.

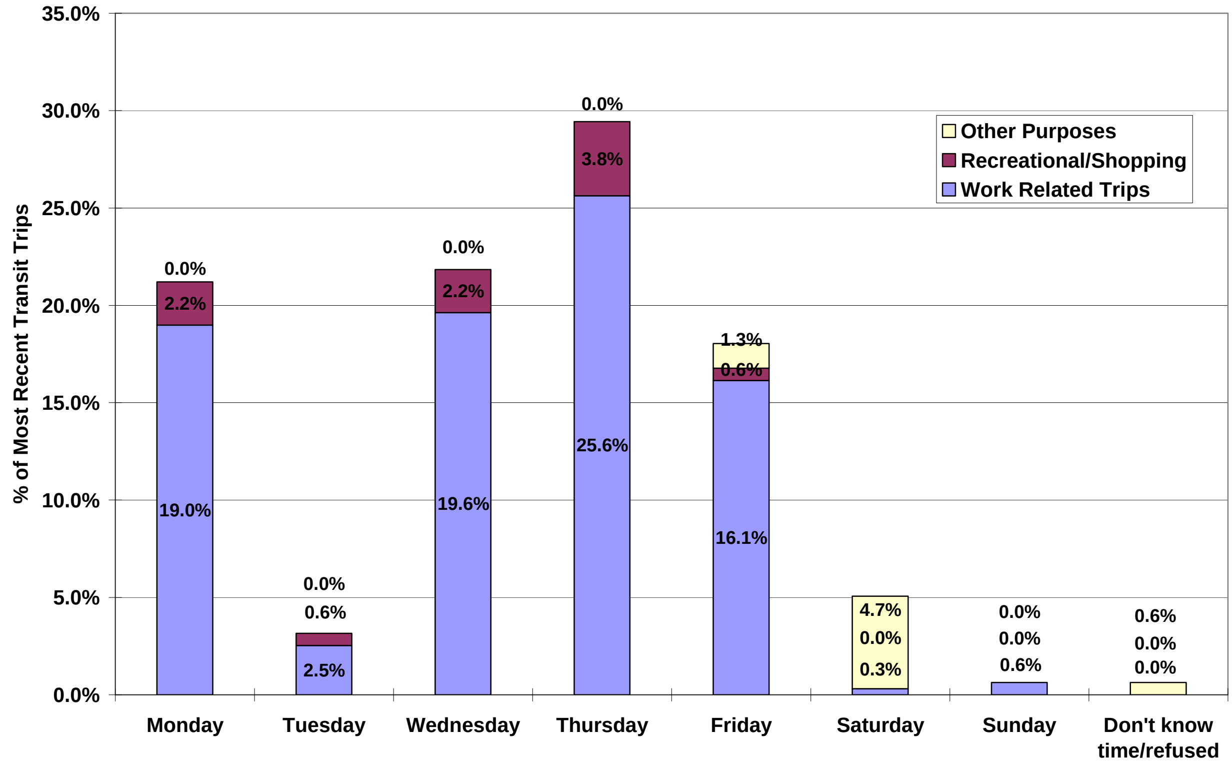


Figure 108. Trip purposes vs. day of week among most recent transit trips

Table 120 presents the distribution of transit trips with respect to time of travel. Using the PANYNJ definition of peak hours (i.e., Weekdays 6-9 AM & 4-7 PM, Weekends Noon-8 PM) [(12)], it was found that approximately 85.0 percent of most recent transit trips were made across toll booths during the peak periods. AM peak trips account for 80.1 percent, followed by weekend peak trips (3.6 percent) and weekday PM peak trips (0.7 percent). Compared with the results from most recent car trips in Table 109, it is obvious that these transit trips were much more likely to be made during peak hours than car trips, and it is consistent with the higher percentage of work-related trips among most recent transit trips as analyzed before. This pattern is confirmed further by Figure 109. Almost all work related trips were made during weekday AM peak and they account for 79.0 percent of most recent transit trips.

Table 120. Trip breakdown by time of travel (former users)

Time of travel	AM Peak	PM Peak	Off-Peak
Weekdays	80.7%	0.7%	15.1%
Weekends		3.6%	0.0%
Combined		84.9%	15.1%

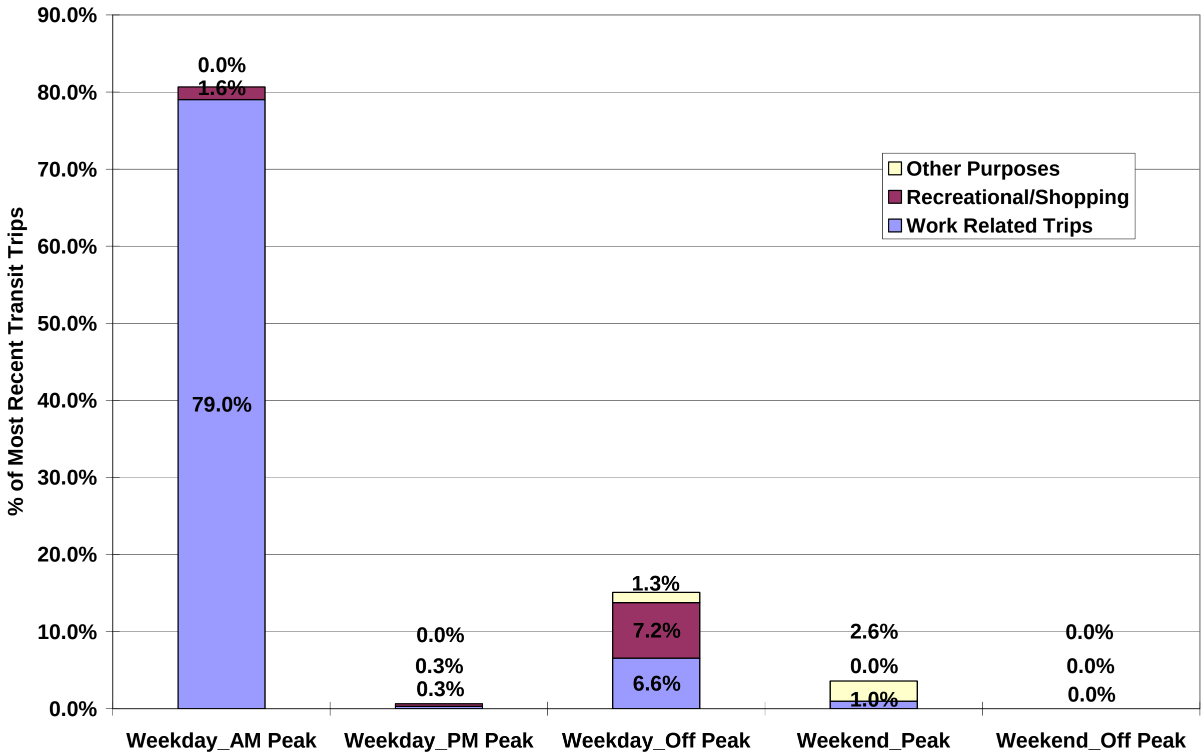


Figure 109. Trip purposes vs. time of day among most recent transit trips

Former regular users were asked why they chose to travel at this time (Table 121). Three quarters of them said that it was because of their work schedules while others did so to avoid congestion (16.5 percent) or to make an appointment (8.5 percent). This proves again that the time of travel for the majority of transit trips tends to be work determined.

Table 121. Reasons for traveling at the stated time (former users)

Reasons for Traveling At That Time	% Among Former Toll Users
Work schedule	74.7%
To avoid congestion	16.5%
To make an appointment/meet people	8.5%
Don't know time/refused	0.3%
Total	100.0%

Table 122 shows the mean values for the travel flexibility of former users. The result should be used with caution since the analyses are based on 364 weighted responses from only 38 former users (265 weighted responses of work related trips, 30 weighted responses of recreation/shopping trips, 21 weighted responses of other trips, and the rest did not specify trip type). In general, the respondents reported having more flexibility for recreation/shopping trips than work related and other trips. On average, the flexibility of recreation/shopping trips is about half an hour, while that of work related trip is within the range of 20 minutes. Also, it seems that the respondents have more flexibility of departing/arriving earlier than later, which is not surprising since people would be willing to travel earlier rather than later in order to be on time especially for work related trips. Table 123 shows the distributions of the flexibility of late/early departure and late/early arrival by trip type for former users, about a quarter have no flexibility of being late, while only 0.5 percent have no flexibility of being early. As shown in Table 123, it seems that former users do not have much flexibility on time of travel, since most of the reported values are within half an hour. In general, former users seem to have more flexibility for recreation/shopping trips than work related trips.

Table 122. Travel flexibility for former users (unit: minutes)

Mean	Trip Purpose			
	Work related	Recreation/shopping	Other	All
Late departure	14.9	24.1	15.6	15.8
Early departure	17.9	30.6	15.6	19.0
Late arrival	9.1	23.6	8.3	10.4
Early arrival	18.3	32.6	19.5	19.9

Table 123. Distributions of travel flexibility for former users

Time Flexibility (minutes)	0	1~5	6~10	11~15	16~30	31~97	98 or more	Do not know/ Refused	Based on Weighted Responses of
Late Departure									
Work Related Trips	27.5%	15.1%	11.3%	19.6%	14.3%	11.3%	0.0%	0.8%	265
Recreation/Shopping Trips	43.3%	0.0%	10.0%	0.0%	33.3%	0.0%	13.3%	0.0%	30
All Trips	23.6%	12.1%	9.6%	14.3%	17.3%	8.2%	1.1%	13.7%	364
Early Departure									
Work Related Trips	0.4%	11.3%	26.8%	11.3%	42.3%	0.0%	0.0%	7.9%	265
Recreation/Shopping Trips	3.3%	0.0%	0.0%	50.0%	33.3%	0.0%	13.3%	0.0%	30
All Trips	0.5%	9.3%	19.5%	14.6%	36.0%	0.0%	1.1%	18.9%	364
Late Arrival									
Work Related Trips	30.6%	0.0%	45.3%	11.7%	12.1%	0.0%	0.0%	0.4%	265
Recreation/Shopping Trips	23.3%	0.0%	10.0%	40.0%	6.7%	0.0%	13.3%	6.7%	30
All Trips	24.2%	1.1%	38.5%	11.8%	9.3%	0.0%	1.1%	14.0%	364
Early Arrival									
Work Related Trips	0.4%	11.7%	30.2%	11.3%	38.9%	0.0%	0.0%	7.5%	265
Recreation/Shopping Trips	3.3%	0.0%	0.0%	36.7%	46.7%	0.0%	13.3%	0.0%	30
All Trips	**0.5%**	**9.6%**	**22.0%**	**13.2%**	**34.9%**	**0.0%**	**1.1%**	**18.7%**	**364**

Note: All trips include work related trips, recreation/shopping trips and other trips.

Travel Costs

The average travel cost by transit ($5.6) for the trip from New Jersey to New York is much lower than the average cost of transit trips estimated by current regular users ($9.6). 55.1 percent of transit users paid less than $5.00 dollars for their trips while about 23.0 percent paid somewhere between $6.00 and $10.00 (18.0 percent) or between $10.00 and $20.00 (14.9 percent). About 12.0 percent said they did not know how much they paid for their transit trips. Meanwhile, the average cost they thought the corresponding car trips would cost them is about three times higher than their current transit costs. The estimated average cost for a car trip by them was $18.4.

Appendix 9. The Passenger Survey Instrument

EAGLETON INSTITUTE OF POLITICS
CENTER FOR PUBLIC INTEREST POLLING
North Jersey Toll Facility User Survey — June 2004
Final REVISED 6.03.04

Hello, my name is _________________ (first and last name) I'm on the staff of the Eagleton Poll, and I'm taking a public opinion survey of [New Jersey/New York] adults for Rutgers University.

I'd like to ask a few questions of the YOUNGEST MALE, 18 years of age or older, who is now at home. [IF NO MALE, ASK: May I please speak with the OLDEST FEMALE, 18 years of age or older, who is now at home?]

RESPONDENT ON PHONE: I'd like your views on toll roads and transportation in ["New Jersey"/"the New York Area"] ---- CONTINUE WITH QUESTIONNAIRE ----

IF NECESSARY: We are not selling anything, not asking for money, and all your answers will be completely confidential.

A. NYNJPA USER SCREEN

A1. Since we're asking about travel in [New Jersey/the New York area], I'd like to start by asking you about toll facilities you may have used. First off, have you personally driven on any of the toll bridges or tunnels to cross the Hudson River in the past three years?

1. Yes >> CONTINUE WITH A2
2. No >>> ASK A1A
9. Don't Know >>> ASK A1A

A1a. Is there someone else in your household who has done this? [If needed: Driven across the Hudson in the past three years]

1. Yes >> Use new respondent/schedule callback
2. No >>> GO TO R1/Turnpike Screener if NJ sample. Term if NY Sample
9. Don't Know >>> GO TO R1/Turnpike Screener if NJ sample. Term if NY Sample

A2. Have you driven these on a regular basis – that is at least once a week for any period during the past three years? [IF "YES" ASK: Do you currently use these facilities on a regular basis?]

1. Yes, current regular user >> CONTINUE WITH A3

2. Was regular user in past three years, but no longer >> ASK A2B
3. Not a regular user in past three years >>> ASK A2A
9. Don't Know >>> ASK A2A

A2A. Is there someone else in your household who has done this? [If needed: Driven across the Hudson at least once a week sometime during the past three years]
1. Yes >> Use new respondent/schedule callback
2. No >>> GO TO R1/Turnpike Screener
9. Don't Know/Ref >>> GO TO R1/Turnpike Screener

A2B. Do you still travel regularly across the Hudson River by bus, train, or ferry?
1. Yes >>> CONTINUE WITH A3
2. No >>> ASK A2C
9. Don't Know/Ref >>> GO TO R1/Turnpike Screener if NJ sample. Term if NY Sample

A2C. Why did you decide to stop using the bridges and tunnels regularly?
1. Change in job location
8. Other, specify: ___________
9. Don't Know/Ref

then GO TO R1/Turnpike Screener if NJ sample.

OR IF Turnpike Quota Filled or NY sample, SKIP TO MODULE Z

AND Keep in data file, but do not count toward quota

A3. Which bridges and tunnels [do/did] you use? [MULTIPLE RESPONSE – ACCEPT ALL MENTIONS BUT DO NOT READ LIST]
1. Holland Tunnel
2. Lincoln Tunnel
3. George Washington Bridge
4. Goethals Bridge
5. Bayonne Bridge
6. Outerbridge Crossing
7. Tappan Zee Bridge
8. Verrazano Narrows Bridge
9. Brooklyn Battery Tunnel
10. Midtown Tunnel
11. Triboro Bridge
12. ThrogsNeck Bridge
18. Other, specify: ______________________
19. DK/Ref

[***NOTE: RESPONDENT MUST GIVE RESPONSES 1-6 TO CONTINUE WITH SURVEY. If punch 1 through 6 not among mentions, skip to R1/Turnpike Screener if NJ sample. NY sample terminate .*****]**

A4. For how many years have you been using these bridges and tunnels on a regular basis?

__________ [Record number. 0=Less than 1 year, 99=DK/Ref]

A5. And overall, how satisfied are you with your trips across these bridges and tunnels – very satisfied, somewhat satisfied, not too satisfied, or not at all satisfied?

1. Very satisfied
2. Somewhat satisfied
3. Not too satisfied
4. Not at all satisfied
9. DK/Ref

NOTE: IF CURRENT USER FROM A2 #1, PROCEED WITH SECTION B

IF PAST USER FROM A2B #1, SKIP AHEAD TO SECTION E

B. MOST RECENT TRIP

B1. In order to understand driving patterns better, I'd like ask you about the most recent trip where you drove across the Hudson River from New Jersey to New York. How long ago did you make this trip?

1. The past 7 days/week
2. The past month
3. The past year
4. Longer ago than 1 year >>> SKIP TO C1
9. DK/Ref >>> SKIP TO C1

B2. Was the main purpose of this trip to commute to your workplace, travel for your job, to get to school, for recreation or shopping, or for some other reason?

1. Commute to Work
2 Travel for job
3. School
4. Recreation/shopping
5. Airport
6. Doctor or other appointment
7. Visit family or friends
8. Other, specify: __________________________
9. DK/ref

B3. And how many times per month do you typically make this trip?

___________ Code number. 0=Less than one, 99=DK/Ref

B4. What day of the week was the most recent trip?

1. Monday
2. Tuesday
3. Wednesday

4. Thursday
5. Friday
6. Saturday
7. Sunday
9. DK/Ref

B4A. Now I'd like you to think about the most recent time you drove from New Jersey to New York, that is in the direction which you paid the Hudson River toll. What time did you leave the place where you started this trip? [NOTE: IF PAID TOLL ON BOTH TRIPS ASK THIS SERIES ABOUT THE MOST RECENT TRIP]

_____ : _____ 1. am 2. pm 99. DK/ref

B4B. Why did you choose to leave at this time? [ACCEPT MULTIPLE RESPONSES. DO NOT READ LIST]

1. Work schedule
2. To avoid congestion
3. To make an appointment/meet people
4. Cheaper toll
5. Out of habit / what I usually do
6. So I could return at a certain time
7. Easier or cheaper parking availability
18. Other, specify: ____________________
19. No reason / DK/REF

B5. And what bridge or tunnel did you use to get to New York from New Jersey?

1. Holland Tunnel
2. Lincoln Tunnel
3. George Washington Bridge
4. Goethals Bridge
5. Bayonne Bridge
6. Outerbridge Crossing
7. Tappan Zee
9. Other, specify: _______________________
10. DK/Ref

B6. About what time of day did you go through the tollbooth?

_____ : _____ 1. am 2. pm 99. DK/ref

B7. Did you use E.Z. Pass to pay the toll?

1. Yes
2. No
9. DK/ref

B7a. How much was the toll?

_________________ record amount

98. Other,

99. DK/REF

B8. And how many people were in the car, including yourself?

___________ Code number 8=8 or more, 9=DK/Ref

[IF B8=3-8 and B7=1, ASK B9:]

B9. Are you registered for the Port Authority carpool discount program?

1. Yes
2. No
9. DK/ref

B10. Did you pay for parking on this trip, was the parking cost shared with other passengers, or did an employer or someone else pay for it?

1. Self >>ASK B10A
2. Shared by passengers >> ASK B10A
3. Employer paid
4. Other paid, specify: ________________
5. (VOL) Parking was free, on street, etc.
9. DK/REF

B10A. And what was [your/your share of the] parking cost?

_________ Record in dollars and cents

B11. What was the total travel time from door to door for the trip from New Jersey to New York?

__________ Code in minutes

B12. Did you make any stops along the way?

1. Yes
2. No
9. DK/ref

B13. What time were you supposed to be at your destination?

_____ : _____ 1. am 2. pm

98. No Specific time >>> SKIP TO B17A

99. DK/ref >>> SKIP TO B17A

B14. And did you arrive more than 10 minutes earlier or later than this time?

1. More than 10 minutes earlier >> ASK B15
2. More than 10 minutes later >> ASK B15
3. Arrived within 10 minutes of target time >>> SKIP TO B17A
8. (VOL) never arrived at destination >>> SKIP TO B17A
9. DK/Ref >>> SKIP TO B17A

B15. How many minutes (early/late) were you?

__________ Code in minutes

B16. Did you specifically plan to be [early/late] when you left?
1. Yes
2. No
9. DK/Ref

B17A. I'd just like to get some idea about your trip flexibility. In general, how much LATER than your desired departure time are you willing to leave the place where you started this trip?

__________ Code in minutes, 0=None

B17B. And, how much LATER than your desired arrival time are you willing to arrive at your destination?

__________ Code in minutes, 0=None

B18A. In general, how much EARLIER than your desired departure time are you willing to leave the place where you started this trip?

__________ Code in minutes, 0=None

B18B. And, how much EARLIER than your desired arrival time are you willing to arrive at your destination?

__________ Code in minutes, 0=None

B19. What is the zip code where you started this trip?

_______________ 98888=DK, 99999=Ref

B20. And what is the zip code of your final destination?

_______________ 98888 = Unknown >> ASK for cross streets and city, 99999 = Ref

B24. Did you use any other toll facilities or toll roads during these trips?
1. Yes >> ASK B25
2. No >>> SKIP TO B26
9. DK/ref >>> SKIP TO B26

B25. What were they? [ACCEPT MULTIPLE RESPONSES. DO NOT READ LIST]
1. New Jersey Turnpike
2. Garden State Parkway
3. Verrazano Narrows Bridge
4. Queens/MidTown Tunnel
5. Tri-Boro Bridge
6. ThrogsNeck Bridge
7. Whitestone Bridge
8. Other, specify: _______________________
9. DK/Ref

B26. Thinking about your total trip – what do you think the cost would have been if you went by public transit? [Note: cost is for respondent only]

_______________ Record in dollars and cents

99. Don't know
100. (VOL) Transit not available for this trip

C. REASONS FOR TOLL USE

C1. Thinking back, do you recall why you first started using the Hudson River bridges and tunnels? [ACCEPT MULTIPLE RESPONSES. DO NOT READ LIST]

1. "Best" way to get there – not specific
2. "Easiest"/"most convenient way to get there
3. "Cheapest" way to get there
4. "Fastest" way to get there
5. "Only" way to get there
6. Got a new job/job moved to different location
7. Moved to a new home/location
8. Public Transit is not convenient
9. Public transit is too expensive
10. Public transit is too slow
18. Other specify: ____________________
19. DK/Can't recall/No answer/Ref

C2. Did you previously travel across the Hudson River on a regular basis by public transit or ferry?

1. Yes, in past >>> ASK C3
2. (VOL) Yes, and still use it regularly now as well >>> SKIP TO C4
3. No >>> SKIP TO C4
9. DK/Ref >>> SKIP TO C4

C3. Why did you stop using transit? [ACCEPT MULTIPLE RESPONSES. DO NOT READ LIST]

1. Formed/joined a carpool
2. Transit is too expensive
3. Transit takes too long
4. Transit is uncomfortable
5. Transit is unsafe
6. Transit is inconvenient
7. Moved home
8. Family situation changed
9. Job relocated
10. Work situation/hours changed
11. Job requires me to have a car
17. Did not stop, still use it regularly
18. Other, specify: ________________
19. DK/ref

C4. Do you happen to know what the CASH toll is to cross the Hudson River? [IF, “YES” ASK: How much do you think it is?]

1. Yes, $6.00
2. Yes, incorrect, C4a. specify incorrect amount: ________________
3. No, Don’t Know
9. Refused

[NOTE: MODULE E PRECEDES MODULE D]

E. E.Z. PASS USE

[IF B7 EQ 1, Read intro: ‘Just to confirm,”]

E1. Do you currently have an E.Z. Pass tag?

1. Yes >>> ASK E1a
2. No
9. DK/ref

E1a. For how many years have you had E.Z. Pass?
__________ [Record number. 0=Less than 1 year, 99=DK/Ref]

E2. Are you aware of any discounts that you can get using E.Z. Pass?

1. Yes >>> ASK E2a
2. No
9. DK/ref

E2a. What are they? [ACCEPT MULTIPLE RESPONSES. DO NOT READ LIST]

1. Time of day/off-peak use discounts
2. Carpool discounts
3. Discounts for frequent use of Goethels/Outerbridge/ Bayonne/Staten Island bridges
4. Just a general discount for using E.Z.Pass instead of cash
8. Other, specify: _____________
9. DK of specific discounts /ref

[IF Punch #1 not mentioned in E2a, ASK E2b:]

E2b. Are you aware that there is a toll discount for crossing the Hudson River during off-peak hours or haven’t you heard of this?

1. Yes, aware
2. No haven’t heard
9. DK/ref

[IF E1=2/No, ASK E3. ALL OTHERS GO TO E4]

E3. There are a number of reasons why people don’t have E.Z. Pass. For each one I read, tell me whether it is a major reason, minor reason, or not a reason for you.
[ROTATE]

a. It really won't save me any time
b. It really won't save me any money
c. The discounts are not large enough
d. Wouldn't use it enough
e. It's too much trouble to get one
f. It's too expensive to get one
g. I don't want to give out personal information
h. Seems complicated to use
i. Afraid of being overcharged or fined if the tag doesn't work right
j. I just never really thought about getting it
k. I don't know where to get E.Z. Pass

Codes for E3a-k
1. Major reason 2. Minor reason 3. Not a reason 9. DK/ref

E3l. Are there any other specific reasons why you do not have E.Z. Pass?
1. Never got around to it
2. Past problems with EZ Pass
3. Anticipate errors or problems
4. Difficult to purchase
5. Puts people out of work
8. Other, specify: ___________________
9. No other reasons

[IF E1=1/Yes, ASK E5. ALL OTHERS GO TO E8]

E5. Who pays your E.Z. Pass account?
1. Self
2. Employer
3. Family member
4. Self and employer
8. Other, specify: ______________
9. DK/ref

E6. What do you like MOST about E.Z. Pass? [ACCEPT MULTIPLE RESPONSES. DO NOT READ LIST]
1. Saves time/quicker
2. Saves money, cheaper than cash toll
3. Don't need to carry cash
4. Don't need to interact with toll collector
5. Safer
6. Less stressful
7. Like the itemized statement/don't need to keep receipts
8. Can use it for parking
9. Can use it for other toll roads
10. Just easier

17. Other, specify: ______________________
18. Nothing in particular
19. DK/ref

E7. Is there anything you don't like about E.Z. Pass? [ACCEPT MULTIPLE RESPONSES. DO NOT READ LIST]
1. Tag doesn't always work
2. You get fined if tag doesn't work
3. Doesn't get you through toll any faster, there is still traffic
4. Have to slow down for toll
5. Hard to know where EZ Pass toll booths are/hard to get to at toll plaza
6. Afraid it won't work, won't be read
7. Afraid of being overcharged
8. Afraid of giving out credit card/personal information
9. Monthly fee
10. Hard to keep track of how much spent on tolls
11. Don't want to tie up money in my account
12. Too complicated to use
13. Battery life
17. Other specify: _____________________
18. NO, NOTHING IN PARTICULAR
19. DK/Can't recall/No answer/Ref

E8. Is there anything that could be done to make E.Z. Pass attractive to more people?

[ACCEPT MULTIPLE RESPONSES. DO NOT READ LIST]
1. High speed toll lanes
2. Make the EZ Pass toll lanes separate from other traffic, move quicker
3. Give a discount for use
4. Give a BIGGER discount for use
5. Get rid of monthly fees
6. Don't place a hold on credit card accounts/don't require prepayment
7. Make it easier to get a tag
8. Make sure that information is not used to track people
9. Better PR, communications
10. Expand use to other venues
11. Better customer service
17. Other specify: _____________________
18. NO, NOTHING IN PARTICULAR
19. DK/Can't recall/No answer/Ref

D. IMPACT OF 2001 TOLL INCREASE

[ONLY THOSE WHO HAVE USED PA TOLLS OVER 3 YEARS –
IF A4=4-98, ASK D1. ALL OTHERS GO TO F1 INSTRUCTIONS]

D1. [READ SLOWLY:] The tolls on Hudson River bridges and tunnels were raised about three years ago. Before the toll change took effect in March 2001 the cash toll was $4 for all passenger vehicles and the E.Z. Pass toll was $3.60. These tolls were in effect 24 hours a day. The cash toll is now $6 at all times. The toll for cars paying with E.Z. Pass is $4 for off-peak travel and $5 for peak hour use, with registered carpools being charged $1.

Do you recall this toll increase at all?

1. Yes >>> ASK D2
2. No >>> SKIP TO F1 INSTRUCTIONS
9. DK/ref >>> SKIP TO F1 INSTRUCTIONS

D2. Do you think the toll increase had any effect on traffic across the Hudson River bridges and tunnels or not?

1. Yes
2. No >>> SKIP TO D4
9. DK/ref >>> SKIP TO D4

D3. Do you think traffic congestion is now better or worse? [PROBE: Is that a lot better/worse or just somewhat?]

1. Lot Better
2. Somewhat Better
3. Somewhat Worse
4. Lot Worse
8. (VOL) Combination, sometimes better/sometimes worse
9. DK/ref

D4. After the March 2001 toll increase some drivers changed the way they traveled across the Hudson. Some changed their start time or route, others decided to carpool or use public transit, and some changed how often they made the trip.

Did the toll increase of March 2001 make you change your travel choices in any way?

1. Yes >>> SKIP TO D6
2. No >>> ASK D5
9. DK/ref >>> SKIP TO F1 INSTRUCTIONS

[ASK D5 IF D4=2]

D5. What are the main reasons your travel behavior did not change? [MULTIPLE RESPONSE. DO NOT READ LIST]

1. Price difference not all that much/can afford it
2. Toll is paid by employer
3. Have no choice, no flexibility
4. My choice, I go when I want to go, convenient
5. Don't use it that much

8. Other, specify: ___________
9. DK/ref >>>>> ALL FROM D5 GO TO F1

INSTRUCTIONS

[ASK D6 ff IF D4=1]
RANDOMIZE UNITS: D6/6a/6b/6c, D7/D8, D10, D11a-b/D12a-b, D13/13a/13b/13c, D14. ALWAYS ASK D14 LAST.

D6. Did you change how often you made the trip across the Hudson because of the toll increase?

1. Yes >>> ASK D6a-c
2. No
9. DK/ref

D6a. How many trips did you make a week on average BEFORE the toll increase?

_____________ Record number , 99=DK/Ref

D6b. How many trips did you make a week on average AFTER the toll increase?

_____________ Record number, 99=DK/Ref

[IF 99/DK/REF TO D6a or D6b, ASK D6c:]

D6c. Was the number of trips you made after the increase more or less than before?

1. More
2. Less
3. Same
9. DK/ref

D7. Did you start to carpool or increase your use of carpools because of the toll increase?

1. Started using carpools >>> SKIP TO D10
2. Increased use of carpools >>> SKIP TO D10
3. No, neither
9. DK/ref

D8. Did you stop carpooling or decrease your use of carpools because of the toll increase?

1. Stopped using carpools
2. Decreased use of carpools
3. No, neither
9. DK/ref

D10. Did your number of trips using public transportation to get into New York increase, decrease or stay about the same because of the toll increase?

1. Increased
2. Decreased

3. Stayed the same
9. DK/ref

D11A. Did your number of trips driving to New York during the weekday peak hours – that is between 6 and 9 a.m. or 4 and 7 p.m. – increase, decrease or stay about the same because of the toll increase?

1. Increased
2. Decreased
3. Stayed the same
9. DK/ref

D11B. Did your number of trips driving to New York during the weekday off-peak hours – that is between 9 a.m. and 4 p.m. or between 7 p.m. and 6 a.m. the next day – increase, decrease or stay about the same because of the toll increase?

1. Increased
2. Decreased
3. Stayed the same
9. DK/ref

D12A. Did your number of trips driving to New York during the weekend peak hours – that is between noon and 8 p.m. – increase, decrease or stay about the same because of the toll increase?

1. Increased
2. Decreased
3. Stayed the same
9. DK/ref

D12B. Did your number of trips driving to New York during the weekend off-peak hours – that is before noon or after 8 p.m. – increase, decrease or stay about the same because of the toll increase?

1. Increased
2. Decreased
3. Stayed the same
9. DK/ref

D13. Did you change how many times you made stops during the trip because of the toll increase?

1. Yes >>> ASK D13a-c
2. No
9. DK/ref

D13a. How many stops did you make a week on average BEFORE the toll increase?

______________ Record number , 99=DK/Ref

D13b. How many stops did you make a week on average AFTER the toll increase?

______________ Record number, 99=DK/Ref

[IF 99/DK/REF TO D13a or D13b, ASK D13c:]

D13c. Was the number of stops you made after the increase more or less than before?
1. More
2. Less
3. Same
9. DK/ref

D14. Did you get an E.Z. Pass tag because of the toll increase or not?
1. Yes
2. No
9. DK/ref

D15. Did you make any other changes in your travel patterns because of the March 2001 toll increase?
1. Yes, specify : ____________________
2. No
9. DK/ref

F. FORMER TOLL USERS

[ASK SECTION F IF A2=2/A2b=1. ALL OTHERS GO TO SECTION G.]
F1. Earlier you stated that you previously used the bridges and tunnels to cross the Hudson, but now you use transit more often. What is the main reason you switched? [ACCEPT MULTIPLE]
1. Moved
2. Convenient or easier
3. Toll costs
4. Other costs
5. Stress driving or parking
6. Change in travel needs
8. Other, specify : ________________
9. No reason/Can't recall/DK/ref

F2. Thinking about the most recent trip you made across the Hudson River using public transportation -- How long ago did you make this trip?
1. The past 7 days/week
2. The past month
3. The past year
4. Longer ago than 1 year >>> SKIP TO G1
9. DK/Ref >>> SKIP TO G1

F3. Was the main purpose of this trip to commute to your workplace, travel for your job, to get to school, for recreation or shopping, or for some other reason?
1. Commute to Work

2 Travel for job
3. School
4. Recreation/shopping
5. Airport
6. Doctor or other appointment
7. Visit family or friends
8. Other, specify: ___________________________
9. DK/ref

F4. And how many times per month do you typically make this trip?
___________ Code number. 0=Less than one, 99=DK/Ref

F5. What day of the week was the most recent trip?
1. Monday
2. Tuesday
3. Wednesday
4. Thursday
5. Friday
6. Saturday
7. Sunday
9. DK/Ref

F6. Did you travel by train, PATH, bus, or ferry across the Hudson?
1. Train
2. PATH
3. Bus
4. Ferry
5. Taxi
8. Other, specify: _______________________
9. DK/Ref

F7. About what time of day did you cross the river?
_____ : _____ 1. am 2. pm 99. DK/ref

F8. Why did you choose to travel at this specific time?
1. Work schedule
2. To avoid congestion
3. To make an appointment
4. Cheaper overall
5. Out of habit / what I usually do
6. So I could return at a certain time
7. Easier or cheaper parking availability
18. Other, specify: ____________________
19. No reason / DK/REF

F9. What was the total travel time from door to door for the trip from New Jersey to New York?

__________ Code in minutes

F10. Did you make any stops along the way?

1. Yes
2. No
9. DK/ref

F11. What time were you supposed to be at your destination?

_____ : _____ 1. am 2. pm

98. No Specific time >>> SKIP TO F15A

99. DK/ref >>> SKIP TO F15A

F12. And did you arrive more than 10 minutes earlier or later than this time?

1. More than 10 minutes earlier >> ASK F13
2. More than 10 minutes later >> ASK F13
3. Arrived within 10 minutes of target time >>> SKIP TO F15A
9. DK/Ref >>> SKIP TO F15A

F13. How many minutes (early/late) were you?

__________ Code in minutes

F14. Did you specifically plan to be [early/late] when you left?

1. Yes
2. No
9. DK/Ref

F15A. I'd just like to get some idea about your trip flexibility. In general, how much LATER than your desired departure time are you willing to leave the place where you started this trip?

__________ Code in minutes, 0=None

F15B. And, how much LATER than your desired arrival time are you willing to arrive at your destination?

__________ Code in minutes, 0=None

F16A. In general, how much EARLIER than your desired departure time are you willing to leave the place where you started this trip?

__________ Code in minutes, 0=None

F16B. And, how much EARLIER than your desired arrival time are you willing to arrive at your destination?

__________ Code in minutes, 0=None

F17. What is the zip code where you started this trip?

________________ 98888=DK, 99999=Ref

F18. And what is the zip code of your final destination?
________________ 98888 = Unknown >> ASK for cross streets and city
99999 = Ref

F20. How much did this total trip cost you?
__________ Round to nearest dollar.
0=less than $1, 98=$98+99=DK/REF

F21. And how much do you think this trip would have cost you if you went by car?
__________ Round to nearest dollar.
0=less than $1, 98=$98+99=DK/REF

G. TOLL SCENARIO TESTS

For research purposes, we're interested in finding out how you might have changed your driving behavior using some hypothetical situations during different times of the day. Peak hours include the morning rush between 6 and 9 a.m. and the evening rush between 4 and 7 p.m. as well as weekend travel between noon and 8 pm. Off-peak hours are all other times.

[CATI: G1 is for CASH TOLL USERS ONLY ::: If B7=2/9 .
ALL OTHERS GO TO G2]
G1. Now thinking about your most recent trip across the Hudson, would you have switched to E.Z. Pass if [READ IN SCENARIO]?
[CATI: READ IN RANDOM 4 of the a-i SCENARIOS. ROTATE]

A. it would have saved you 15 minutes in travel time no matter when you traveled?
1. Yes 2. No 9. DK/Ref

B. it would have saved you 15 minutes in travel time no matter when you traveled AND $5 in tolls if you traveled during off-peak hours?
1. Yes >>>ASK G1bb 2. No 9. DK/Ref
BB. Would you have traveled during peak or off-peak hours?
1. Peak 2. Off-peak 9. DK/Ref

C. it would have saved you 15 minutes in travel time no matter when you traveled AND $4 in tolls if you traveled during off-peak hours?
1. Yes >>>ASK G1cc 2. No 9. DK/Ref
CC. Would you have traveled during peak or off-peak hours?
1. Peak 2. Off-peak 9. DK/Ref

D. it would have saved you 15 minutes in travel time no matter when you traveled AND $3 in tolls if you traveled during peak hours or $5 if you traveled off-peak?

1. Yes >>>ASK G1dd 2. No 9. DK/Ref

DD. Would you have traveled during peak or off-peak hours?

1. Peak 2. Off-peak 9. DK/Ref

E. it would have saved you 15 minutes in travel time no matter when you traveled AND $2 in tolls if you traveled during peak hours or $5 if you traveled off-peak?

1. Yes >>>ASK G1ee 2. No 9. DK/Ref

EE. Would you have traveled during peak or off-peak hours?

1. Peak 2. Off-peak 9. DK/Ref

F. it would have saved you 15 minutes in travel time no matter when you traveled AND $2 in tolls if you traveled during peak hours or $4 if you traveled off-peak?

1. Yes >>>ASK G1ff 2. No 9. DK/Ref

FF. Would you have traveled during peak or off-peak hours?

1. Peak 2. Off-peak 9. DK/Ref

G. it would have saved you $3 in tolls if you traveled during peak hours or $5 if you traveled off-peak?

1. Yes >>>ASK G1gg 2. No 9. DK/Ref

GG. Would you have traveled during peak or off-peak hours?

1. Peak 2. Off-peak 9. DK/Ref

H. it would have saved you $2 in tolls if you traveled during peak hours or $5 if you traveled off-peak?

1. Yes >>>ASK G1hh 2. No 9. DK/Ref

HH. Would you have traveled during peak or off-peak hours?

1. Peak 2. Off-peak 9. DK/Ref

I. it would have saved you $2 in tolls if you traveled during peak hours or $4 if you traveled off-peak?

1. Yes >>>ASK G1ii 2. No 9. DK/Ref

II. Would you have traveled during peak or off-peak hours?

1. Peak 2. Off-peak 9. DK/Ref

[CATI: G2 is for EZPASS Peak Hour users ONLY :::

If B7=1 and (B6 is 6-9 am or 4-7 pm and B4=1-5) or

If B7=1 and (B6 is 12Noon-8 pm and B4=6-7).

ALL OTHERS GO TO NEXT MODULE]

G2. Now thinking about your most recent trip across the Hudson, would you have switched to off-peak travel if [READ IN SCENARIO]?

a. it would have saved you $2 in tolls?

1. Yes 2. No 9. DK/Ref

b it would have saved you $4 in tolls?

1. Yes 2. No 9. DK/Ref

NOTE: THERE ARE NO MODULES FOR CURRENT OFF-PEAK EZPASS USERS or CURRENT TRANSIT USERS, THESE RESPONDENTS WILL GO DIRECTLY TO MODULE H

H. PUBLIC OPINION

[RANDOMIZE H1-H7]

Now a few quick questions on your opinions. I'm going to read you some statements and want you to tell me whether you strongly agree, somewhat agree, somewhat disagree or strongly disagree with each.

[REPEAT AS NEEDED AFTER READING EACH STATEMENT: Do you strongly agree, somewhat agree, somewhat disagree or strongly disagree with that?]

H1. It is fair to charge higher bridge and tunnel tolls during peak travel periods.

H2. It is fair to give discounts to E.Z. Pass users.

H3. It is fair to give discounts to commuters who frequently travel during the peak hours.

H4. Bridge and tunnel toll revenues should be used to support public transit.

H5. It's a good idea to vary toll rates during different times of the day to help improve traffic congestion.

H6. I would be willing to pay a higher toll for a faster trip.

H7. I would be willing to pay a higher toll for a more reliable trip.

1. Strongly Agree
2. Somewhat Agree
3. Somewhat Disagree
4. Strongly Disagree
9. DK/ref

Z. DEMOGRAPHICS

Just a few more questions so we can classify your answers.

Z1. What was the last grade in school you completed?
1. 8TH GRADE OR LESS
2. HIGH SCHOOL INCOMPLETE (GRADES 9, 10 AND 11)
3. HIGH SCHOOL COMPLETE (GRADE 12)
4. VOCATIONAL/TECHNICAL SCHOOL
5. SOME COLLEGE
6. JUNIOR COLLEGE GRADUATE (2 YEAR, ASSOCIATES DEGREE)
7. 4 YEAR COLLEGE GRADUATE (BACHELOR'S DEGREE)
8. GRADUATE WORK (MASTERS, LAW/MEDICAL SCHOOL, ETC.)
9. DK/REF

Z2. What was your age on your last birthday?
/ / / (CODE # OF YEARS, 99 = REFUSED)

Z2A. [IF REFUSED IN Z2, ASK:] Is it between...
1. 18 - 20
2. 21 - 24
3. 25 - 29
4. THIRTIES (30 - 39)
5. FORTIES (40 - 49)
6. FIFTIES (50 - 59)
7. 60 - 64
8. 65 OR OVER
9. NO ANSWER/REFUSED

Z3. Including yourself, how many adults live in your household?
________ Code number 1-9, 8=8 or more, 9=DK/ref

Z4. How many children under the age of 18 live in your household?
________ Code number 0-9, 8=8 or more, 9=DK/ref

Z4A. And how many licensed drivers live in your household?
________ Code number 1-9, 8=8 or more, 9=DK/ref

Z5. Are you of Latino or Hispanic origin?
1. Yes
2. No
9. (VOL) Don't Know / Refused

Z6. And are you white, black or Asian?
1. White
2. Black
3. Asian
4. (VOL) Other, specify: ______________________

5. (VOL) Hispanic\Latino
9. Don't Know/Refused

Z7. Is your current working status employed full-time, employed part-time, retired, or not working outside the home?

1. Employed full-time >> Z8-9
2. Employed part-time >> ASK Z8-9
3. Retired >>> SKIP TO Z10
4. Not working outside the home >>> SKIP TO Z10
5. (VOL) Student >>> SKIP TO Z10
8. (VOL) Other, specify: ____________________ >>> SKIP TO Z10
9. DK/ref >>> SKIP TO Z10

Z8. What kind of work do you do – management, professional, office work, sales, technical, or something else?

1. Management/professional
2. Office work or clerical
3. Sales
4. Technical
5. Laborer
6. Driver
8. Other, specify: ___________________
9. DK/ref

Z9. Does your job allow you to work at home at all?

1. Yes
2. No
9. DK/ref

Z10. How many vehicles are available for use by your household?

________ Code number 0-9, 8=8 or more, 9=DK/ref

Z11. In what county do you live?

1. Bergen
2. Essex
3. Hudson
4. Kings
5. Middlesex
6. Monmouth
7. Morris
8. Nassau
9. Passaic
10. Queens
11. Somerset
12. Staten Island\Richmond
13. Suffolk

14. Union
18. Other, specify: ___________________
19. DK/REF

Z12. What is your zip code? /____/____/____/____/____/
(Range 07001 to 08904; DK/RF=99999)

Z13. So that we can group all answers, what is your household's total annual income before taxes. Please stop me when I get to the right category. Is it under $15,000; from $15,000 to just under $25,000; $25,000 to just under $35,000; $35,000 to just under $45,000; $45,000 to just under $55,000; $55,000 to just under $75,000; $75,000 to just under $100,000; $100,000 to just under $125,000; $125,000 to just under $150,000; $150,000 to just under $200,000; or $200,000 or more?
1. < $15K
2. $15 - 25K
3. $25 - 35K
4. $35 - 45K
5. $45 - 55K
6. $55 - 75 K
7. $75 - 100 K
8. $100 - 125K
9. $125 - 150K
10. $150 - 200 K
11. $200 K or more
18. DON'T KNOW
19. REF

Z14. Did your household income change significantly from 2001 to 2003? [IF YES, ASK: Did it go up or go down?]
1. Change, went UP
2. Change, went DOWN
3. Change, but NA on direction
4. NO CHANGE
9. DK/ref

Z15. RESPONDENT SEX (from observation): 1. MALE 2. FEMALE

That is the end of the survey. You've been very helpful. Thank you very much for your participation.

Appendix 10. Breakdown of Sampling Frame

Table 124. Breakdown of sampling frame for for-hire carriers

Potential For-Hire Carriers	NJ (1)				NY (2)			
Number of Employees of Individual Establishment	<5	5~25	25~50	>=50	<5	5~25	25~50	>=50
Motor Freight Transportation:	425	320	80	76	454	271	43	31
4213. Trucking, Except Local								
4215. Courier Services, Except By Air								
4731. Freight transportation arrangement								
	Total in NJ			900	Total in NY			800

Note (1): The target counties include six counties in New Jersey: Bergen, Essex, Hudson, Middlesex, Passaic and Union. (2): The target counties include two counties in New York: Kings, Queens

Table 125. Breakdown of sampling frame for private carriers (agriculture and manufacturing)

Potential Private Carriers	NJ(1)
Number of Employees of Individual Establishment	>=25
Agriculture:	3
01. Agricultural Production - Crops	
02. Agricultural Production - Livestock and Animal Specialties	
Manufacturing:	1028
20. Food and Kindred Products	
21. Tobacco Products	
22. Textile Mill products	
23. Apparel, Finished products from Fabrics and Similar materials	
24. Lumber and Wood Products, Except Furniture	
25. Furniture and fixtures	
26. Paper and Allied Products	
27. Printing, Publishing and Allied Industries	
28. Chemicals and Allied Products	
29 Petroleum Refining and Related Industries	
30. Rubber and Miscellaneous Plastic Products	
31. Leather and Leather products	
32. Stone, Clay, Glass, and Concrete Products	
33. Primary Metal Industries	
34. Fabricated Metal Prdcts, Except Machinery & Transport Eqpmnt	
35. Industrial and Commercial Machinery and computer equipment	
36. Electronic, elctrcl, eqpmnt & cmpnts,	
37. Transportation Equipment	
38. Mesr/anlyz/cntrl instrmnts	
39. Misc Manufacturing industries	

Note (1): The target counties include six counties in New Jersey: Bergen, Essex, Hudson, Middlesex, Passaic and Union.

Table 126. Breakdown of sampling frame for private carriers (wholesale and retail)

Potential Private Carriers	NJ(1)
Number of Employees of Individual Establishment	>=25
Wholesale:	
50. Wholesale Trade - Durable Goods	432
51. Wholesale Trade - Nondurable Goods	
Food	81
5141. Groceries, General Line	
5142. Packaged Frozen Goods	
5144. Poultry and Poultry Products	
5145. Confectionery	
5146. Fish and Seafoods	
5147. Meats and Meat Products	
5148. Fresh Fruits and Vegetables	
5149. Groceries and Related Products, Nec	
5153. Grain and Field Beans	
5154. Livestock	
5159. Farm-product Raw Materials, Nec	
Clothes	50
5136. Men's and Boy's Clothing	
5137. Women's and Children's Clothing	
5139. Footwear	
Tobacco	6
5194. Tobacco and Tobacco Products	
Plastics	9
5162. Plastics Materials and Basic Shapes	
Paper	23
5111. Printing and Writing Paper	
5113. Industrial and Personal Service Paper	
Pinting	4
5198. Paints, Varnishes, and Supplies	
Chemical	34
5169. Chemicals and Allied Products, Nec	
Others	122
5112. Stationery and Office Supplies	
5122. Drugs, Proprietaries, and Sundries	
5131. Piece Goods and Notions	
5181. Beer and Ale	
5182. Wine and Distilled Beverages	
5191. Farm Supplies	
5192. Books, Periodicals, and Newspapers	
5193. Flowers and Florists Supplies	
5199. Nondurable Goods, Nec	
Petroleum	8
5171. Petroleum Bulk Stations and Terminals	
5172. Petroleum Products, Nec	
Petroleum Product Retail:	
5984 Liquefied Petroleum Gas Dealers (Retail Trade)	3

Note (1): The target counties include six counties in New Jersey: Bergen, Essex, Hudson, Middlesex, Passaic and Union.

Appendix 11. Sample Letter for Participating the Survey

Dear «Salutation» «Last Name»:

The Department of Civil and Environmental Engineering at Rensselaer Polytechnic Institute and the Center for Advanced Infrastructure and Transportation at Rutgers University have embarked on a comprehensive study of travel patterns in the New York metropolitan area.

The goal of this study is gain a better understanding of the current travel needs and experiences of all types of road users in the metro area. This information will be used to inform policymakers on conditions that either aid or impede the flow of traffic. Our current objective is to learn about the needs and experiences of businesses that send and receive shipments in the New York area, particularly in ways that impact the conduct of day-to-day business. We are especially interested in hearing from businesses that send or receive shipments across the Hudson River between New York and New Jersey.

To this end, we are conducting a short telephone survey of businesses in the greater New York metropolitan area. The survey will be conducted by the Eagleton Institute's Center for Public Interest Polling. An Eagleton staff member will be contacting you in the coming week to conduct a short telephone interview about the regional infrastructure and its effects on your business. The interview will take only 8 to 10 minutes to complete. We would like to speak to someone in your company who is familiar with your distribution and/or dispatching operations.

Your participation is critical to the success of the study. We will maintain complete confidentiality of all responses and no individual responses will be revealed. If you have any questions, please do not hesitate to contact either of us.

Thank you in advance for participating in this important project.

Appendix 12. The Carrier Questionnaire

THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS

EAGLETON INSTITUTE OF POLITICS

CENTER FOR PUBLIC INTEREST POLLING

Dispatcher Toll Facility User Survey — Fall 2004

FINAL CLEAN 12/15/04

INITITAL INTRO SCREEN:

WITH RECEPTIONIST:
Hello, my name is _______________(first and last name). I'm on the staff of the Eagleton Poll at Rutgers University. I'd like to speak to the head dispatcher or other manager in charge of shipping.

This is for a joint research study by Rensselaer [REN-SAH-LEER] Polytechnic Institute and Rutgers University on trucking services in the New York - New Jersey region.

IF NEEDED: We sent a letter about this to [READ IN RESP NAME]. The goal of this study is gain a better understanding of the current travel needs and experiences of all types of road users in the metro area. This information will be used to inform policymakers on conditions that either aid or impede the flow of traffic. Our current objective is to learn about the needs and experiences of businesses that send and receive shipments in the New York area, particularly in ways that impact the conduct of day-to-day business. We are especially interested in hearing from businesses that send or receive shipments across the Hudson River between New York and New Jersey.

RESPONDENT INTRO SCREEN:

WHEN ELIGIBLE RESPONDENT IS ON PHONE:
Hello, my name is (first and last name). I'm on the staff of the Eagleton Poll at Rutgers University. We are conducting a study of businesses in the New York - New Jersey area. The study is designed to gain an understanding of the potential issues facing trucking companies that do business in the region. The interview will take about 15 minutes. All of your responses are completely confidential.

AS NEEDED: The goal of this study is gain a better understanding of the current travel needs and experiences of all types of road users in the metro area. This information will be used to inform policymakers on conditions that either aid or impede the flow of traffic. Our current objective is to learn about the needs and experiences of businesses that send and receive shipments in the New York area, particularly in ways that impact the conduct of day-to-day business. We are especially interested in hearing from businesses that send or receive shipments across the Hudson River between New York and New Jersey.

IF DECLINES: Yours is one of 200 businesses that have been selected to participate in this survey. Therefore your participation is critical to the success of the study.

To confirm, are you the head dispatcher or other manager in charge of shipping?
1. Yes—continue
2. No--RESCREEN May I please speak to the head dispatcher or other manager in charge of shipping.
3. Not available—callback and record name.
9. Refused

A. NYNJPA USER SCREEN

A1. Just to confirm your type of business for this survey, is your company involved in dispatching or shipping services involving trucks with at least six wheels?
1. Yes >> CONTINUE WITH A2
2. No/DK >>> TERMINATE

A2. Does your company currently dispatch trucks between New York City and New Jersey at least once a week?
1. Yes >> SKIP TO A3
2. No/DK >>> ASK A2A

A2A. Did you dispatch between New York City and New Jersey at least once a week at any time in the past three years?

1. Yes >> CONTINUE WITH A2B
2. No/DK >>> TERMINATE

A2B. Which bridges or tunnels did you use? [MULTIPLE RESPONSE – ACCEPT ALL MENTIONS BUT DO NOT READ LIST]

1. Holland Tunnel
2. Lincoln Tunnel
3. George Washington Bridge
4. Goethals Bridge
5. Bayonne Bridge
6. Outerbridge Crossing
7. Tappan Zee Bridge
8. Verrazano Narrows Bridge
9. Brooklyn Battery Tunnel
10. Midtown Tunnel
11. Triboro Bridge
12. ThrogsNeck Bridge
18. Other, specify: ______________________
19. DK/Ref

[***NOTE: RESPONDENT MUST GIVE RESPONSES 1-6 TO CONTINUE WITH SURVEY. If punch 1 through 6 not among mentions, terminate interview .*****]**

A2C. Why did you stop using these facilities?

1. Tolls increased
2. Gas prices, other operation costs
3. Travel route changed
4. Demand changed
5. Congestion delay
6. Company downsized
8. Other, specify: ______________________
9. DK/Ref

[IF PUNCH 1-"Tolls Increased" NOT mentioned in A2C, ASK A2D.
OTHERS GO TO SECTION F]

A2D. You didn't mention anything about the toll increases of March 2001. Why weren't they a factor in your company no longer dispatching trucks between New York City and New Jersey?

______________________ [Record verbatim]

>>> ALL FROM A2D GO TO SECTION F

A3. Which toll bridges, tunnels and roads do you use when you deliver merchandise in the New York/New Jersey metropolitan area? [MULTIPLE RESPONSE – ACCEPT ALL MENTIONS BUT DO NOT READ LIST] IF RESP SAYS "ALL," PROBE: "Which do you use most often?"

1. Holland Tunnel

2. Lincoln Tunnel
3. George Washington Bridge
4. Goethals Bridge
5. Bayonne Bridge
6. Outerbridge Crossing
7. Tappan Zee Bridge
8. Verrazano Narrows Bridge
9. Brooklyn Battery Tunnel
10. Midtown Tunnel
11. Triboro Bridge
12. ThrogsNeck Bridge
13. New Jersey Turnpike
14. Garden State Parkway
15. Queens/MidTown Tunnel
16. Whitestone Bridge
18. Other, specify: ______________________
19. DK/Ref

[***NOTE: RESPONDENT MUST GIVE RESPONSES 1-6 TO CONTINUE WITH SURVEY. If punch 1 through 6 not among mentions, terminate interview .*****]**

A4. For how many years have you been using these bridges and tunnels on a regular basis?

__________ [Record number. 0=Less than 1 year, 99=DK/Ref]

B. CURRENT OPERATIONS AND FLEXIBILITY

B1. What types of commodities or products do you carry the most? [MULTIPLE RESPONSE – ACCEPT ALL MENTIONS]

1. Agriculture, Forestry, Fishing
2. Food
3. Beverages
4. Alcohol
5. Tobacco
6. Textiles / clothing
7. Furniture
8. Wood / lumber
9. Paper
10. Petroleum / coal
11. Chemicals
12. Plastics / rubber
13. Metal
14. Machinery
15. Electronics
16. Household goods/various
17. Stone/concrete

18. Other, specify: ___________________
19. DK/ref

B2. Typically how many times per day do your trucks cross the Hudson River in the east bound direction into New York City ?
____________ number of times per day
0=less than once per day **>>> ASK B2A**
998 = 998 or more
999 = DK/ref

B2A. How many times per week? ____________ number of times per week
0=less than once per week **>>> ASK B2B**
98 = 98 or more
99 = DK/ref

B2B. How many times per month then? ____________ number of times per month
0=less than once per month
98 = 98 or more
99 = DK/ref

B3. How many stops do your trucks make on a typical roundtrip between New York City and New Jersey?
____________ number of stops per tour
0=None; 98 = 98 or more; 99 = DK/ref

B4. Of the vehicles that make these cross-Hudson trips, what percentage go eastbound through the toll booths between New Jersey and New York City during peak hours -- that is between 6 and 9 a.m. or between 4 and 7 p.m. during weekdays, or between noon and 8 p.m. on weekends?
__________ percent, 999=DK/ref

B5. And what percentage go eastbound through the toll booths during day time off-peak hours – that is between 9 a.m. and 4 p.m. or between 7 p.m. and midnight during weekdays, or before noon or after 8 p.m. on weekends?
__________ percent, 999=DK/ref

B6. And what percentage go eastbound through the toll booths during overnight hours – that is between midnight and 6 a.m. during weekdays?
__________ percent, 999=DK/ref

B7. Why do your trucks travel on this schedule as opposed to other times of the day? **[ACCEPT MULTIPLE RESPONSES. DO NOT READ LIST]**
1. The toll is cheaper

2. To avoid congestion
3. Customer requirements dictate schedule
4. Have to deliver during normal business/daytime hours
18. Other, specify: ___________________
19. No reason / DK/REF

B8. I'd like to get some idea about your schedule flexibility. Does your company have any control over what time of day you can choose to make deliveries?

1. Yes >>> ASK B8A/B
2. No >>> GO TO B9
9. DK/REF >>> GO TO B9

B8A. In general, how much LATER than your typical delivery time would your trucks be able to arrive at their destination and still meet your company needs?

__________ Code in minutes, 0=None

B8B. And how much EARLIER can they arrive?

__________ Code in minutes, 0=None

B9. How long does a typical round-trip tour take when making a delivery between New York and New Jersey?

__________ Code in minutes;
8888 VOL No typical time; 9999. DK/ref

B10. What is your typical shipment size in pounds?

___________ Enter response in pounds
88888. Gave answer in different units, record verbatim: ___________
99998 VOL No typical size;
99999. DK/refused

B11. And what percentage of a truck's cargo capacity is typically utilized?

______________ %
998 VOL No typical percentage; 999=DK/refused

C. TOLL PAYMENT AND E.Z. PASS USE

C1. Does your company currently use E.Z. Pass for these deliveries?

1. Yes **>>> GO TO C2**
2. No **>>> ASK C1A**
3. (VOL) Not applicable, individual drivers pay tolls **>>> GO TO C2**
9. DK/ref **>>> GO TO C2**

C1A. Why don't you use E.Z. Pass currently?

1. It really won't save the company any time
2. It really won't save the company any money

3. The discounts are not large enough
4. Wouldn’t use it enough
5. It’s too much trouble to get one
6. It’s too expensive to get E.Z. PASS tags
7. I don’t want to give out company information
8. Seems complicated to use
9. Afraid of being overcharged or fined if the tag doesn’t work right
10. The company just never really thought about getting it
11. I don’t know where to get E.Z. PASS
12. Past problems with E.Z. PASS
13. We haven’t gotten around to do it
14. We were not aware of E.Z. PASS
15. No specific reasons
16. Monthly fee
17. Driver abuse/need receipts for use
18. Other, specify: ______________
19. DK/ref

[IF C1=1 PROCEED WITH C2. ALL OTHERS GO TO C5]

C2. For how many years has your company used E.Z. Pass?

__________ [Record number. 0=Less than 1 year, 99=DK/Ref]

C3. What do you like MOST about E.Z. Pass? [ACCEPT MULTIPLE RESPONSES. DO NOT READ LIST]

1. Saves time/quicker
2. Saves money, cheaper than cash toll
3. Don’t need to carry cash
4. Don’t need to interact with toll collector
5. Safer
6. Less stressful
7. Like the itemized statement/don’t need to keep receipts
8. Can use it for parking
9. Can use it for other toll roads
10. Just easier
11. Simplifies accounting
17. Other, specify: ______________________
18. Nothing in particular
19. DK/ref

C4. How many E.Z. Pass tags does your company currently have?

____________ record number; 999. DK/ref

C5. Are you aware of any discounts that commercial vehicles can get using E.Z. Pass for the Hudson River crossings?

1. Yes **>>> ASK C5A**
2. No

9. DK/ref

C5A. What are they? **[ACCEPT MULTIPLE RESPONSES. DO NOT READ LIST]**

1. Off-peak/non-rush hour use discounts
2. Overnight use discounts
3. General EZ Pass discount
8. Other, specify: ______________
9. DK of specific discounts /ref
10. No/DK from question C5

C6. Are you aware of the increase in the Hudson River crossing tolls that took place in March 2001?

1. Yes
2. No **>> SKIP TO C8**
9. DK/ref **>> SKIP TO C8**

[IF C2=3 to 98, ASK C7, ALL OTHERS (C2=0,1,2 or 99 or C1=2/3/9) GO TO C8]

C7. Did your company switch from cash to E.Z. Pass or increase your use of E.Z. Pass because of the Hudson River toll increases of March 2001?

1. Yes, switched
2. Yes, increased use
3. Yes, both
4. No
9. DK/ref

C8. Is there anything that could be done to make E.Z. Pass attractive to more companies like yours? **[ACCEPT MULTIPLE RESPONSES. DO NOT READ LIST.]**

1. High speed toll lanes
2. Make the EZ Pass toll lanes separate from other traffic, move quicker
3. Give a discount for use
4. Give a BIGGER discount for use
5. Get rid of monthly fees
6. Don’t place a hold on credit card accounts/don’t require prepayment
7. Make it easier to get a tag
8. Make sure that information is not used to track people
9. Better PR, communications
10. Expand use to other venues
11. Better customer service
12. Lower deposit requirement
13. Simplified/accurate billing with receipts
14. Make scanner easier to read/different position
17. Other specify: ______________________
18. NO, NOTHING IN PARTICULAR
19. DK/Can’t recall/No answer/Ref

D. CHANGES DUE TO TOLL INCREASE

[ASK SECTION D ONLY FOR THOSE WHO HAVE USED PA TOLLS OVER 3 YEARS AND ARE AWARE OF THE TOLL INCREASES – * A4=3-98 AND C6=1 ALL OTHERS GO TO SECTION E]**

D1. Now I'd like you to think back to the March 2001 toll increase on the Hudson River crossings. Do you think the toll increase had any effect on traffic between New York City and New Jersey bridges and tunnels or not?

1. Yes **>>> ASK D1A**
2. No **>>> SKIP TO D2**
9. DK/ref **>>> SKIP TO D2**

D1A. Do you think traffic congestion is now better or worse? [PROBE: Is that a lot better/worse or just somewhat?]

1. Lot Better
2. Somewhat Better
3. Somewhat Worse
4. Lot Worse
8. (VOL) Combination, sometimes better/sometimes worse
9. DK/ref

D2. Did this toll increase lead to any changes in your dispatching operations, or not?

1. Yes **>>> SKIP TO D3**
2. No **>>> ASK D2A**
9. DK/ref **>>> SKIP TO SECTION E**

D2A. What are the main reasons your operations did not change? **[DO NOT READ LIST]**

1. Price difference not all that much/can afford it
2. Few trips to New York
3. Can't change schedule due to customer requirements
4. Cost paid by shippers
5. Cost paid by receivers
6. Cost paid by individual drivers
7. There was no change in the cost for off-peak travel
8. Customers absorb costs
9. Must use quickest route
18. Other, specify: ___________
19. DK/ref

>>>>> ALL FROM D2A GO TO SECTION E

D3. Did you change how often your vehicles made the trip between New York City and New Jersey because of the toll increase?

1. Yes >>> ASK D3A
2. No >> GO TO D4
9. DK/ref >> GO TO D4

D3A. On a scale of 1 to 5, with 5 being very significant and 1 being very insignificant, how would you rate the impact of the toll increase on the number of trips your company makes between New York City and New Jersey?

________ record 1-5; 9=DK/ref

[If D3A =2 thru 5, ASK D3B. Otherwise go to D4]

D3B. How many trips did your vehicles make a week on average BEFORE the toll increase?

______________ Record number , 99=DK/Ref

D3C. Did your vehicles generally make more or fewer trips after the toll increase went into effect?

1. More
2. Fewer
3. Same
9. DK/ref

D4. Did you change how many times your vehicles made stops, deliveries, or pickups during a tour because of the toll increase?

1. Yes **>>> ASK D4A**
2. No **>> GO TO D5**
9. DK/ref **>> GO TO D5**

D4A. On a scale of 1 to 5, with 5 being very significant and 1 being very INSIGNIFICANT, how would you rate the impact of the toll increase on the number of stops per tour your vehicles make?

________ record 1-5; 9=DK/ref

[If D4A =2 thru 5, ASK D4B. Otherwise go to D5]

D4B. How many stops did your vehicles make a tour on average BEFORE the toll increase?

______________ Record number , 99=DK/Ref

D4C. Did your vehicles generally make more or fewer stops after the toll increase went into effect?

1. More
2. Fewer
3. Same
9. DK/ref

D5. Did you make any changes to the time of day when your vehicles make the trip between New York City and New Jersey going east through the toll booths?

1. Yes **>>> ASK D5A**
2. No **>> GO TO D6**
9. DK/ref **>> GO TO D6**

D5A. On a scale of 1 to 5, with 5 being very significant and 1 being very INsignificant, how would you rate the impact of the toll increase on the time of day your vehicles make the trip between New York City and New Jersey?

________ record 1-5; 9=DK/ref

[If D5A =2 thru 5, ASK D5B. Otherwise go to D6]

D5B. What percentage of your vehicles went through the toll booths between New York City and New Jersey before the toll increase during peak hours – that is between 6 and 9 a.m. or 4 and 7 p.m. during weekdays, or between noon and 8 p.m. on weekends?

__________ percent, 999=DK/ref

D5C. What percentage of your vehicles went through the toll booths between New York City and New Jersey before the toll increase during day time off-peak hours-that is between 9 a.m. and 4 p.m. or 7 p.m. and midnight during weekdays, or before noon or after 8 p.m. on weekends?

__________ percent, 999=DK/ref

D5D. What percentage of your vehicles went through the toll booths between New York City and New Jersey before the toll increase during overnight hours-that is between midnight and 6 a.m. during weekdays?

__________ percent, 999=DK/ref

D6. Did the toll increase affect the amount of time it takes your vehicles to make a round trip tour?

1. Yes **>>> ASK D6A**
2. No **>> GO TO D7**
9. DK/ref **>> GO TO D7**

D6A. On a scale of 1 to 5, with 5 being very significant and 1 being very INsignificant, how would you rate the impact of the toll increase on the travel time for a typical tour?

________ record 1-5; 9=DK/ref

[If D6A =2 thru 5, ASK D6B. Otherwise go to D7]

D6B. Before the toll increase, how long did a typical round trip take on tours involving one of the Hudson River crossings?

__________ percent, 999=DK/ref

D6C. Did the typical trip take longer or shorter after the toll increase?

1. Longer
2. Shorter
3. Same
9. DK/ref

D7. Did the toll increase affect the typical shipment size?

1. Yes >>> ASK D7A
2. No >> GO TO D8
9. DK/ref >> GO TO D8

D7A. On a scale of 1 to 5, with 5 being very significant and 1 being very INsignificant, how would you rate the impact of the toll increase on the typical shipment size?

________ record 1-5; 9=DK/ref

[If D7A =2 thru 5, ASK D7B. Otherwise go to D8]

D7B. Before the toll increase, what was your typical shipment size in pounds?

___________ Enter response in pounds
88888. Gave answer in different units, record verbatim: ___________
99999. DK/refused

D7C. Did the typical shipment size increase or decrease after the toll increase?

1. Increase
2. Decrease
3. Same
9. DK/ref

D8. Did the toll increase affect the amount you charge for shipments?

1. Yes **>>> ASK D8A**
2. No **>> GO TO D9**
9. DK/ref **>> GO TO D9**

D8A. On a scale of 1 to 5, with 5 being very significant and 1 being very INsignificant, how would you rate the impact of the toll increase on the amount you charge for shipments?

________ record 1-5; 9=DK/ref

[If D8A =2 thru 5, ASK D8B. Otherwise go to D9]

D8B. Did your shipment charges go up or down?

1. Up
2. Down
9. DK/ref >>> SKIP TO D9

D8C. By what percent?

___________ Enter percent, 999. DK/refused

D9. Did the toll increase affect your typical load of the truck's cargo capacity?

1. Yes **>>> ASK D9A**
2. No **>> GO TO D10**
9. DK/ref **>> GO TO D10**

D9A. On a scale of 1 to 5, with 5 being very significant and 1 being very INSIGNIFICANT, how would you rate the impact of the toll increase on your typical truck load?

________ record 1-5; 9=DK/ref

[If D9A =2 thru 5, ASK D9B. Otherwise go to D10]

D9B. What was your typical load of the truck's cargo capacity for this type of trip before the toll increase in percent?

____________ percent; 999. DK/ref

D9C. Did you use more or less of the truck's cargo load after the toll increase?

1. More
2. Less
3. Same
9. DK/ref

D10. Did the toll increase affect the types of vehicles you used in your fleet?

1. Yes **>>> ASK D10A**
2. No **>> GO TO D11**
9. DK/ref **>> GO TO D11**

D10A. On a scale of 1 to 5, with 5 being very significant and 1 being very INsignificant, how would you rate the impact of the toll increase on the types of vehicles in your fleet?

________ record 1-5; 9=DK/ref

[If D10A =2 thru 5, ASK D10B. Otherwise go to D11]

D10B. Before the toll increase, how many small trucks, large straight trucks and semi-trailers did you have?

D10BA. ____________ number of small trucks

D10BB. ____________ number of straight trucks

D10BC. ____________ number of semi-trailers

D10C. Did the number of [READ IN] in your fleet increase or decrease after the toll increase?

D10CA. small trucks

D10CB. straight trucks

D10CC. semi-trailers

1. Increase
2. Decrease
3. Same
9. DK/ref

D11. Did the toll increase affect the routes you use for deliveries?

1. Yes **>>> ASK D11A**
2. No **>> GO TO D12**
9. DK/ref **>> GO TO D12**

D11A. On a scale of 1 to 5, with 5 being very significant and 1 being very INsignificant, how would you rate the impact of the toll increase on your delivery routes?

________ record 1-5; 9=DK/ref

[If D11A =2 thru 5, ASK D11B. Otherwise go to D12]

D11B. How have your delivery routes changed?

____________ record verbatim

D12. Did the March 2001 Hudson River toll increases have any impact on your company's other operations?

1. Yes, specify : ____________________
2. No
9. DK/ref

E. TOLL SCENARIO TESTS

For research purposes, we're interested in finding out how your operations might have changed using some hypothetical situations about the tolls for the trips between New York City and New Jersey. In these instances, peak hours include the morning rush between 6 and 9 a.m. and the evening rush between 4 and 7 p.m. Off-peak hours are all other times during the day and overnight hours run from midnight to 6 a.m. during weekdays or between noon and 8
p.m. on weekends?

**[CATI: E1-E5 is for CASH TOLL USERS ONLY ::: If C1=2 or 9 .
ALL OTHERS GO TO E6 INSTRUCTIONS]**

[CATI: ROTATE E1, E2, E3]

E1. Would your company switch to E.Z. Pass if it saved your vehicles [READ IN X] per axle in tolls if they traveled during peak hours, [READ IN Y] if they traveled off peak, and [READ IN Z] if they traveled during overnight hours?

[CATI: SELECT 4 RANDOM SCENARIOS PER RESPONDENT]
ROTATE:

Scenario	X read-in	Y read-in	Z read-in
A.	$3	$4	$5
B.	$2	$4	$5
C.	No money	$4	$5
D.	$2	$3	$5
E.	No money	$3	$5

F.	$2	$3	$4
G.	No money	$3	$4

E2. Would your company switch to E.Z. Pass if it saved your vehicles 15 minutes in travel time getting through the toll plaza, and saved you [READ IN X] per axle in tolls if they traveled during peak hours, [READ IN Y] if they traveled off peak, and [READ IN Z] if they traveled during overnight hours?

[CATI: SELECT 4 RANDOM SCENARIOS PER RESPONDENT]
ROTATE:

Scenario	X read-in	Y read-in	Z read-in
A.	$3	$4	$5
B.	$2	$4	$5
C.	No money	$4	$5
D.	$2	$3	$5
E.	No money	$3	$5
F.	$2	$3	$4
G.	No money	$3	$4

E3. Would your company switch to E.Z. Pass if it saved your vehicles 15 minutes in travel time getting through the toll plaza and no savings in the tolls.

Answer codes for E1/E2/E3

1. Yes **>>> ASK E4 as appropriate after each "Yes"**
2. No
9. DK/ref

E4. [For each yes:] Under this scenario, would you have your fleet generally travel during peak hours, off-peak hours, or overnight hours?

1. Peak hours
2. Off-peak hours
3. Overnight hours
4. Both off-peak and overnight hours
9. Don't know

E5. Would your company make any other changes in its operations under any of these scenarios?

1. Yes, describe: ______________________
2. No
9. DK/ref

[CATI: E6-8 is for E.Z. PASS PEAK HOUR USERS ONLY ::: If C1=1 and B4 is between 25 and 100. ALL OTHERS GO TO E9 INSTRUCTIONS]

E6. Would your company switch many of your deliveries to off-peak or overnight travel if it saved your vehicles [READ IN Y] per axle in tolls if they traveled during off-peak hours, and [READ IN Z] if they traveled during overnight hours?

ROTATE:

Scenario	Y read-in	Z read-in
A.	$4	$5
B.	$3	$5
C.	No money	$5
D.	$3	$4
E.	No money	$4

Answer codes for E6

1. Yes >>> ASK E7 as appropriate after each "Yes"
2. No
9. DK/ref

E7. [For each yes:] Under this scenario, would you have your fleet generally travel during off-peak hours or overnight hours?

1. (n/a)
2. Off-peak hours
3. Overnight hours
4. Both off-peak and overnight hours
9. Don't know

E8. Would your company make any other changes in its operations under any of these scenarios?

1. Yes, describe: ______________________
2. No
9. DK/ref

[CATI: E9-10 is for E.Z. PASS NON-PEAK HOUR USERS ONLY ::: If C1=1 and B5 is between 25 and 100. ALL OTHERS GO TO SECTION F]
[IF RESPONDENT ALREADY ANSWERED E6, SKIP TO SECTION F EVEN IF THEY QUALIFY FOR E9 AS WELL.]

E9. Would your company switch many of your deliveries to overnight travel if it saved your vehicles [READ IN Z] per axle in tolls if they traveled during that time?

ROTATE:

Scenario	Z read-in
A.	$4
B.	$3

Answer codes for E9

1. Yes
2. No
9. DK/ref

E10. Would your company make any other changes in its operations under any of these scenarios?

1. Yes, describe: ____________________
2. No
9. DK/ref

F. PUBLIC OPINION

[RANDOMIZE F1-F5]
Now a few quick questions on your opinions. I'm going to read you some statements and want you to tell me whether you strongly agree, somewhat agree, somewhat disagree or strongly disagree with each.
[REPEAT AS NEEDED AFTER READING EACH STATEMENT: Do you strongly agree, somewhat agree, somewhat disagree or strongly disagree with that?]

F1. It is fair to charge lower tolls for trucks with fewer axles.

F2. It is fair to give discounts to E.Z. Pass users.

F3. It is fair to charge commercial users higher tolls during peak hours.

F4. It is fair to charge commercial users lower tolls during the overnight hours.

F5. Hudson River bridge and tunnel toll revenues should be used to support public transit.

1. Strongly Agree
2. Somewhat Agree
3. Somewhat Disagree
4. Strongly Disagree
9. DK/ref

G. COMPANY ATTRIBUTES
Just a few more questions so we can classify your answers.
G1. Is your company a private carrier, a common carrier, or a contract carrier?

1. Private carrier (maintains its own fleet and freight)
2. Common carrier (offers services to general public)
3. Contract carrier
4. (VOL) Independent owner/operator
5. (VOL) Combination – private and common
8. Other, specify: ______________
9. DK/ref

G2. Would you classify your company as F.T.L, L.T.L., intermodal, drayage, or marine? [ACCEPT MULTIPLE RESPONSES]

1. F.T.L
2. L.T.L.
3. Intermodal
4. Drayage
5. Marine containers
8. Other, specify: ________________
9. DK/ref

G3. How many small, 2-axle trucks are in your fleet? __________ record number, 99=DK/ref, 98=98+

G4. How many 3- or 4-axle straight trucks are in your fleet? __________ record number, 99=DK/ref

G5. How many trailers or semi-trailers are in your fleet? __________ record number, 99=DK/ref

G6. From which state do most of your shipments originate?

1. New Jersey
2. New York
3. Connecticut
4. Pennsylvania
5. California
6. Ohio
7. North Carolina
8. Georgia
9. Maryland
10. Indiana
11. Regional
12. Overseas
18. Other, specify: _____________
19. DK/ref

G7. And to which states are most of your shipments sent? **[ACCEPT MULTIPLE]**

1. New Jersey
2. New York
3. Connecticut
4. Pennsylvania
5. California
6. Massachusetts
7. Florida
8. Maryland
9. Delaware

10. NC/VA/GA
11. Michigan/Ohio
12. Minnesota
13. RI/VT/ME
14. Illinois
15. Texas
18. Other, specify: ____________
19. DK/ref

G8. What is your company's zip code? /____/____/____/____/____/
DK/RF=99999

G9. How many interstate licensed truck drivers are in your company?
______ record number, 99=DK/ref, 98=98 or more

That is the end of the survey. You've been very helpful.
Thank you very much for your participation.

Appendix 13. Findings Pertaining to Former Regular Users

In the sample, there are 18 former regular users which account for 115 trip-based weighted responses. These companies are dominated by private carriers that represent 61.1 percent of the trips made by former regular users. Most of the survey respondents are from New Jersey (83.3 percent of the trips), reflecting the nature of the survey response rather than the geographic distribution of the commercial user population of the PANYNJ crossings (Figure 110). It is important to highlight that, because of the relatively small number of observations in this subgroup, the results in this subsection must be interpreted with caution. Details of former regular users' company attributes are contained in Appendix 14.

The average former regular users in this sample of 18 firms tend to:

- Provide only two types of services, less than truckload (55.6 percent) and intermodal service (27.8 percent), while the remaining did not tell their types of service (Figure 111);
- Focus on local operations, with a focus on intra-state shipments. For instance, 60.0 percent of New Jersey former regular users sent the majority of their shipments to some place within New Jersey, suggesting that these firms that changed their usage patterns at PANYNJ crossings were not particularly dependent on these services to begin with.
- Have smaller fleets that average 12.9 trucks per firm (Table 127).
- Own smaller fleets, averaging 2.2 two-axle trucks, 1.4 three / four-axle trucks, and 9.3 trailers / semi-trailers (Table 127).
- The average number of interstate truck drivers employed by former regular users 12.9 drivers (Table 128). Meanwhile, the average numbers of interstate truck drivers per truck are 0.7 drivers per truck (Table 129).

Appendix 14. Former Regular Users' Company Attributes

The findings presented in this Appendix relate to a very limited survey sample of firms that are not likely to be geographically representative of the universe of PANYNJ truck customers. Given the limitations of the sample and the geographic orientation to New Jersey firms the reader should interpret the results in this section with this limitation in mind.

Eighteen former regular users were found during the data collection process. These companies used to use the PANYNJ toll facilities on a regular basis (at least once per week) though they do not do it any more. The purpose of this subsection is to characterize these former regular users. Since no data were collected about trip frequency from former regular users, no expansion factors were used and the information is based on individual responses. For comparison purposes, this subsection follows the same structure as the subsection for current regular users.

As illustrated by Figure 110, the carriers that are no longer regular users of the PANYNJ facilities are dominated by private carriers (61.1 percent). Most of these former regular users are from New Jersey (83.3 percent) which may be a reflection of the fact that the majority of carriers in the data set are from New Jersey. Compared with current regular users, former regular users have smaller fleet sizes and employ less interstate truck drivers. Meanwhile, they are more likely to dispatch their trucks within the state where the companies are located. These patterns were found to vary by carrier type and sometimes by business location. The corresponding findings are discussed next.

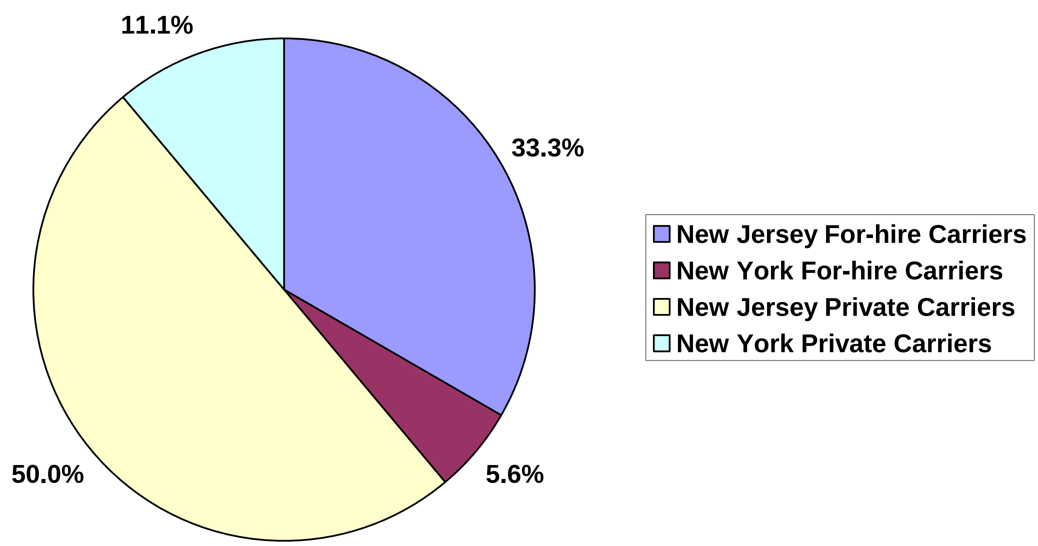
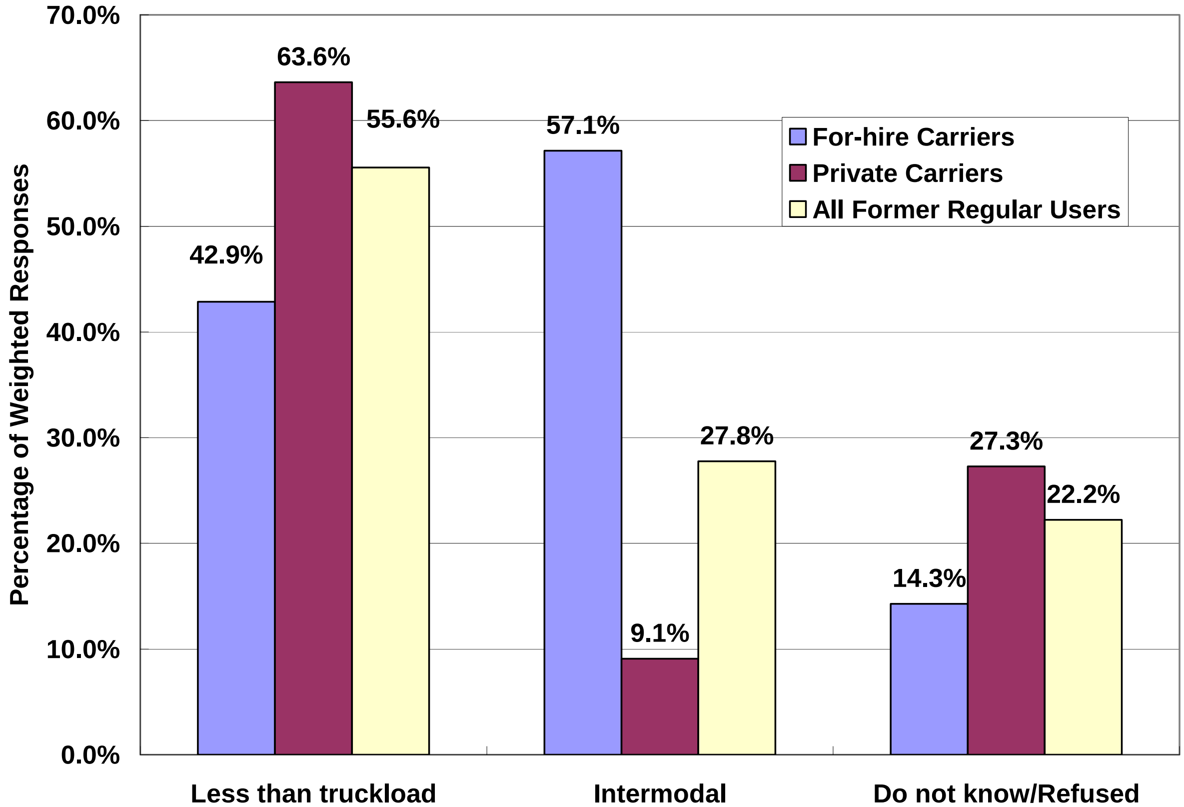


Figure 110. Breakdown of former regular users by carrier type and area

(1) Business type

As shown in Figure 111, former regular users provided only two types of services, less than truckload (LTL) (55.6 percent) and intermodal service (27.8 percent). Compared with for-hire carriers, private carriers are more likely to focus on less than truckload (LTL) service (63.6 percent) than intermodal service (9.1 percent).



Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

Figure 111. Distributions of business type (former regular users)

(2) Fleet size and composition

This subsection discusses the data about carriers' fleet size. It was found that former regular users have smaller fleets than current regular users, on average. The average fleet size for former regular users is 12.9 trucks compared with 53.9 trucks for current regular users. Meanwhile, as shown in Figure 112, only 11.2 percent of former regular users have 21 to 49 trucks (5.6 percent) or more than 49 trucks (5.6 percent), compared with 21.2 percent and 34.9 percent for current regular users (Figure 33).

Similar as the pattern identified earlier for current regular users, for-hire carriers tend to be larger than private carriers among former regular users. A little less than 30 percent of for-hire carriers (28.6 percent) own more than 20 trucks while none of private carriers have such a large fleet size. The average fleet sizes of these carriers confirm this finding (Table 127). The number of trucks owned by for-hire carriers is 24.1 trucks on average which is about four times higher than the one for private carriers (5.8 trucks).

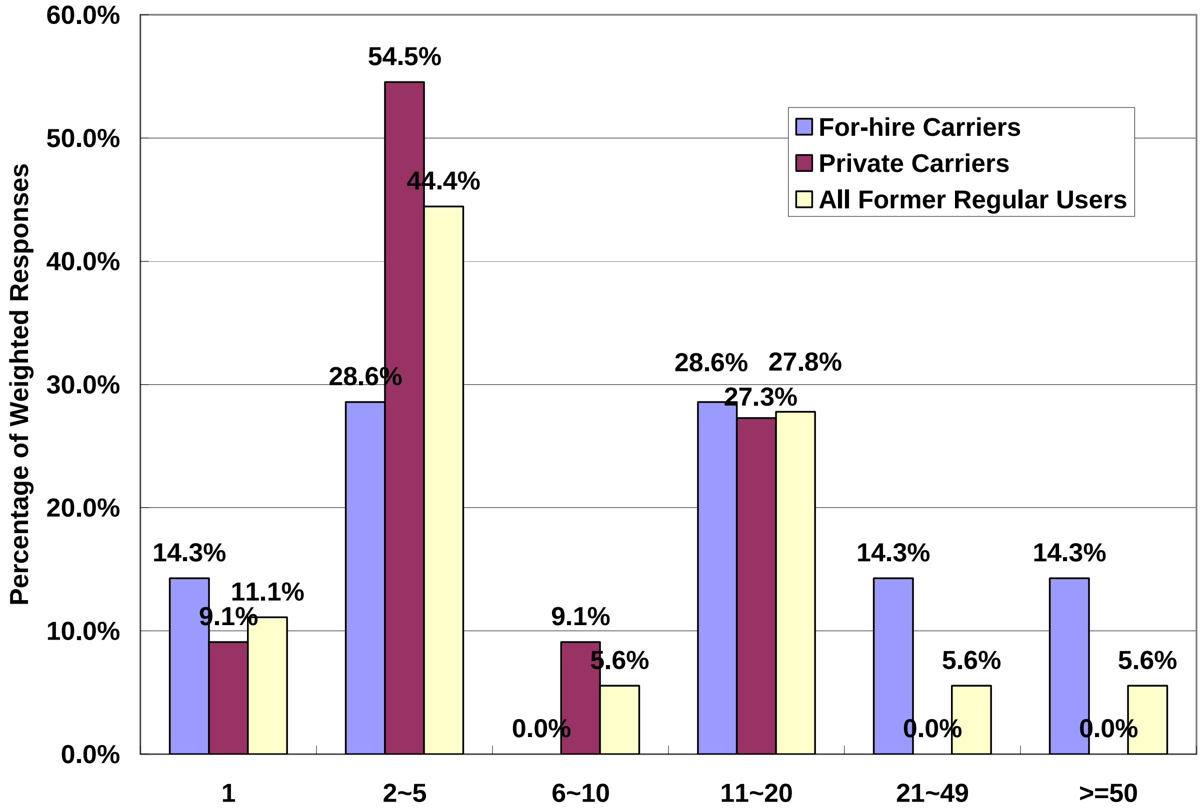


Figure 112. Distributions of fleet size (former regular users)

Table 127. Average number of trucks owned (former regular users)

Truck type	For-hire Carriers	Private Carriers	All Former Regular Users
Two axle trucks	1.4	2.7	2.2
Three / four axle trucks	3.0	0.5	1.4
Trailers / semi-trailers	19.7	2.6	9.3
Fleet size (trucks)	**24.1**	**5.8**	**12.9**

The distributions of number of trucks owned by type are shown in Figure 113 through Figure 115. The key findings are summarized below:

1) Former regular users reported smaller fleets, of each truck type, than current regular users. The average numbers of trucks for former regular users are 2.2 two-axle trucks, 1.4 three / four-axle trucks, and 9.3 trailers / semi-trailers (Table 127) while the

numbers for current regular users are 9.4 two-axle trucks, 4.2 three / four-axle trucks, and 33.8 trailers / semi-trailers (Table 60).

2) One key component of the former regular users' fleets is trailers / semi-trailers. The average numbers of trailers / semi-trailers is 9.4, while the average numbers of two-axle trucks and three / four-axle trucks are 2.2 and 1.4 respectively (Table 127).

3) The compositions of fleet vary by carrier types. Similar to current regular users, private carriers in the former users group are more likely to own small-size trucks e.g., two-axle trucks; while for-hire carriers exhibit the opposite behavior (see Table 127). As can be seen, the average number of two-axle trucks owned by for-hire carriers (1.4 two-axle trucks) is less than the one of private carriers (2.7 two-axle trucks). Conversely, when the truck type is three / four-axle trucks, the average number of trucks owned by for-hire carriers (3.0 trailers / semi-trailers) is six times higher than the one owned by private carriers (0.5 trailers / semi-trailers). Moreover, when the truck type is trailer / semi-trailer, the difference is even more (19.7 trailers / semi-trailers for for-hire carriers vs. 2.6 trailers / semi-trailers for private carriers).

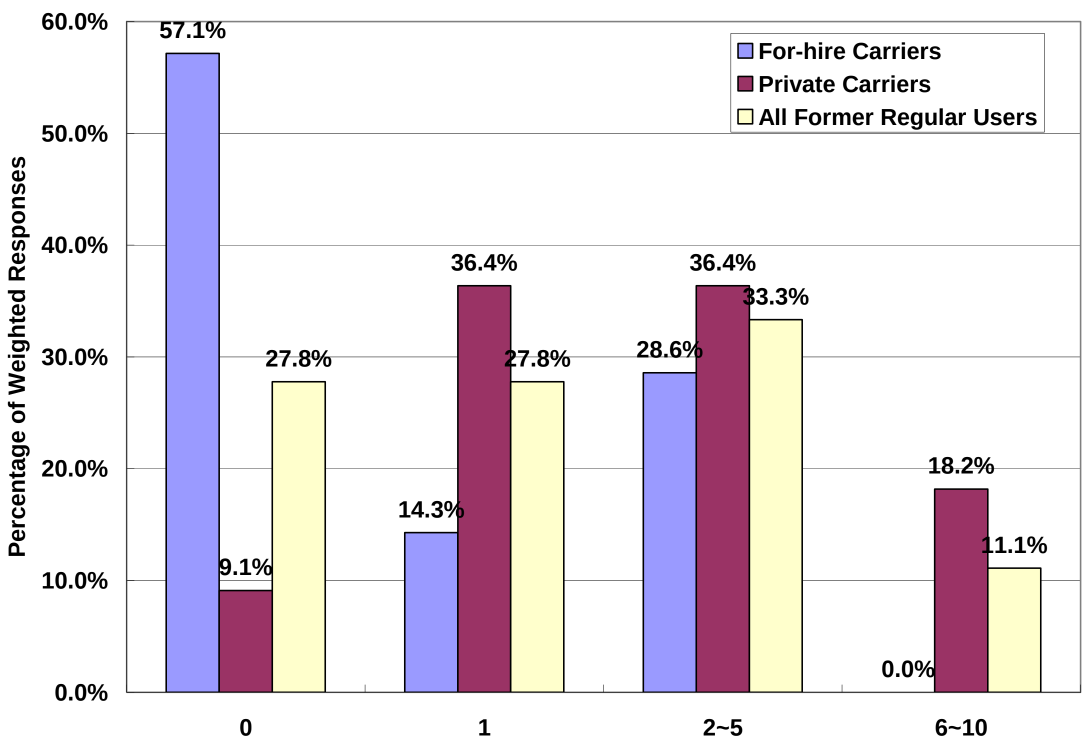


Figure 113. Distributions of two-axle trucks (former regular users)

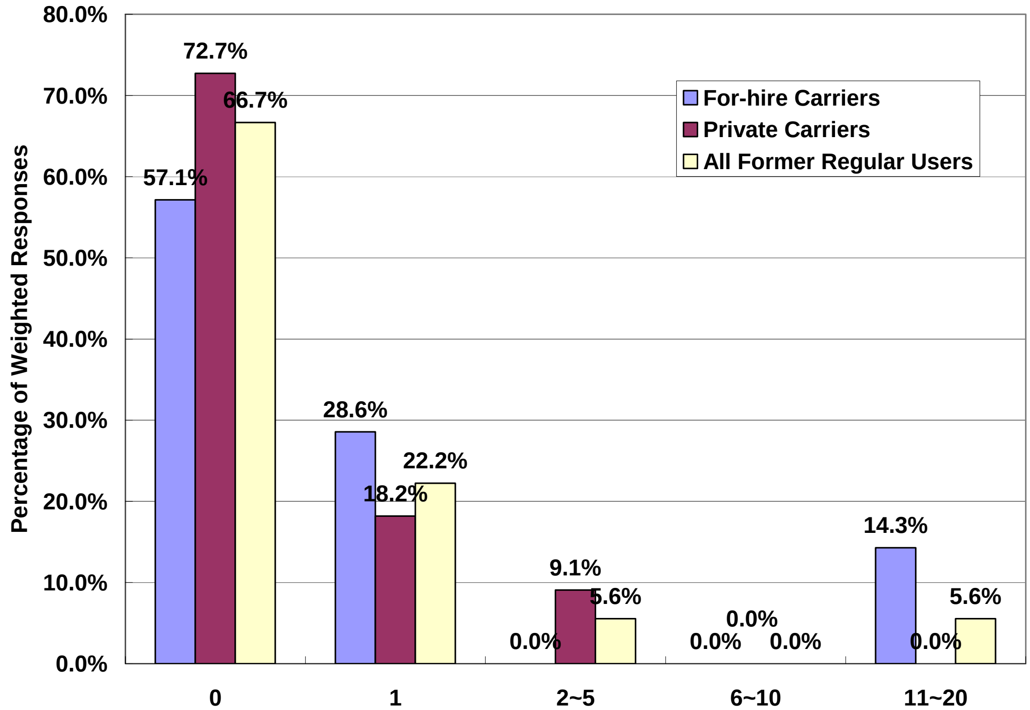


Figure 114. Distributions of three / four-axle trucks (former regular users)

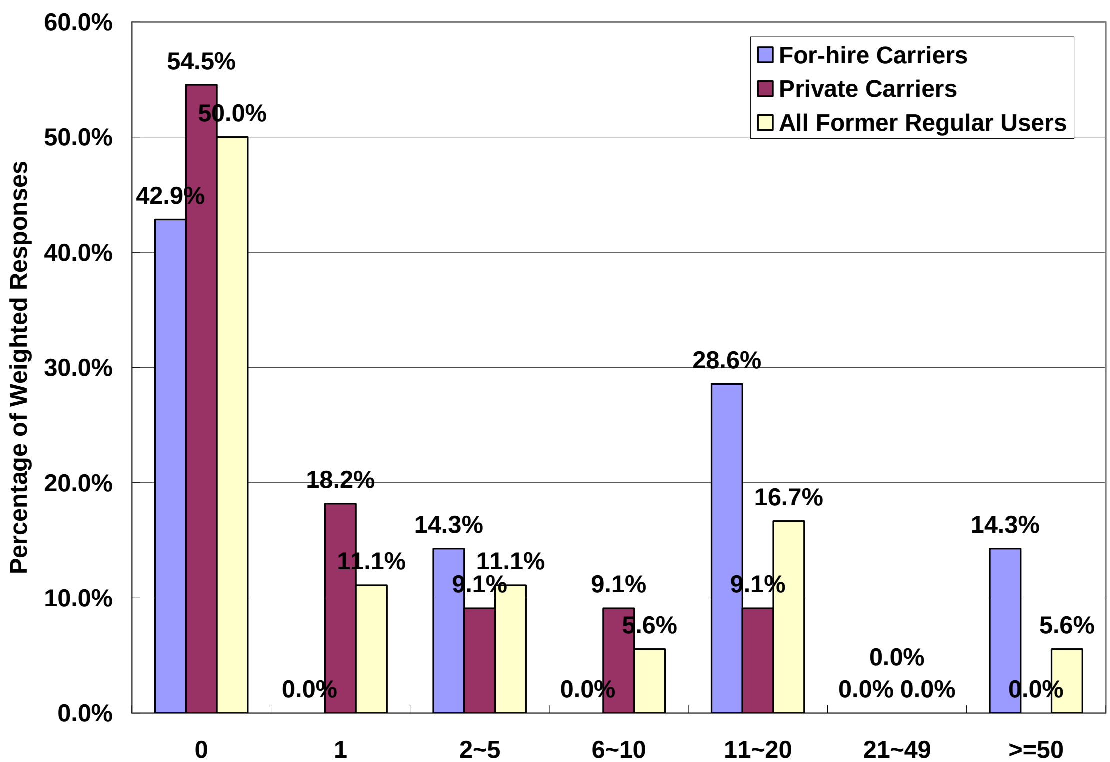


Figure 115. Distributions of trailers and semi-trailers (former regular users)

(3) Number of interstate truck drivers

As in the case of the distributions of fleet size, the distributions of interstate licensed truck drivers employed by former regular users follow a different pattern from current regular users. The average number of interstate drivers in each category (Table 128) is generally two to four times less than the corresponding value for current regular users. Similarly, for-hire carriers employ more interstate truck drivers than private carriers among former regular users. The average number of interstate drivers for for-hire carriers (29.0 drivers) is about nine times higher than the one for private carriers (3.2 drivers).

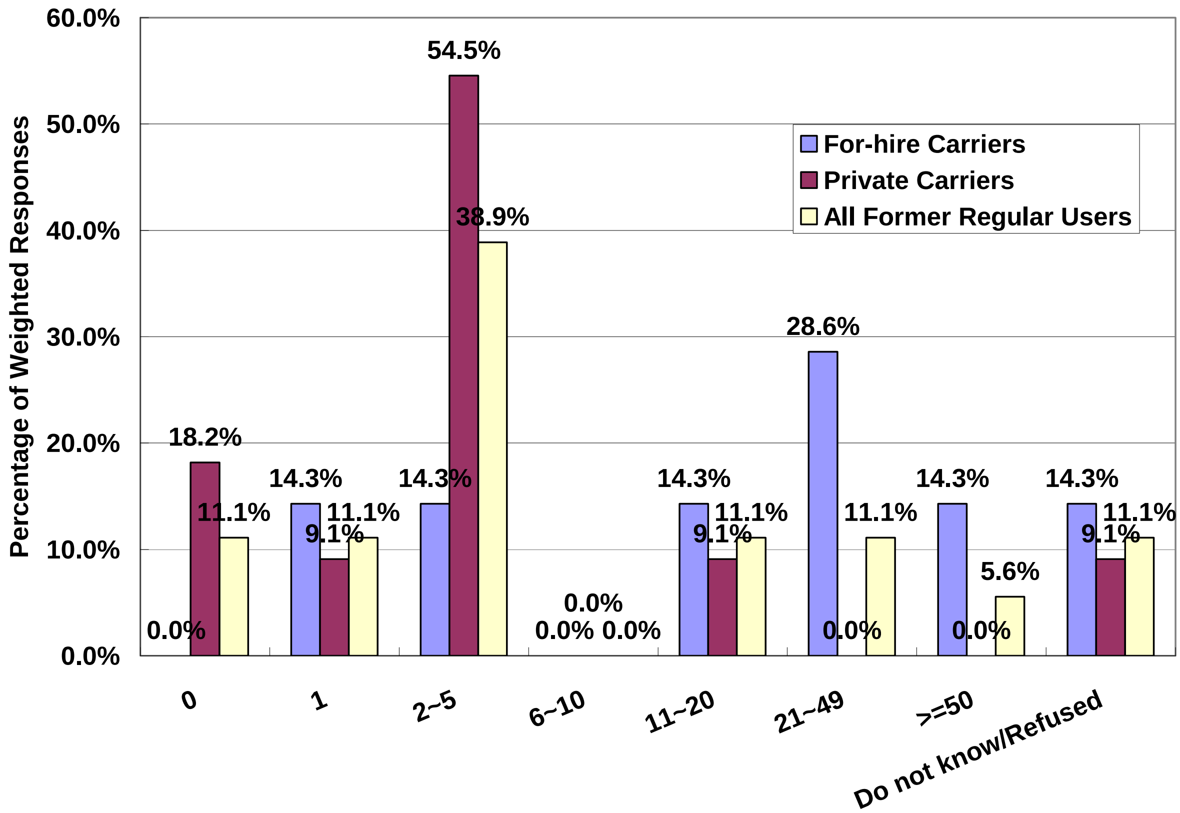


Figure 116. Distributions of interstate drivers (former regular users)

Table 128. The average number of interstate truck drivers (former regular users)

Carrier type	Average number of interstate truck drivers
For-hire Carriers	29.0
Private Carriers	3.2
All Former Regular Users	12.9

The analysis was also done with respect to the interstate truck drivers per truck to identify the relative importance of interstate truck trips. Similar as current regular users, former regular users are dominated with these companies with high numbers of interstate truck drivers per truck. As shown in Figure 117, the largest group of former regular users are those that have 0.75 to 1.0 interstate drivers per truck (33.3 percent). The proportions of former regular users that have zero (11.1 percent) or zero to 0.25 (16.7 percent) interstate drivers per truck are higher than the ones of current regular users (2.4 percent and 13.1 percent respectively). Meanwhile, the group with 0.25 to 0.5 interstate drivers per truck is much lower among former regular users (5.6 percent) than current regular users (21.1 percent).

The calculated average interstate truck drivers per truck for former regular users are very similar to the ones for current regular users (Table 129 vs. Table 62). The interstate truck drivers per truck for former regular users are the same as current regular users on average (0.7 drivers per truck). For-hire carriers among former regular users have a similar number of the average interstate truck drivers per truck (0.9 drivers per truck) as the ones among current regular users (0.8 drivers per truck). The average interstate truck drivers per truck owned by private carriers (0.6 drivers per truck) are the same no matter they are current or former regular users. Similar as current regular users, the average number of interstate drivers per truck owned by for-hire carriers (0.9 drivers per truck) is higher than the one owned by private carriers (0.6 drivers per truck) among former regular users.

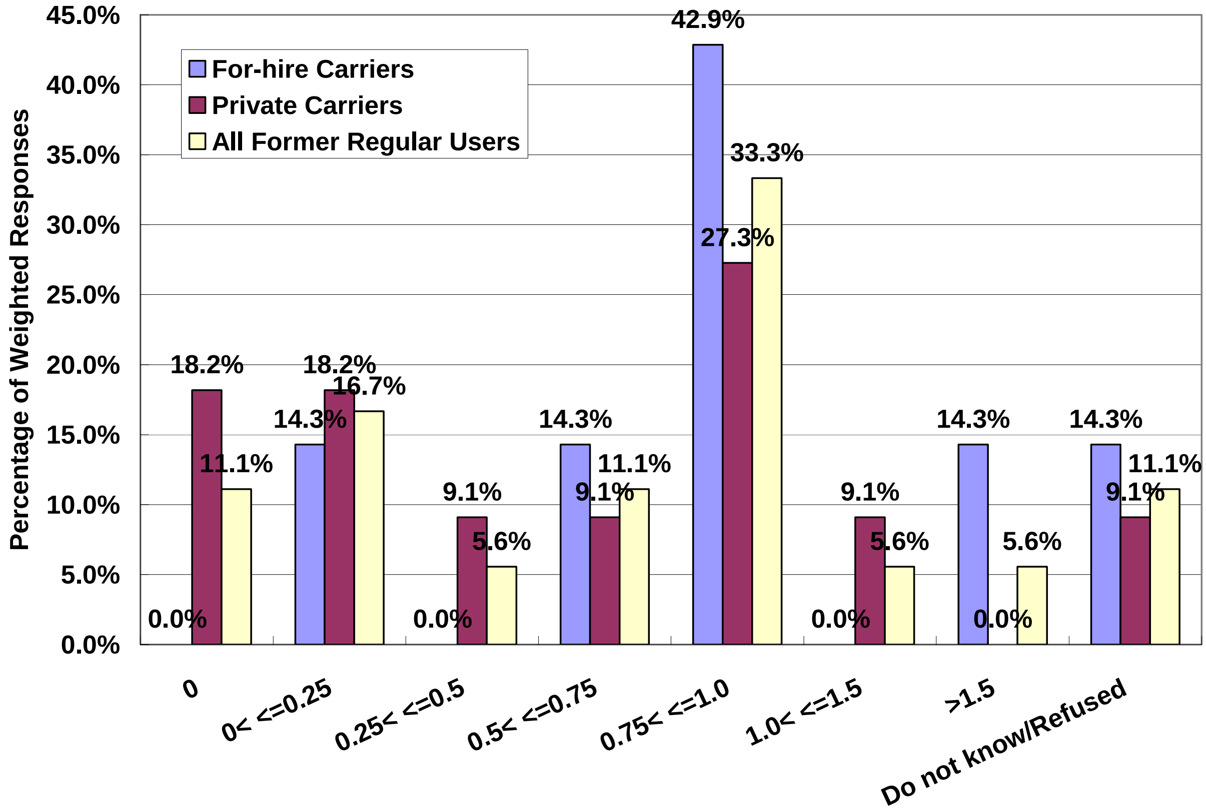


Figure 117. Distributions of interstate drivers per truck (former regular users)

Table 129. The average interstate truck drivers per truck (former regular users)

Carrier type	Average interstate truck drivers per truck
For-hire Carriers	0.9
Private Carriers	0.6
All Former Regular Users	0.7

(4) Origins and destinations of majority of shipments

Due to the small size of former regular users, only four states were reported as the origins of most of their shipments. New Jersey is the most cited origin (72.2 percent) followed by New York (16.7 percent), North Carolina (5.6 percent), and Indiana (5.6 percent). For-hire carriers and private carriers present similar patterns of the distributions of origins.

Table 130. Origins of majority of shipments by carrier type (former regular users)

Origin	For-hire Carriers	Private Carriers	All Former Regular Users
New Jersey	71.4%	72.7%	72.2%
New York	14.3%	18.2%	16.7%
North Carolina	0.0%	9.1%	5.6%
Indiana	14.3%	0.0%	5.6%
Total	100.0%	100.0%	100.0%
Based on weighted responses of	**45**	**70**	**115**

The origins of most of shipments are highly correlated with locations of former regular users, and this correlation is even stronger than the one for current regular users. As shown in Table 131, the vast majority of former regular users from New Jersey (86.7 percent) have New Jersey as their most important origin; while all of New York former regular users originate somewhere in New York State. New Jersey former regular users reported other two points of origin which are North Carolina (6.7 percent) and Indiana (6.7 percent).

Table 131. Origins of majority of shipments by carriers' location (former users)

Origin	For-hire Carriers	Private Carriers	All Former Regular Users
New Jersey	71.4%	72.7%	72.2%
New York	14.3%	18.2%	16.7%
North Carolina	0.0%	9.1%	5.6%
Indiana	14.3%	0.0%	5.6%
Total	100.0%	100.0%	100.0%
Based on raw responses of	**45**	**70**	**115**

Same as current regular users, former regular users reported multiple destinations for their deliveries and, and as before, do not generally venture far from the Mid-Atlantic region. The same four large states of the Mid-Atlantic region represent the destinations of most shipments for former regular users. However, New Jersey instead of New York becomes the most cited destination (55.6 percent). New York is identified as the second main destination by about 39 percent of these users, followed by Pennsylvania (27.8 percent) and Connecticut (5.6 percent). Other minor destinations include California, Massachusetts, Florida, Rhode Island/Vermont/Maine, and Texas.

Table 132. Destinations of majority of shipments by carrier (former regular users)

Destination	For-hire Carriers	Private Carriers	All Former Regular Users
New Jersey	71.4%	45.5%	55.6%
New York	57.1%	27.3%	38.9%
Pennsylvania	42.9%	18.2%	27.8%
Connecticut	14.3%	0.0%	5.6%
California	0.0%	9.1%	5.6%
Massachusetts	0.0%	9.1%	5.6%
Florida	0.0%	9.1%	5.6%
Rhode Island/Vermont/Maine	0.0%	9.1%	5.6%
Texas	14.3%	0.0%	5.6%
Based on weighted responses of	**45**	**70**	**135**

Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.

Table 133, combining the findings from Table 131, shows the local nature of former regular users' operations. As shown by Table 133, former regular users usually send their shipments to destinations within the state where their business is located. 60.0 percent of New Jersey former users cited New Jersey as the destination of most of their shipments, and 66.7 percent of New York former users cited New York as their destination. Meanwhile, as analyzed earlier, the vast majority of former regular users have shipments originating within the state where they are located. Therefore, it can be deduced that former regular users are more likely to dispatching trucks within the state where they are from.

Table 133. Destinations of majority of shipments by carriers' location (former users)

Destination	New Jersey Carriers	New York Carriers	All Former Regular Users
New Jersey	60.0%	33.3%	55.6%
New York	33.3%	66.7%	38.9%
Pennsylvania	33.3%	0.0%	27.8%
Connecticut	6.7%	0.0%	5.6%
California	6.7%	0.0%	5.6%
Massachusetts	6.7%	0.0%	5.6%
Florida	6.7%	0.0%	5.6%
Rhode Island/Vermont/Maine	6.7%	0.0%	5.6%
Texas	0.0%	33.3%	5.6%
Based on weighted responses of	**96**	**19**	**115**

Note: This question accepts multiple options; therefore, the total percentage is greater than 100 percent.