DEPARTMENT OF TRANSPORTATION

The Effects of Highway Improvement Projects on Nearby Business Activity

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16. Abstract (Limit: 250 words)

This report analyzes how state-funded highway improvement projects in the seven county Twin Cities metropolitan area affected businesses in adjacent Census Tracts. We first identify demographic factors associated with the temporal and financial prioritization of some projects over others, finding that the per capita income of a Census Tract is associated with it featuring more heavily prioritized highway improvement construction. We then turn to the effects of highway improvement construction and operation, using results from the previous analysis to account for endogeneity of improvement timing. While we find largely null results of highway improvement on sales, employment, establishment counts, and turnover for both single-establishment and multiple-establishment firms, we also find that pooling data masks several sources of effect heterogeneity. Specifically, we find that single-establishment firms experience negative sales effects from construction when tracts are affected only by infrastructure replacement projects (improvements that do not affect traffic operations, i.e., a bridge replacement). Furthermore, negative sales and employment effects occur after construction is completed for single-establishment firms in urban areas and in tracts affected by longer bouts of construction. Meanwhile, in suburban areas, some modest gains accrue to multiple-establishment firms. These results suggest that regional planners need to account for potential externalities from highway construction on particularly nearby small business establishments.

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The Effects of Highway Improvement Projects on Nearby Business Activity

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Contents

List of Tables

List of Figures

Executive Summary

This report analyzes how state-funded highway improvement projects in the seven county Twin Cities metro area affected businesses in adjacent Census Tracts. We first identify demographic factors associated with the temporal and financial prioritization of some projects over others, finding that the per capita income of a Census Tract is associated with it featuring more heavily prioritized highway improvement construction. We then turn to the effects of highway improvement construction and operation, using results from the previous analysis to account for endogeneity of improvement timing. While we find largely null results of highway improvement on sales, employment, establishment counts, and turnover for both single-location firm and multiple-location firm establishments, we find that pooling data masks several sources of effect heterogeneity. Specifically, we find that single-location firm establishments experience negative sales effects from construction when Tracts are affected only by infrastructure replacement projects (improvements that do not affect traffic operations ie. a bridge replacement). Further, negative sales and employment effects occur after construction is completed for single-location firm establishments in urban areas and in Tracts affected by longer bouts of construction. Meanwhile, in suburban areas, some modest gains go to firms. These results suggest that regional planners need to account for potential externalities from highway construction on particularly nearby small business establishments.

Chapter 1

Introduction

Municipal and regional planners regularly rehabilitate general-use highway corridors to ensure roadway safety and improve traffic flow efficiency. Typically, such improvements benefit regional economies and quality of life by improving connectivity, ensuring safety, and reducing congestion. However, local businesses can be negatively affected by the construction needed to repave highways, build new exits and overpasses, replace bridges, and more. Further, long-term traffic-pattern effects induced by highway improvements may disproportionately affect some businesses at the expense of others. For example, if a highway improvement leads to more through-traffic along a corridor, businesses closer to the street or closer to exits may absorb consumer demand, while others farther away lose out.

In our sister study, we documented how similar patterns may occur with the development of new transit projects (Wexler and Fan 2022). This report builds on that research by examining how highway improvements funded by the Minnesota Department of Transportation (MnDOT) and constructed between 2007 and 2018 in the Twin Cities (Minneapolis and St. Paul, Minnesota) metropolitan area affected nearby businesses. In the report, we answer two main research questions. First, we identify the economic and demographic factors associated with the temporal prioritization of some improvement projects over others. We then use this information to account for potential selection of some highway corridors for improvement when identifying how business sales, employment, counts, and turnover changed during and after construction. For example, it is possible that highway segments in areas experiencing higher-than-average economic activity were prioritized for improvement. We find that this is indeed the case; Census Tract per capita income positively and strongly correlates with the first date highway improvement affects a Tract and whether that Tract is affected by highway improvement during our study period. Accounting for this endogeneity into highway improvement, we use Census Tracts that were slated for highway improvement after our study period as a comparison group for those that did experience improvement between 2007 and 2018. After matching "treated" Tracts to comparison Tracts with similar economic and demographic characteristics, we find no overall effect of highway improvement on our primary business outcomes for both small single-location firms and establishments owned by multiple-location firms. We check if this overall null result masks heterogeneity associated with the purpose of construction, the duration of the construction period, Tract geography, and business sector. We find that the construction of projects that primarily affect infrastructure conditions without affecting traffic flow disproportionately harm sales and employment for small single-location establishments, while projects that improve traffic flow reduce closure and induce establishment count growth among businesses owned by multiple-location firms. Additionally, single-location firm establishments in urban Tracts are disproportionately harmed by highway improvements, both during and after construction, experiencing higher rates of closure in both periods. Single-location firm food service establishments also appear especially vulnerable.

1.1 Project Benefits and Report Outline

By examining small-scale effects of highway improvement projects as opposed to new highway construction on already existing nearby businesses, this report fills an important practical research gap. Much of the empirical literature on highway construction and economic activity focuses on the effect of initial highway development on large-scale economic trends and patterns. Evidence suggests in both urban and rural areas, businesses cluster along and nearby trunk highways (Lakshmanan 2011; Zhou and Clapp 2015), often changing urban geography through agglomeration effects (Hartshorn and Muller 1989). Additionally, highways have altered industrial composition along affected corridors by reducing the costs of transporting goods and services (Chandra and Thompson 2000). Positive effects of new highway-induced transportation activity effects on business activity have been well documented, as improved highway efficiency and safety may attract more traffic to nearby businesses, increasing sales and inducing localized agglomeration and growth (Forkenbrock and Foster 1990; Wink et al. 1998). However, there is not much literature examining potential drawbacks from highway construction on immediately adjacent businesses, likely due to the unavailability of detailed geographic data on highway construction and nearby business activity. This temporal tradeoff for businesses nearby highway segments slated for improvement — between short-term negative effects and long-term positive effects — presents a dilemma for policymakers and urban planners attempting to balance traffic safety and efficiency goals with local economic development objectives. Furthermore, some businesses might weather construction and take advantage of improved transportation access better than others, especially those that can take advantage of economies of scale (Zhou and Clapp 2015). This secondary problem presents further equity concerns when more vulnerable establishments are in low-income areas or more likely to be owned by minorities or women.

Filling this research gap is especially important in the context of MnDOT's goal of promoting equitable policymaking and planning in ongoing and planned highway improvement projects across the metro area. These results are useful for determining which businesses may be more vulnerable to negative effects from improvement projects. As MnDOT continues to collaborate with municipal and regional agencies to improve highway connectivity in the Twin Cities metro area, this project's detailed findings on business vulnerability allow for more equitable policymaking. Specifically, this research promotes stronger consideration of the small business community in local highway and transitway planning efforts.

We structure the report as follows. In Chapter 2 we discuss our data sources and detail how we constructed the dataset used in the report's econometric analysis. Then we examine socioeconomic determinants of highway improvement in Chapter 3 before estimating its effects in Chapter 4. We discuss comparisons between these findings and our previous findings on the effects of transitway development in Wexler and Fan (2022) in Chapter 5 before concluding in Chapter 6.

Chapter 2

Data

For all analysis in this report, we construct an original panel comprised of annual repeated Census Tract-sector observations. This section explains the sources and construction of this panel before providing summary statistics.

2.1 Data Sources

Our data come primarily from four sources:

- MnDOT files on highway improvements: these files include shapefiles of each of MnDOT's completed, current, and slated highway improvement segments from 2007 through 2024 that cost more than $15 million. The files also include the total cost of each improvement, detailed construction start and end dates, qualitative information on the type and location of each project, and detailed narratives on each project's history and benefits.
- Metropolitan Council Twin Cities metro Census Tract shapefiles: GIS boundaries of all Census Tracts within the Twin Cities metro area.
- The INFOUSA business survey: an annually repeated cross section of business establishments within the seven county Twin Cities metro area taken between 2000 and 2019. Useful data fields for this project include geographic coordinates of business location, business sales and employment, and information on the sector and firm ownership structure of each establishment. We restrict this cross section to "stores" – establishments in the retail, food services, or personal services sectors. Table 2.1 shows the NAICS codes and types of businesses included in each sector.
- The National Historical GIS files from the US Census Bureau and curated by IPUMS: Census Tract level time series data on important economic and demographic factors, including Census Tract population, per capita income, and poverty. We use data specifically from the ACS 2005-2009 five-year estimates.

Table 2.1: NAICS Codes of Establishments Used

Sector	4-Digit NAICS	Subsector
Retail	4411	Automobile Dealers
	4412	Other Motor Vehicle Dealers
	4413	Automotive Parts, Accessories, and Tire Stores
	4421	Furniture Stores
	4422	Home Furnishings Stores
	4431	Electronics and Appliance Stores
	4441	Building Material and Supplies Dealers
	4442	Lawn and Garden Equipment and Supplies Stores
	4451	Grocery Stores
	4452	Specialty Food Stores
	4453	Beer, Wine, and Liquor Stores
	4461	Health and Personal Care Stores
	4471	Gasoline Stations
	4481	Clothing Stores
	4482	Shoe Stores
	4483	Jewelry, Luggage, and Leather Goods Stores
	4511	Sporting Goods, Hobby, and Musical Instrument Stores
	4512	Book Stores and News Dealers
	4521	Department Stores
	4529	Other General Merchandise Stores
	4531	Florists
	4532	Office Supplies, Stationery, and Gift Stores
	4533	Used Merchandise Stores
	4539	Other Miscellaneous Store Retailers
	4541	Electronic Shopping and Mail-Order Houses
	4542	Vending Machine Operators
	4543	Direct Selling Establishments
Food	7211	Traveler Accommodation
	7212	RV (Recreational Vehicle) Parks and Recreational
	7213	Rooming and Boarding Houses
	7223	Special Food Services
	7224	Drinking Places (Alcoholic Beverages)
	7225	Restaurants and Other Eating Places
Personal Services	8111	Automotive Repair and Maintenance
	8112	Electronic and Precision Equipment
	8113	Commercial and Industrial Machinery
	8114	Personal and Household Goods Repair
	8121	Personal Care Services
	8122	Death Care Services
	8123	Drycleaning and Laundry Services
	8129	Other Personal Services

Notes: Four digit NAICS codes shown. NAICS codes for retail, food, and personal/other establishments are 44000-46000, 72000-73000, and 81000-81300 respectively.

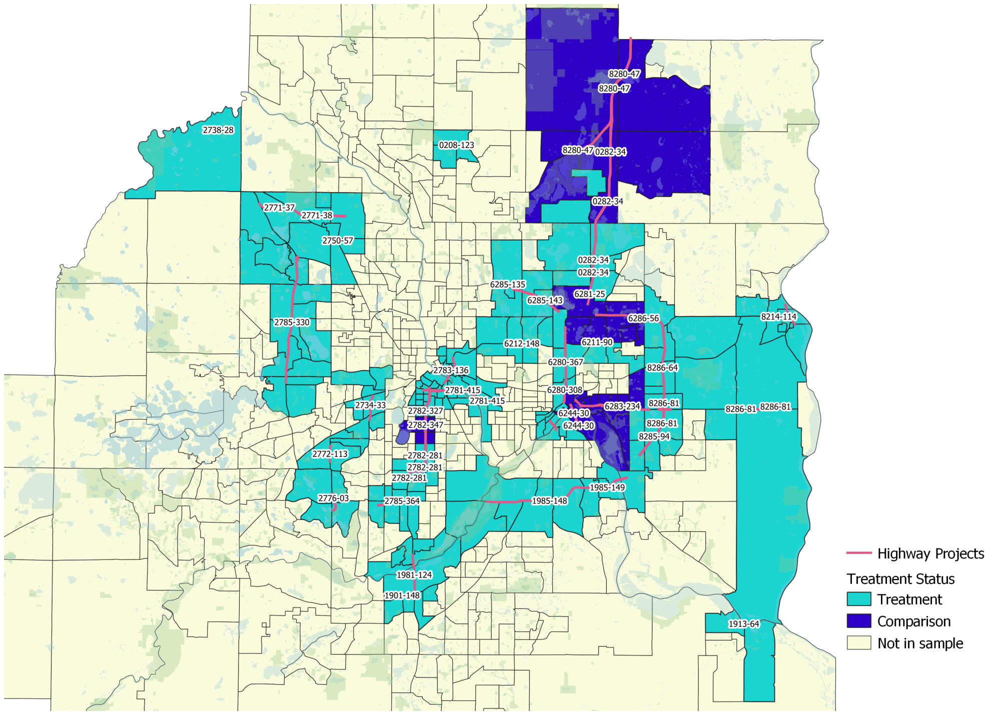


Figure 2.1: Map of Census Tracts by Treatment Status

2.2 Dataset Construction

Our final dataset merges each of these four sources together into a panel. First, we created a 0.5 mile buffer around each geocoded highway improvement since 2007 provided to us by MnDOT. We then identify each Census Tract that intersected with this 0.5 mile buffer and link data on highway improvement details (type, cost, and timing) to Census Tract data from the Met Council. We then identify the first year that highway improvement began and the last year that highway improvement ended for each affected Census Tract.

We removed from the sample data from all Census Tracts untouched by the buffer around completed or future highway improvements. This allows us to obtain a sample of areas that were not only adjacent to highways, but adjacent to highways that were slated to undergo improvement after 2010. This restriction is particularly important, given evidence of selection of high growth potential areas into highway construction and improvement (Lakshmanan 2011). The final sample included 170 Census Tracts associated with 35 specific construction projects. The 35 construction projects used in our final sample are described in Table 2.2. Most projects involved repaving, mill and overlay, or bridge replacement, and affected highways ranged from interstates to smaller state trunk highways. Notably, projects cover the entire seven county metropolitan region and affected highways in urban, suburban, exurban, and rural areas.

To identify when treatment occurred, we defined a "construction period" for each Tract, because some Tracts were affected by several improvements between 2007 and 2019. The construction period is defined as the period of consecutive years during which a given Tract fell within any 0.5 mile buffer surrounding a highway improvement corridor undergoing construction. Tracts with gaps in construction were removed from the sample to allow for clear and Tractable causal identification. Once a construction period has ended, we consider that Tract "improved".

Figure 2.1 maps the relevant highway improvement segments and their adjacent Census Tracts by treatment status. While the treatment group is spread across the metro area, the comparison group includes Census Tracts in only a few areas. Specifically, it includes areas in East St. Paul and the nearby suburbs along the Mississippi River downriver of Downtown St. Paul, parts of South Minneapolis including the Whittier, Powderhorn, and Uptown neighborhoods, and parts of the Northeast metro by White Bear Lake.

Table 2.2: Descriptions and Details of Sample Improvements

SP	Hwy	Start	End	Cost ($ mil.)	Project Description	Type
0208-123	MN65	2007	2009	67	New interchange at Hwy. 65 and County Road 14, new overpasses for Paul Parkway and 129th Street over Hwy. 65	OT
1985-132	I494	2008	2010	60	Construction of Wakota Bridge over Mississippi River (Wakota)	IC. OT
2750-57	US169	2008	2011	50	Build Hwy. 169 over the top of County Road 81, County Road 109 and BNSF railroad tracks in Brooklyn Park, enabling Hwy. 169 traffic to move unimpeded through the “triangle” area. A diamond interchange at County Road 109 is included.	OT
2771-37	MN610	2009	2011	139.9	Extend a four-lane freeway section from Hennepin County Road 81 to I94 on new alignment.	OT
8285-93, 8285-94	I494,I694	2010	2010	60	Bituminous widening, temporary bypass construction, widen Bridge 9775, majority of new drainage and project grading, unbonded concrete overlay, pave shoulders, guardrail, median barrier, impact attenuators from Lake Road to I-94	IC, OT
2772-113	US169	2010	2012	69.9	Replace Bridge #27568 (New Br 27W35) over Nine Mile Creek in Hopkins/Edina and replace culvert 90478 (new Culvert 27X15).	IC
1913-64	US61	2010	2014	147.8	Replace two-lane Hastings Bridge with a four-lane bridge over Mississippi River	OC
0282-34	I35E	2011	2015	25.4	Unbonded concrete overlay, drainage corrections, cable median barrier, etc. I-135 E from south of Ramsey Co CSAH 96 to north junction I-35W	IC
6223-20	Hwy 149	2011	2015	65.9	Repair Mississippi River bridge and approaches from West 7th Street (MN Highway 5) to George Street in St Paul	IC,OT
6285-143	I694	2012	2012	41.5	Construct general purpose lane from Rice Street in Little Canada to Lexington Avenue in Arden Hills and reconstruction of existing lanes, adding low slump overlay on the Island Lake Channel bridge, a noise wall, and median barrier construction.	IC, OT
2738-28	MN101	2012	2014	22.4	Construct a grade-separated interchange at the intersection with County Road 144 in Rogers.	OT
2785-330	I494	2012	2013	102.5	Adds a general purpose lane between Highway 55 and I-94/I-694, an auxiliary lane northbound between I-394 and Carlson Parkway, and auxiliary lanes between Highway 55 and County Road 6. It also includes pavement resurfacing and reconstruction, ponds, noise walls, signal revisions, lighting, traffic management system, bridge replacements and repairs.	IC, OT
6244-30	Hwy 52	2012	2017	197.2	Hwy 52 Bridge replacement, ramps, loops to Hwy. 94 and connection to East 7th Street, replace/rehab Hwy. 52 Bridge over Plato Blvd and Hwy. Bridge over Hwy. 94	IC

Table 2.2: Descriptions and Details of Sample Improvements (continued)

SP	Hwy	Start	End	Cost ($ mil.)	Project Description	Type
2785-364	I494	2013	2013	30.4	Mill & Overlay, construct WB Aux lane from Penn Ave to NB TH 100, replace Xerxes Ave Bridge.	IC, OT
1901-148	MN13	2013	2015	38.1	Construct grade separated interchange at Hwy 13/County Road 5 in Burnsville, add a new bridge (with trail) to carry County Road 5 over Hwy 13, add noise walls, retaining wall and ponding.	IC, OT
6280-308	I35E	2013	2015	143.9	Replaces the Cayuga Bridge, Pennsylvania Ave. Bridge, and the BNSF RR Bridge from University Ave to Maryland Ave in Saint Paul. Also replaces the Pennsylvania interchange with the interchange at Cayuga to solve safety and operational problems, improve geometrics on 35E and extend the auxiliary lane from Pennsylvania to Maryland.	IC, OT
6211-90	MN36	2014	2015	21.3	Construct a grade-separated interchange at the intersection of English St and Hwy 36 in Maplewood.	OT
SP	Hwy	Start	End	Cost ($ mil.)	Project Description	Type
2734-33	MN100	2014	2016	61.4	Replace Tier 2 bridges, correct flooding problems, address noise mitigation, correct geometric deficiencies, improve drainage and water quality from 36th Street to 25 1/2 Street in St. Louis Park	IC
6280-367	I35E	2015	2016	110.92	The I-35E MnPASS project includes long-term pavement rehabilitation between Maryland Avenue and Little Canada Road, replacement of the Arlington, Wheelock and Larpenteur bridges, and replacement of the I-35E mainline bridges at Roselawn, County Road B and Highway 36.	IC
2771-38	MN610	2016	2017	49.8	Extend a four-lane freeway section from Hwy. 169 to Hennepin County Road 81 on new alignment.	OT
6284-180	I35W, Hwy 10	2016	2017	236.3	Construct MnPass lane, resurface, replace 5 bridges from County Road B-2 in Roseville to 0.1 mile north of Sunset Avenue in Lino Lakes; on MN Hwy 10 from junction with I-35W to 0.7 miles east of County Road J.	IC, OT
6285-135	I694	2016	2017	53.6	Realign a portion from Snelling Ave on the west to Lexington Avenue. Remove nine bridges. Realign several highway sections and construct a new connection between the north and southbound lanes. Hwy 51 will have two loops that allow for merging. No new right of way is required.	OT
6281-25	I35E	2016	2017	26.7	Replace bridges over Goose Lake Road and the BNSF railroad in Vadnais Heights with new wide structures to accommodate three lanes of traffic and include profile adjustments of pavement on both sides of the bridges. In addition there is pavement work, drainage, traffic management systems, guardrail, retaining walls and ADA improvements.	IC, OT
2781-415	I94	2017	2018	28	Mill and Overlay and develop a managed corridor using advance traffic technology from Lowry Hill Tunnel to John Ireland Boulevard.	IC, OT
2783-136	I35W	2017	2018	24.4	Construct new ramp from downtown Minneapolis to northbound I-35W and auxiliary lane from 3rd and 4th Street north to Johnson St.	OT
8214-114	MN36	2017	2018	689.3	Replace St Croix bridge near Stillwater.	IC
6212-148	MN36	2018	2018	33.6	Replace bridge and reconstruct interchange from Hamline Ave to Victoria Ave.	IC, OT
1985-148	MN62	2019	2020	38.6	Resurface, repair drainage, add and upgrade guardrail from 0.1 miles east of 5th Avenue in St. Paul to I-35E in Mendota Heights.	IC
8286-81	I-694	2018	2020	37.4	Replace bridges around the Northbound MN 77 exit ramp to Old Shakopee	IC

Table 2.2: Descriptions and Details of Sample Improvements (continued)

SP	Hwy	Start	End	Cost ($ mil.)	Project Description	Type
1985-149	I494	2018	2019	24.1	Resurface, construct auxiliary lane, repair bridge, construct retaining noise walls, install lighting, signs, and traffic management system, rebuild storm sewer, and improve drainage from Hardman Avenue in South St. Paul to Blaine Avenue East in Inver Grove Heights.	IC, OT
8286-64	I694	2018	2019	26	Pavement preservation, improve ride, bridge improvement from I-94 to 40th St.	IC
2782-281	I35W	2018	2021	288	Reconstruction of I35W/Highway 62 commons area, addition of high occupancy vehicle (HOV) lane, addition of general purpose lane, additional capacity on Highway 62, proposed new access ramp, closure of existing access to westbound Highway 62 .	OT
1981-124	I35W	2019	2020	147.6	Replace bridge on I35W over Minnesota River from Black Dog Road in Burnsville to 106th Street in Bloomington and Design-Build Activities.	IC
2776-03	US169	2019	2021	172.6	Remove three signals, connect the north and south frontage roads under Hwy. 169, convert expressway to freeway with partial-directional interchange reconstruction, construct noise barriers/visual barriers, and construct drainage and water quality facilities at the Hwy 169 and I494 interchange in Bloomington.	IC, OT
2782-327	I35W	2020	2021	378.3	Construct MnPASS lane, reconstruct road, construct transit station noise walls, retaining walls, build 6 bridges, replace 13 bridges, and repair 3 bridges in Minneapolis from 43rd st to 11th Ave, on I-94 from 1st Ave to Park Ave, and on MN Hwy 65 from 24th St to 10th St. Construct a Storm Water Storage Facility located on NB I-35W between 42nd Street and 40th Street.	IC, OT
6283-234	I94, US61	2021	2023	39	Construct an unbonded concrete overlay from Mounds Boulevard to east of Ruth Street, a bituminous resurfacing to east of Highway 120 and on Highway 61 north of Mounds Boulevard, application of a concrete overlay, and repair of nine bridges. Signals, signing, lighting, guardrail, concrete median barrier, drainage, traffic management system and ADA also included.	IC, OT
2782-347	I35W	2022	2023	27.4	Construct a storm water holding cavern system on I-35W, from 42nd Street to 39th Street in Minneapolis.	IC
6286-56	I694	2022	2023	23.7	Unbonded concrete overlay from 40th St. in Oakdale to just west of Hwy 61 in Vadnais Heights.	IC
8280-47	CSAH54	2022	2024	70	Construct an unbonded concrete overlay on from 80th Street E to the junction of I-35/I-35W/I-35E, on I-35W from north of Main Street to the junction of I-35/I-35W/I-35E, and on I-35 from the junction of I-35/I-35W/I-35E to north of Highway 8. Replace northbound I-35W bridge over southbound I-35E, Highway 97 bridge over I-35, and Highway 8 bridge over I-35.	IC

We aggregated micro-level business data from INFOUSA to obtain four dependent variables, each observed at the Census Tract-sector level, defined by the interaction of each Census Tract with each business sector and an indicator for whether establishments are standalone single-location firms or owned by a multiple-location firm. The three variables (average sales volume, average employment size, establishment count) serve as our main dependent variables in the second part of the analysis, along with an additional measure of annual business closure.

Table 2.3: Summary Statistics by Firm Size and Treatment Status

	A: Single-Location Firm Establishments		B: Multiple-Location Firm Establishments	
	(1)	(2)	(3)	(4)
Variable	Treatment	Comparison	Treatment	Comparison
Average Business Outcomes				
Sales	1363.133	796.992	3700.567	2237.560
	(2401.711)	(1307.998)	(9694.701)	(3025.937)
Employment Size	9.907	7.697	40.970	18.273
	(11.537)	(6.792)	(147.620)	(17.986)
Establishment Count	13.023	11.842	7.870	4.235
	(14.712)	(11.198)	(14.565)	(5.513)
Demographics				
Per Capita Income	32980.78		25373.55	
	(12173.97)		(10369.73)	
Population	309.675		365.485	
	(185.440)		(144.224)	
Median Gross Rent	946.940		826.152	
	(278.973)		(186.040)	
% White	83.874%		87.391%	
	(29.954)		(30.800)	
% Housing Vacant	5.381%		7.109%	
	(3.607)		(5.886)	
Observations	5,586	1,553	4,489	949

Notes: Natural log was taken for all outcome variables, so coefficients represent approximate percentage change effects. Observations are Tract-Sector-Years. All models include Tract-Sector and Sector-Year fixed effects. Standard errors clustered at the Tract level. ***p<0.1, **p<0.5, *p<0.01.

2.3 Summary Statistics

Table 2.3 presents summary statistics, showing notable differences in sector environments between the treated and comparison groups. Businesses owned by firms enjoy higher sales and employer more people on average, but are also less populous within Census Tracts. Additionally, "treated" Tracts have higher business counts and businesses with higher sales and employment than "comparison" Tracts, a fact that holds for both single-location firm and multiple-location firm establishments. This suggests that MnDOT's prioritization of highways in certain areas for improvement may reflect differences in socioeconomic status or economic activity. The next section formally tests for this endogeneity by estimating the correlation between baseline Tract-level demographic and economic factors and whether, when, and to what extent MnDOT prioritized Tracts for improvement.

Chapter 3

How Does MnDOT Prioritize Highway Improvements?

Planning agencies typically develop methods to prioritize specific improvements over others, given scarce time and money (Yu and Liu 2012). This section aims to identify the extent to which MnDOT temporally prioritized improvements in some Tracts over others and which Census Tract level factors affected this temporal prioritization. We use three variables to define prioritization. First, we use a binary indicator for whether a Census Tract was affected by a highway improvement during the study period or if it was slated to be affected after the study period ended. We use probit regressions of this variable on a set of Census Tract demographic indicators to determine differences between the treated Tracts and the Tracts slated for highway improvement later. We also run ordered probit models, using the year construction began as a dependent variable and the same covariates as independent variables. Finally, we run regressions of the natural log of each Tract's total construction cost on the same set of covariates using ordinary least sqaures. The demographic factors included in our regressions include the natural log of per capita income, the natural log of census Tract population, the natural log of the median housing rent, the percentage of Tract residents who are white nonhispanic, and the percentage of Tract housing units that are vacant, sourced from the ACS 2005-2009 five year estimates as described earlier.

Table 3.1 shows results of these regressions. Notably, a 100% increase in per capita income increases the probability of treatment (improvement initiation before 2019) by about 22 and percentage points pushes the first year of construction earlier by about 0.75 years. Additionally a 100% increase in median rent increases the probability of treatment by 25 percentage points.[1] Other coefficients were insignificant, including all estimated coefficients from the linear regression of the natural log of total construction cost on demographic factors.

Out of the 170 Census Tracts in our overall sample, 140 were in the "common support", meaning their underlying characteristics were sufficiently similar to other Tracts treated differently to conduct analysis. The probit regression displaced in Table 3.1 was used to generate propensity scores, scalar values that capture the likelihood of each Tract to experience improvement during the study period. In the next section, we use these propensity scores to account for Tract level selection into construction prioritization.

[1] These marginal effects for the probit $P(Treated)$ models were computed using Stata's *margins* command.

Table 3.1: Correlates of Highway Improvement Prioritization

	(1) P(Treated)	(2) Construction Start	(3) log(Cost)
log(Per Capita Income)	1.404***	-0.748***	0.388
	(0.543)	(0.284)	(0.262)
log(Median Rent)	1.662*	-0.311	-0.201
	(0.863)	(0.381)	(0.356)
log(Population)	-0.628	-0.255	0.315
	(0.519)	(0.259)	(0.240)
% White	-0.785	-0.317	-0.460
	(0.580)	(0.333)	(0.308)
% Housing Units Vacant	0.134	-1.766	0.099
	(4.557)	(2.509)	(2.329)
Observations	140	140	140
R^2	0.227	0.020	0.073
Estimation	Probit	Ordered Probit	OLS

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
R^2 in columns 1 and 2 is a maximum likelihood estimation $pseudo - R^2$.

Chapter 4

Effects of Highway Improvements on Nearby Businesses

This section discusses models used to estimate the effect of highway improvement on Tract-Sector level outcomes. After specifying models and outlining econometric strategies, we provide results for main models and examine potential heterogeneity by improvement type, construction period length, Tract geography, and firm sector.

4.1 Identification and Estimation

Our simplest specification estimates a difference-in-differences for both the construction and post-construction periods of highway improvement. Specifically, we estimate 4.1 with OLS separately for businesses that are groups of single-location firm and multiple-location firm establishments.

$$Y_{cst} = \alpha_{cs} + \tau_{st} + \theta * (Placebo_{ct}) + \beta * (Construction_{ct}) + \gamma * (Improved_{ct}) + \epsilon_{igt} \tag{4.1}$$

where c indexes Census Tracts, s indexes sectors, and t indexes years. Census Tract-sector fixed effects and year-sector fixed effects are respectively represented as α_{cs} and τ_{st}. Y_{cst} is one of four possible outcomes: the natural log of the average sales volume within a sector in a Census Block, the natural log of the average employment size within a sector in a Census Block, the establishment count of each Census Tract sector, and the rate of business closure within a Census Tract sector, each indexed yearly. $Construction_{ct}$ is a binary coded 1 when a Tract is affected by a highway construction project and $Improved_{ct}$ is a binary coded 1 once a Tract has been "improved" — meaning it is no longer experiencing construction. As such, the two parameters of interest are β and γ, which respectively capture the effect of highway improvement construction and completion on Census Tract sectors that overlap with a 0.5 mile buffer of highway improvements. Finally, $Placebo_{ct}$ is a binary coded 1 for the same Census Tract sectors but for years at least a year before construction began. Including this variable serves as a loose test for the "parallel trends" assumption that outcomes evolved similarly between comparison and treated groups before treatment — in this case before the construction period was initiated.

To deal with potential endogeneous treatment timing associated with the prioritization of past improvements before future ones, we use propensity scores predicted from the last section's probit regressions of treatment on Tract-level demographic factors. We identify the control Tract with the closest propensity score to each treated Tract and then match treated Tracts to control Tracts accordingly. After matching, we generate a strata variable, which serves as an indicator for a collection of treated Tracts and their corresponding close propensity control Tract.

We modify equation 1 by accounting for improvement propensity estimated in the last section. Equation 4.2 shows this new specification

$$Y_{cst} = \alpha_{cs} + \tau_{st} + \sigma_{cs} + \theta * (Placebo_{ct}) + \beta * (Construction_{ct}) + \gamma * (Improved_{ct}) + \epsilon_{igt} \tag{4.2}$$

where adding strata-year fixed effects σ_{cs} ensures that our difference-in-difference estimates capture a weighted average of differences-in-differences within each strata, with near-propensity Tracts compared to each other. Because highway improvements were introduced across Census Tracts in a staggered manner, traditional two-way (in this case Tract and year) fixed effects regressions may suffer from weighting issues and improper comparisons between newly treated and already treated Tracts (Goodman-Bacon 2021; Callaway and Sant'Anna 2021; Sun and Abraham 2021). Unfortunately alternative estimators specified by Callaway & Sant'Anna (2021) and Sun & Abraham (2021) do not easily align with the two distinct treatment periods (construction and operation) relevant to this setting. Thus, we proceed with the easier to interpret traditional DID results.

4.2 Main Results

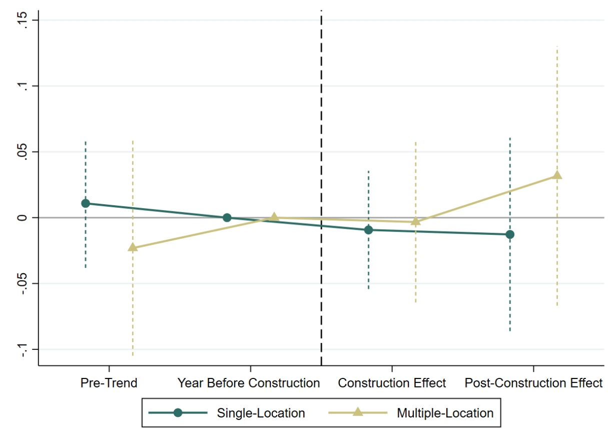
Panel A of Table 4.1 provides results from the main DID models, estimated according to Equation 4.1. First, there are no significant treatment coefficients for any of the single-location firm models, suggesting that neither highway improvement construction nor completion yielded any effects on small single-location firms. However, there were a few statistically significant coefficients for multiple-location firm establishments. Completion of highway improvement increased the employment count for multiple-location firm establishments within affected Tracts by about 9.8%. However, the placebo test for multiple-location establishment counts is significant and negative, suggesting that establishment counts may have been growing in Tracts affected by highway improvements before construction actually began, challenging our ability to infer causality.

Adding in strata fixed effects alters results slightly, as presented in Panel B of Table 4.1. All construction and operation effects were statistically insignificant, but both placebo tests on establishment counts were significant at 90% confidence. Results from these regression models are displayed graphically in Figure 4.1, along with the "zero effect" at the omitted reference period, which in this case is the year before construction began. This figure illustrates that average sales volume was the least effected outcome, regardless of firm size or scale. Further, effects of sales and employment size generally mirrored each other. Similarly, there was a negative relationship between effects on log establishment count and effects on the percentage of firms closing.

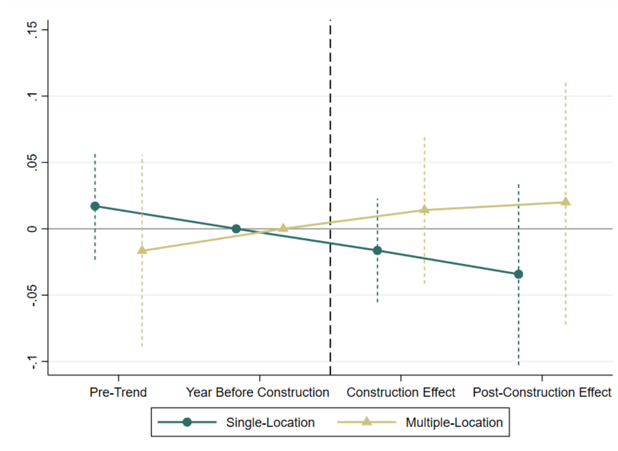
Table 4.1: Main DID Results

Variable	A: Single-Location Firm Establishments (1) Avg. Sales	(2) Emp.	(3) Est. Count	(4) % Closing	B: Multiple-Location Firm Establishments (5) Avg. Sales	(6) Emp.	(7) Est. Count	(8) % Closing
A- Basic DID								
Placebo	0.010	0.014	-0.031	.004	-0.008	-0.025	-0.071**	-.007
	(0.022)	(0.018)	(0.022)	(0.007)	(0.030)	(0.028)	(0.033)	(0.008)
Construction	-0.004	-0.005	-0.012	.0004	0.005	0.012	0.011	-0.008
	(0.018)	(0.016)	(0.021)	(0.007)	(0.028)	(0.024)	(0.027)	(0.009)
Operation	-0.026	-0.033	-0.006	.008	0.013	0.016	0.098*	-0.018*
	(0.034)	(0.030)	(0.041)	(0.008)	(0.041)	(0.035)	(0.056)	(0 .010)
Clusters (Tracts)	158	158	158	158	157	157	157	157
Observations	7,562	7,562	7,562	7,562	6,993	7,049	7,053	7,053
R^2	0.893	0.839	0.908	0.820	0.842	0.823	0.885	0.792
B- Propensity-Adjusted DID								
Placebo	0.011	0.017	-0.028	-0.004	-0.023	-0.017	-0.051	-0.011
	(0.025)	(0.020)	(0.026)	(0.009)	(0.041)	(0.037)	(0.036)	(0.007)
Construction	-0.009	-0.016	-0.023	-0.001	-0.003	0.014	-0.008	-0.011
	(0.023)	(0.020)	(0.023)	(0.007)	(0.031)	(0.028)	(0.032)	(0.009)
Operation	-0.013	-0.034	-0.040	0.012	0.032	0.020	0.087	-0.014
	(0.037)	(0.035)	(0.047)	(0.007)	(0.050)	(0.047)	(0.063)	(0.012)
Clusters (Tracts)	137	137	137	137	136	136	136	136
Observations	6,608	6,608	6,608	6,608	6,188	6,222	6,226	6,226
R^2	0.898	0.847	0.910	0.834	0.858	0.842	0.894	0.815

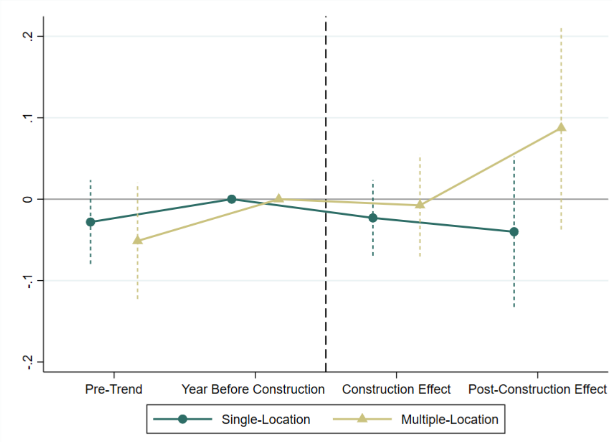
Notes: Natural log was taken for all outcome variables, so coefficients represent approximate percentage change effects. Observations are Tract-Sector-Years. All models include Tract-Sector and Sector-Year fixed effects. Standard errors clustered at the Tract level. ***p<0.1, **p<0.5, *p<0.01.



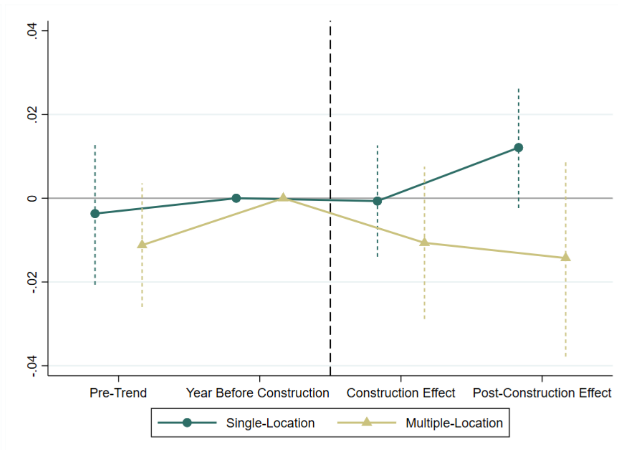
(a) Log Sales Volume



(b) Log Employment Size



(c) Log Establishment Count



(d) % Closing Percent

Figure 4.1: Estimated Effects of Highway Construction and Improvement

Table 4.2: Effects by Construction Purpose

	A: Single-Location Firm Establishments				B: Multiple-Location Firm Establishments			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable	Avg. Sales	Emp.	Est. Count	% Closing	Avg. Sales	Emp.	Est. Count	% Closing
IC*Placebo	0.058	0.013	-0.024	-0.001	-0.017	-0.033	-0.053	-0.002
	(0.044)	(0.038)	(0.044)	(0.014)	(0.070)	(0.058)	(0.077)	(0.018)
OT*Placebo	0.023	0.040	-0.072	0.000	-0.019	-0.026	-0.005	0.003
	(0.056)	(0.043)	(0.053)	(0.013)	(0.062)	(0.054)	(0.060)	(0.013)
OT*IC*Placebo	0.001	0.017	-0.022	0.002	-0.015	-0.012	-0.103*	-0.017
	(0.026)	(0.020)	(0.026)	(0.011)	(0.041)	(0.035)	(0.057)	(0.013)
IC*Construction	-0.101**	-0.092**	-0.028	0.010	-0.077	-0.011	0.006	-0.005
	(0.044)	(0.037)	(0.046)	(0.017)	(0.071)	(0.062)	(0.054)	(0.018)
OT*Construction	0.038	0.033	-0.036	0.002	0.016	0.010	0.045	-0.008
	(0.043)	(0.034)	(0.042)	(0.013)	(0.045)	(0.034)	(0.040)	(0.013)
OT*IC*Construction	0.015	0.006	-0.002	-0.004	-0.003	-0.004	-0.046	0.000
	(0.023)	(0.022)	(0.032)	(0.010)	(0.035)	(0.029)	(0.046)	(0.015)
IC*Operation	-0.108	-0.074	-0.062	0.020	-0.019	-0.052	-0.079	-0.002
	(0.094)	(0.072)	(0.071)	(0.014)	(0.114)	(0.090)	(0.137)	(0.025)
OT*Operation	0.036	0.004	-0.024	0.008	0.026	0.009	0.223**	0.003
	(0.050)	(0.040)	(0.063)	(0.013)	(0.060)	(0.053)	(0.105)	(0.015)
IC*OT*Operation	-0.016	-0.033	-0.012	0.010	0.002	0.012	0.020	-0.024*
	(0.039)	(0.038)	(0.054)	(0.014)	(0.054)	(0.043)	(0.067)	(0.013)
Clusters (Tracts)	135	135	135	135	135	135	135	135
Observations	6,608	6,608	6,608	6,608	6,188	6,222	6,226	6,226
R^2	0.895	0.841	0.907	0.824	0.843	0.825	0.888	0.805

Notes: Natural log was taken for all outcome variables, so coefficients represent approximate percentage change effects. Observations are Tract-Sector-Years. All models include Tract-Sector and Sector-Year fixed effects. Standard errors clustered at the Tract level. ***p<0.1, **p<0.5, *p<0.01.

4.3 Heterogeneity Analysis

Although there were no statistically significant effects on main models, it is possible that heterogeneous effects by construction type, construction period length, Tract geography, and establishment sector mask main results. The next sets of analyses disaggregates models by these factors and examines heterogeneous effects. For heterogeneity analysis, we do not use strata-year fixed effects, since there is rarely common support within each category of tract within each strata.[1] For example, it is unlikely that within a given strata, there are untreated and treated tracts of both urban and suburban geography. Additionally, for construction period models, there is no known construction period for the comparison group tracts, so within-strata analysis is impossible. However, we do restrict analysis to tracts in the overall common support.

[1]To ensure robustness, we ran regressions with strata-year fixed effects and found little difference in results across all models.

4.3.1 Construction Purpose

To test whether effects differed between Tracts affected by different types of construction, we interacted each placebo and treatment coefficient with the construction types listed in Table 2.2. Thus, we have three specific interactions for each treatment indicator: effects for Tracts affected only by infrastructure condition improvements, effects for Tracts affected by operations/traffic improvements, and effects for Tracts affected by both.[2] Results are provided in Table 4.2.

Although most results are not statistically significant, Table 4.2 shows a few notable findings.

- Infrastructure condition improvement construction reduces sales and employment for single-location establishments.
- Establishment counts increase after operations/traffic improvement construction for multiple-location establishments.
- Similarly, there is a reduction in the likelihood a multiple-location establishment closes after construction ends in Tracts affected by both operations/traffic and infrastructure condition improvements.

These findings suggest that businesses of different sizes are differently able to respond to changes in transportation infrastructure around them. For example, small firms lose out when adjacent to construction associated with improvements that simply replace old or outdated infrastructure without offering operational benefits. Similarly, there is business count growth and less closure among establishments owned by multiple-location firms after traffic operations are improved, meaning that multiple-location firms may opt to take advantage of improved traffic flow by retaining and adding businesses around more highly trafficked areas.

4.3.2 Construction Period Duration

We also examine how duration of the construction within each Tract affects overall outcomes. Figure 4.2 shows the distribution of Tract construction period duration in our sample. We use this distribution to categorize Tracts as affected by either long construction periods (two years or more of consistent highway construction) or short construction periods (one or fewer years of consistent highway construction). This partition roughly reflects the median of the construction period distribution, as shown in Figure 4.2. About half of Census Tracts were affected by highway improvement construction for fewer than two years, while the other half experienced continuous construction for at least two years.

We split our sample according to this categorization and rerun models. Figure 4.3 shows regression coefficients from these models, specifically on the log sales and log distance outcomes. Notably, there are no statistically significant distinctions between Tracts affect by long or short construction periods. As shown in Section 4.3.1, the purpose of construction plays a greater role in shaping outcomes for both types of establishments, compared to how long construction affects a specific Tract.

[2] A Tract could be affected by both types of improvements for two reasons. First, it falls within the 0.5 mile buffer of any single project categorized as both an operational/traffic improvement and and infrastructural condition improvements. Second, it falls within the 0.5 mile of buffers of multiple distinct projects, with at least one project embodying each type of improvement.

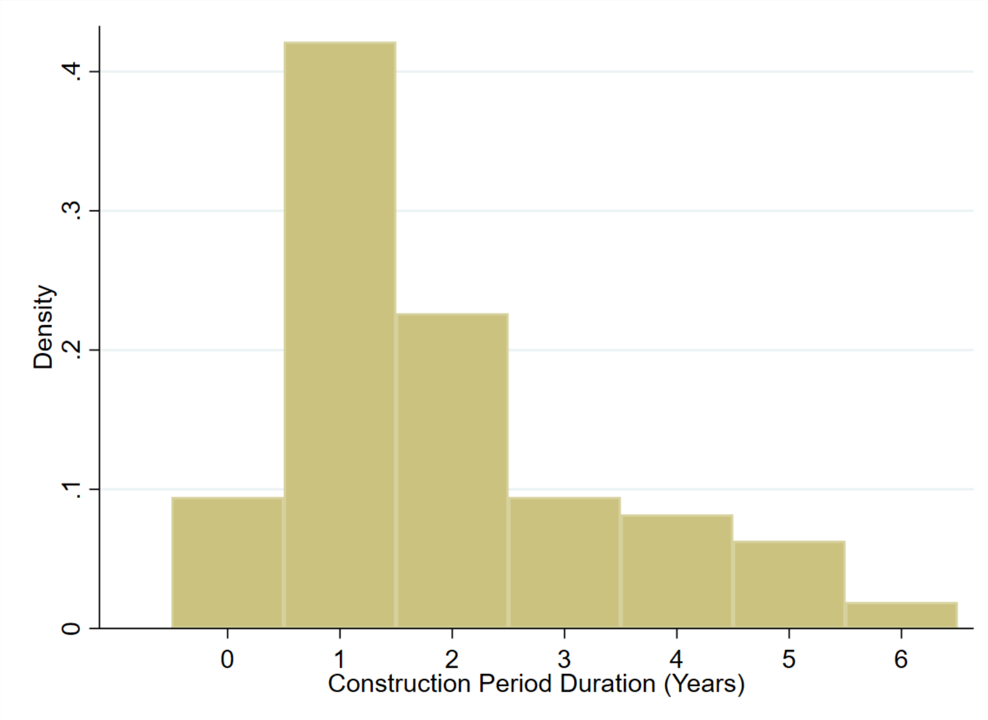


Figure 4.2: Histogram of Construction Period Durations

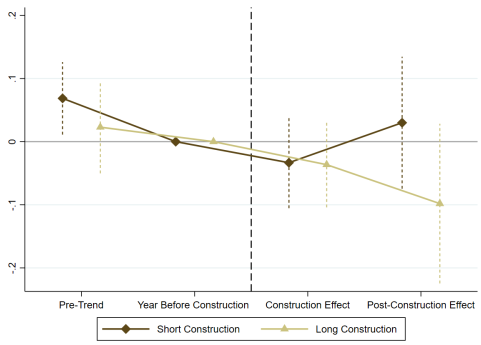
4.3.3 Tract Geography

We also examine the role of Tract geography, splitting our sample between urban and suburban Tracts. We consider any Tract in the central cities of Minneapolis and Saint Paul as urban, and all others suburban. As with other heterogeneity analyses, we split our sample according to this categorization and rerun models according to Equation (4.2). Figure 4.4 shows regression coefficients from these models, specifically on the log sales and log distance outcomes.

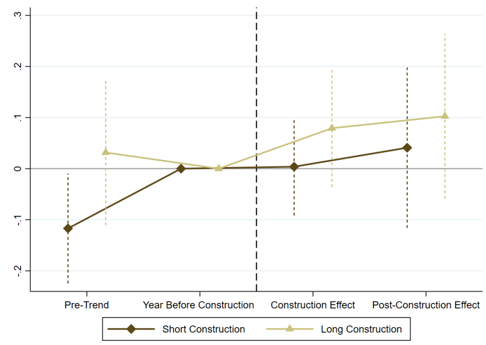
These models show the following:

- There is some heterogeneity between urban and suburban Tracts in post-construction sales and employment effects for single-location establishments, although it is not statistically significant. It appears that any possible negative effect detected earlier was driven by urban Tracts.
- Although not statistically significant at 95% confidence, highway construction and post-construction multiple-location establishment count effects for urban Tracts are negative. This suggests that multiple-location firms in the suburbs were better able to weather highway improvement.
- There is a statistically significant spike in single-location establishments closing in urban Tracts during construction. After construction, this increase in the probability a business is closing persists, but is less statistically significant due to higher standard errors.

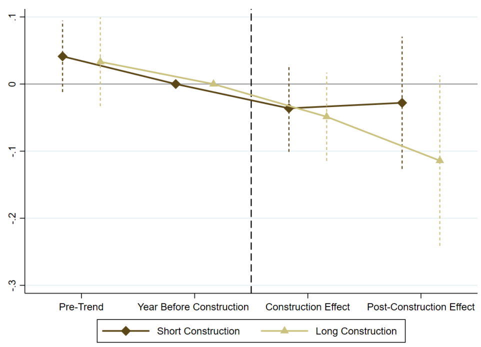
Ultimately, these findings suggest that there are notable differences in small business vulnerability to highway improvement constructions between establishments located in denser urban areas and those located in the suburbs. It is possible this distinction exists because businesses located in urban corridors



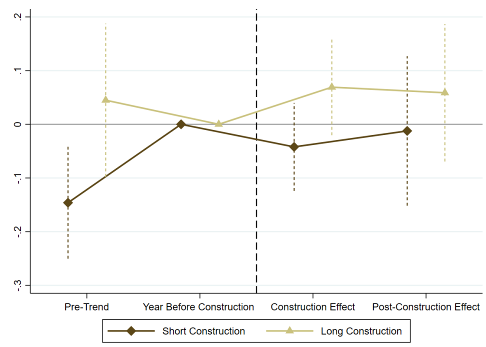
(a) Sales - Single-Location



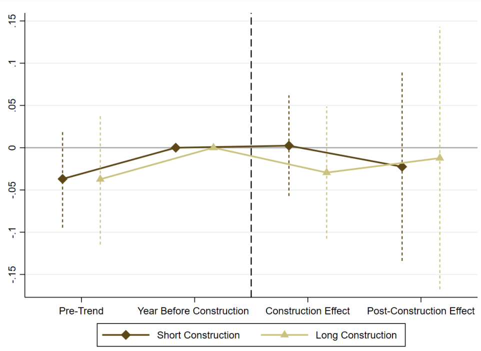
(b) Sales - Multiple-Location



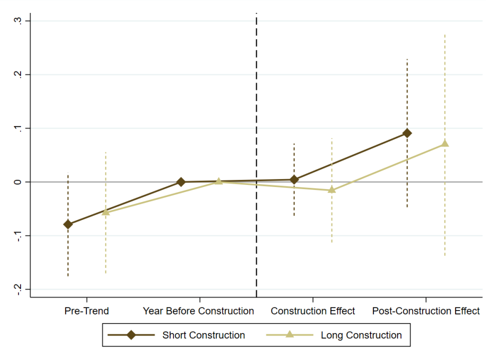
(c) Employment - Single-Location



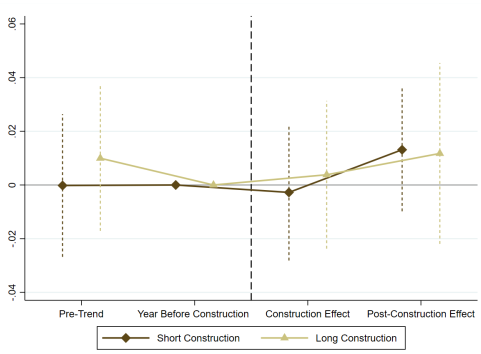
(d) Employment - Multiple-Location



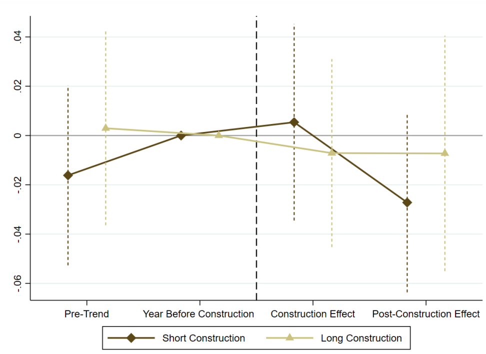
(e) Est. Counts - Single-Location



(f) Est. Counts - Multiple-Location



(g) % Closing - Single-Location



(h) % Closing - Multiple-Location

Figure 4.3: Effects from Strata Regressions By Tract Construction Period Length

are located closer to the actual point of construction than those located in suburban areas, meaning that construction disrupts physical infrastructure more acutely.

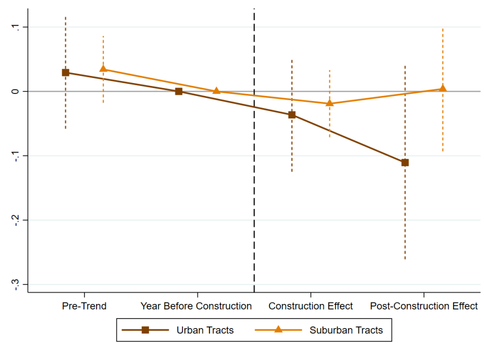
4.3.4 Sector

The last set of models tests for potential heterogeneity between different sectors of establishments. We ran the models from the previous section but interacted the $Placebo$, $Construction$, and $Improved$ with indicators for cells of each sector (retail, food, and personal services). Figure 4.5 shows results from these models for log sales, showing that there are few statistically significant differences in effects by sector.[3]

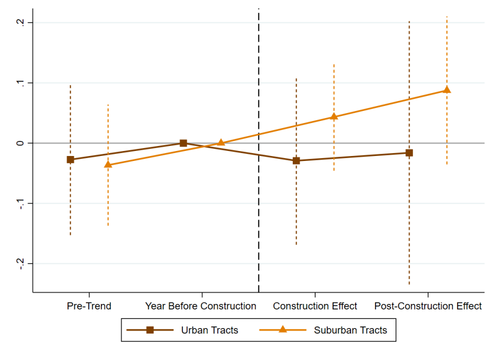
We find the following results:

- Food services single-location establishments experienced statistically significant declines in sales and employment during construction. However it is possible that this decline is not causal, as there is evidence that sales and employment for single-location food services establishments were declining prior to the onset of affected Tracts' construction periods.
- Multiple-location personal services establishments experienced a significant increase in sales and employment during construction, suggesting that as highway improvements occurred throughout a construction period, personal services firms able to take advantage of economies of scale experienced gains.
- Closure rates among single-location personal services establishments were higher in affected areas before construction began, relative to those in unaffected areas. During construction this same type of establishment was more likely to close than similar establishments in the comparison group.

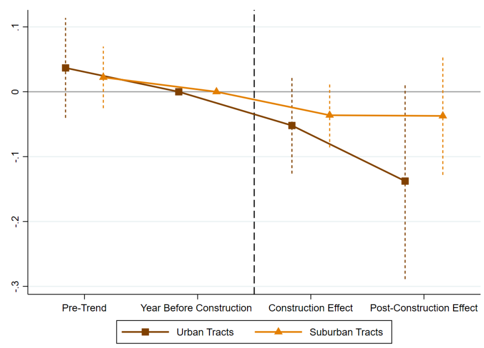
[3] Chow tests for coefficient equality verify this assertion and similar assertions made in the previous subsections.



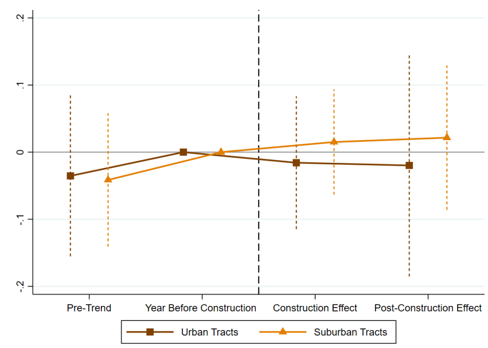
(a) Sales - Single-Location



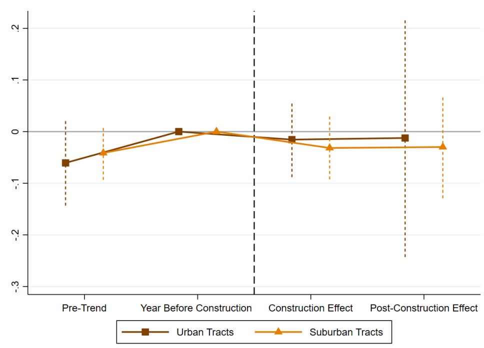
(b) Sales - Multiple-Location



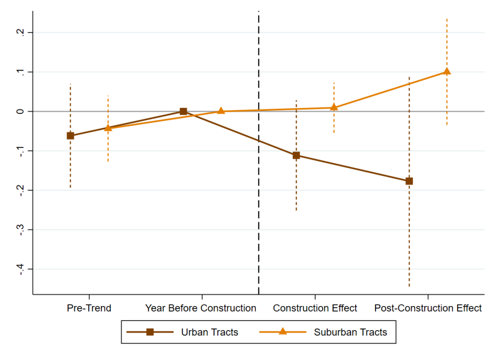
(c) Employment - Single-Location



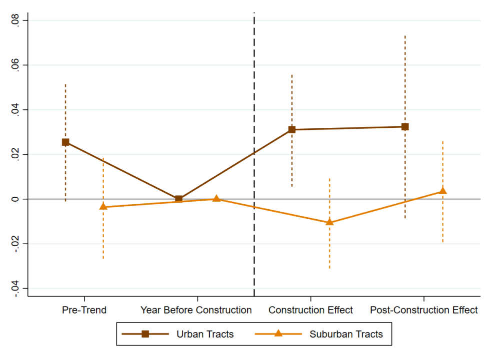
(d) Employment - Multiple-Location



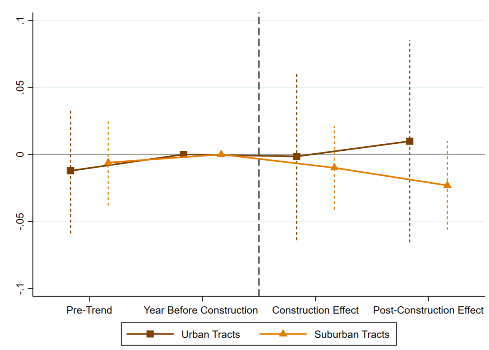
(e) Est. Counts - Single-Location



(f) Est. Counts - Multiple-Location

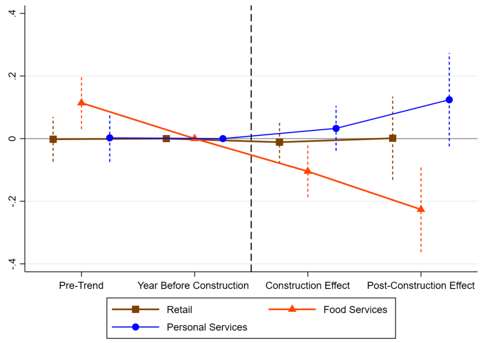


(g) % Closing - Single-Location

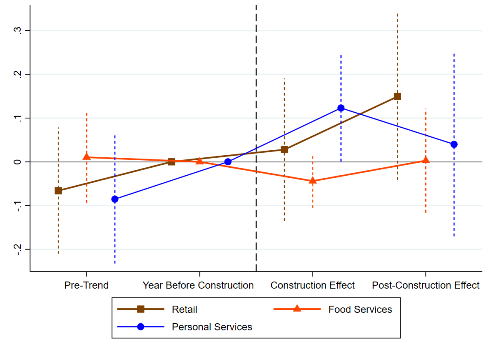


(h) % Closing - Multiple-Location

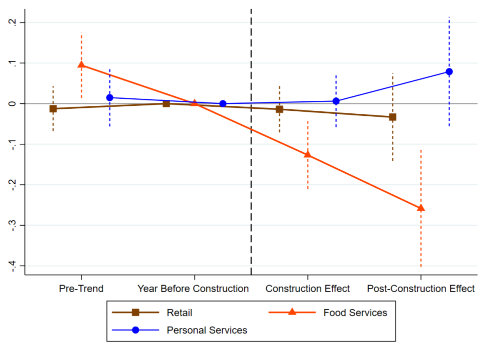
Figure 4.4: Effects from Strata Regressions By Tract Geography



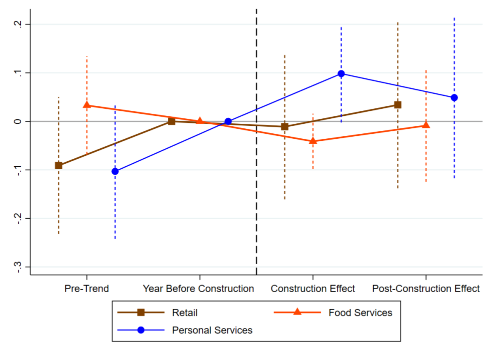
(a) Sales - Single-Location



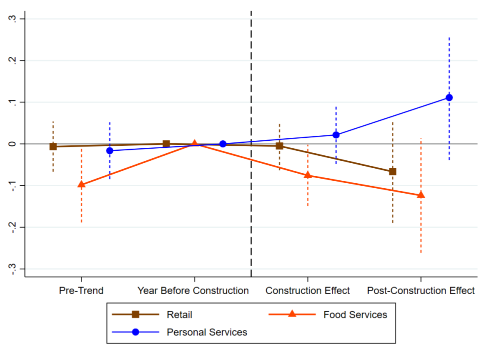
(b) Sales - Multiple-Location



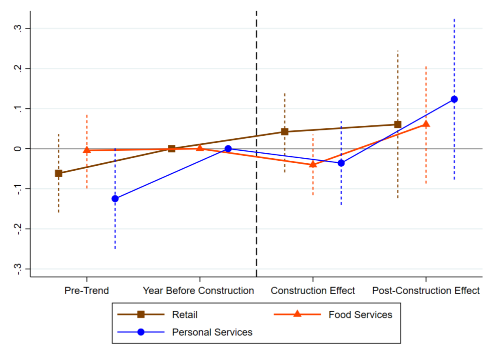
(c) Employment - Single-Location



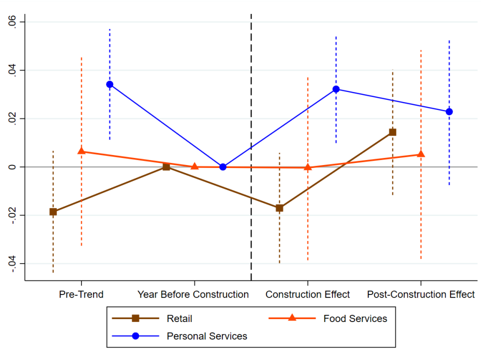
(d) Employment - Multiple-Location



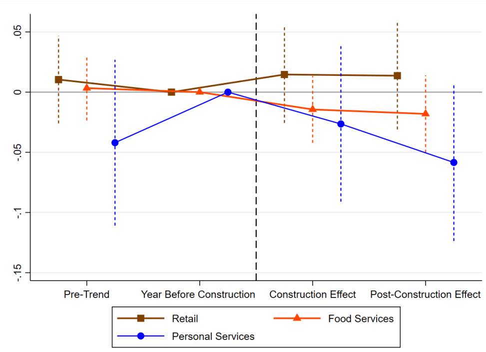
(e) Est. Counts - Single-Location



(f) Est. Counts - Multiple-Location



(g) % Closing - Single-Location



(h) % Closing - Multiple-Location

Figure 4.5: Effects from Strata Regressions By Establishment Type

Chapter 5

Comparing the Effects of Highway Improvement and Transitway Development

We finally turn to a set of models that compares the effects of highway projects and transit projects. This approach also allows us to account to interactive effects of the two transportation infrastructure improvements. This section ties in the analysis of our other report on the effects of transitway development on adjacent businesses with our analysis of highway projects in the earlier sections of this report.

5.1 Estimation

For the sake of simplicity and the ease of estimation, we specify a traditional, two period difference-in-differences model. We use cross-sections of businesses from 2003 and 2019 and specify models that account for interactions between different transit improvements and different types of highway improvements. We consider a business "treated" if it falls within a half mile buffer of a constructed transit line or a completed highway improvement corridor. Businesses that fall in the half mile buffer of highway and transit construction scheduled after 2019 are included in the control group.

We categorize highway improvements according to the same scheme used in the rest of the report. Thus, it is possible for an individual business to be effected by both an infrastructure condition improvement and an operational traffic improvement if it falls within the buffers of two separate projects of different types or if it falls within the buffer of a single project that included both construction purposes. Similarly, there are some businesses that fall within the buffer of multiple transitways, especially considering the connectivity of the A-Line with the Green Line and the Blue Line respectively.

This approach is slightly simpler than other methods used in this report. While it does not capture the effects of construction, it allows us to capture the interactions of several different types of transportation infrastructure improvement on adjacent businesses after construction is done.

Figure 5.1 shows plots businesses in this dataset and color-codes them by treatment status. Gold dots indicate businesses affected by both highway and transit projects. Bolder blue dots represent businesses affected by transit construction, while dimmer blue dots capture businesses in the transit comparison groups. Businesses affected by highway improvement are marked by bolder green dots, with lighter green dots showing the highway control group.

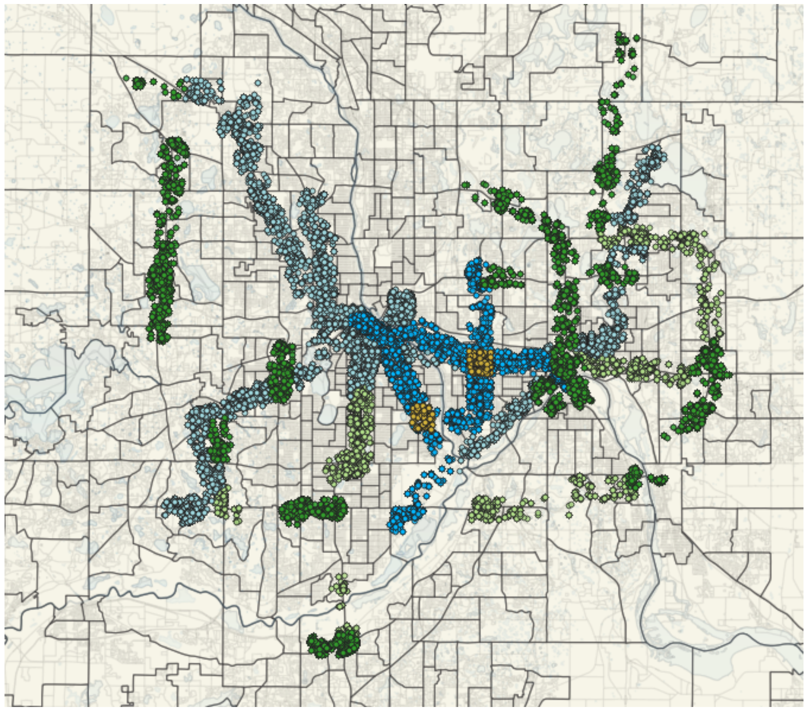


Figure 5.1: Map: Highway-Transit Comparisons

5.2 Results

Figure 5.2 displays several different difference-in-differences coefficients for log sales. Each regression controls for indicators for whether a business was affected by a current or future highway improvement, a current or future transit improvement, or both. The single-location firm establishment regression has about 13,000 observations and the multiple-location firm-owned establishment regression has about 5,000 observations.

Generally, results mirror other findings from this report and the transitway analysis. While many coefficients are statistically insignificant at 95% confidence, the combination of operational/traffic and infrastructure condition improvement increases sales volumes modestly for both types of establishments. Also aligning with earlier findings, the Green Line, when coupled with the A Line or an infrastructure condition highway improvement, reduced sales by about 25%.

Findings around the effect of the Blue Line contrast those from the transitways project. Single-location businesses affected by both the Blue and Green Line in Downtown and Southeast Minneapolis experienced about 50% gains in sales. Further, businesses affected by only the Blue Line experienced sales gains of about 40% over the 16 year period, regardless of chain status. One explanation for this is the different time range used here, compared to the transit analysis.

Figure 5.3 displays results of the sames regressions, now using employment size as a dependent variable. Generally, employment results mirror the sales results. One difference is the slight gain in employment for establishments affected only by the Green Line.

Figure 5.4 shows differential effects by store type. Multiple establishment retailers appear to gain in sales (but not in employment) after transportation improvement. Similarly, single-location food services

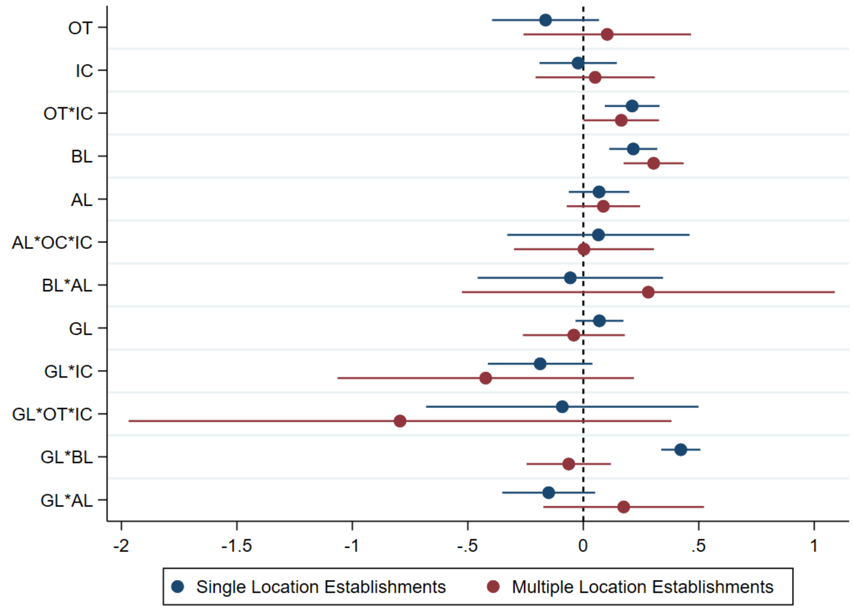


Figure 5.2: Log Sales Volume Highway-Transit Comparisons

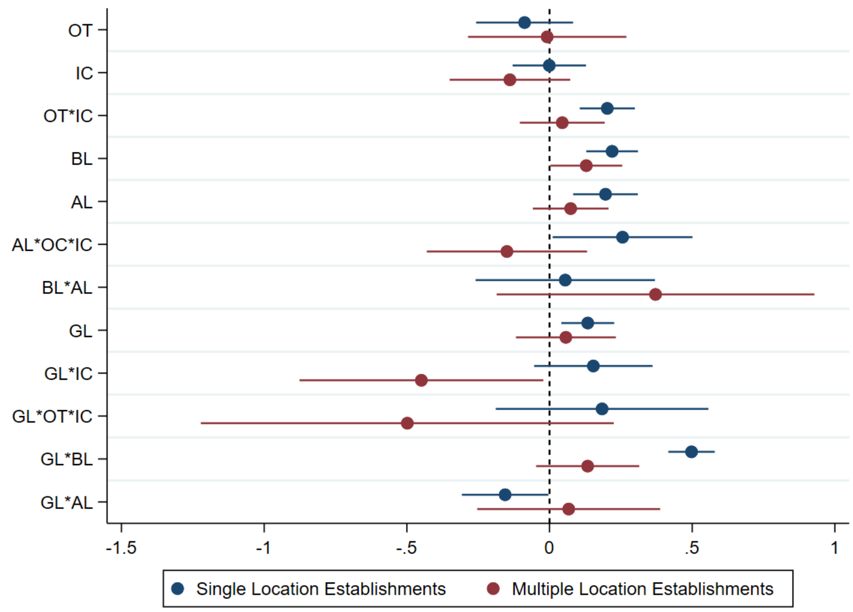


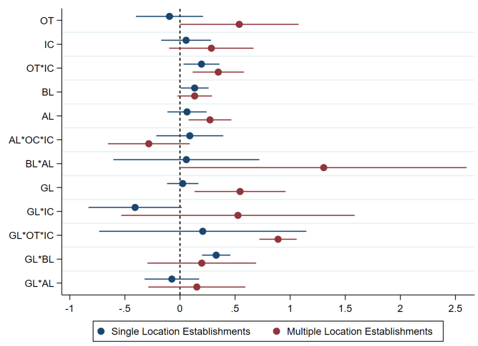
Figure 5.3: Log Employment Size Highway-Transit Comparisons

businesses gain as well, with the exception of those affected by the Green Line and both types of highway improvement, which experience about a 25% loss. Personal services effects were very mixed for both single-location and multiple-location establishments.

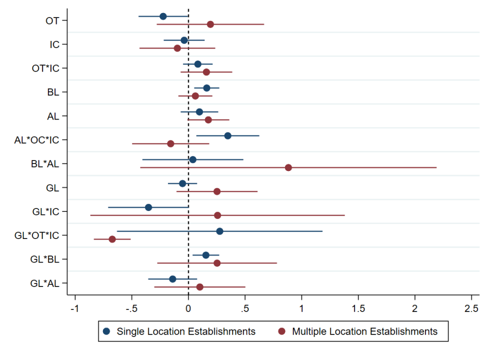
5.3 Mapping Predicted Effects

To accompany this report, we worked with a team of Geographic Information Science researchers to develop an interacting mapping interface for general public use. The interface, which can be found here shows annual business outcomes for Census Tracts across the metro area (sales, employment, and establishment counts), using the same aggregated INFOUSA data from this report and its sister project (Wexler and Fan 2022).

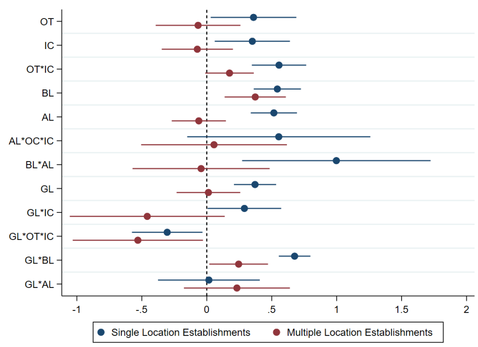
Additionally, the interface displays predicted yearly percentage growth effects of each business outcome under different transportation infrastructure improvement scenarios. To predict future sales volume effects, we first ran "training" regressions of 2004-2019 Tract-level percentage change in each of the main three outcomes on baseline data from the 2000 Census. We multiplied these coefficients on baseline demographic data from the 2020 Census for each Tract to predict 2020-2035 percentage changes. The predicted annual percentage changes in each outcome shown in the interface are these 2020-2035 divided by 15. Baseline demographic variables included the log Census Tract population, the proportion of white nonhispanic residents in a Tract, the proportion of vacant housing units in a Tract and the average household size (population divided by number of occupied housing units).



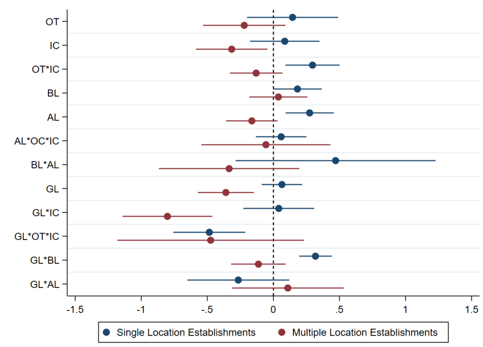
(a) Sales - Retail



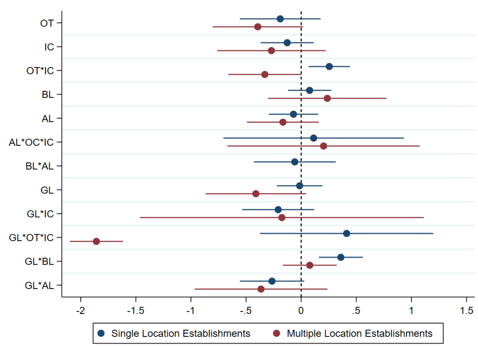
(b) Employment - Retail



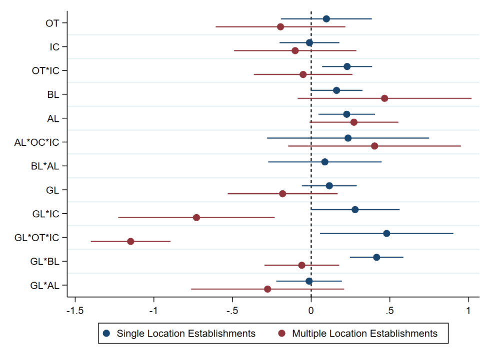
(c) Sales - Food Service



(d) Employment - Food Service



(e) Sales - Personal Services



(f) Employment - Personal Services

Figure 5.4: Effects from Strata Regressions By Establishment Type

Chapter 6

Conclusion

Municipal governments regularly schedule and implement highway improvements to ensure both infrastructure safety and more efficient traffic operations. This report contributes to the sparse empirical research examining the effect of these improvements on adjacent businesses, impacts felt both during and after construction. By merging a geocoded dataset of major highway improvement projects in the Twin Cities metropolitan area with detailed repeated cross-sectional business establishment-level data, we were able to examine how highway improvement affected business sales, employment, and closure rates, paying special attention to vulnerable small single-location firm establishments.

The analysis used in this study has a few limitations. First, because the construction and post-construction periods of highway improvements are likely to have different effects and differed in duration between each Census Tract, the new robust difference-in-differences estimators of Sun and Abraham (2021) and Callaway and Sant'Anna (2021) were difficult to implement. Second, our dataset, while rich in information about the affected businesses and about the nature of the highway improvements themselves, lacks detailed information about land use and local economic conditions, especially observed regularly over time. However, our approach of first identifying the time-invariant determinants of highway improvement and then matching affected Census Tracts with those slated to be affected after our study period should reduce potential unobserved bias from spatial heterogeneity in changing economic conditions.

Despite these limitations, the study still provides valuable insight into how highway improvement heterogeneously affects nearby businesses. While the main results are null, these findings mask considerable heterogeneity along several dimensions, many of which can be helpful for urban and regional transportation planners hoping to improve highway infrastructure without harming vulnerable business enterprises. Specifically, small single-location establishments in denser urban settings are more at risk than those in suburban areas. Highway improvement also increases the closing rate for small firms in urban Tracts, a trend that persists even after construction concludes. Additionally, longer construction periods — thus a longer period of disruption to nearby businesses — are associated with sharper reductions in sales and employment for single-location establishments.

References

B. Callaway and P. H. Sant'Anna. Difference-in-differences with multiple time periods. *Journal of Econometrics*, 225:200–230, 12 2021.

A. Chandra and E. Thompson. Does public infrastructure affect economic activity? evidence from the rural interstate highway system, 2000.

D. J. Forkenbrock and N. S. J. Foster. Economic benefits of a corridor highway investment, 1990.

A. Goodman-Bacon. Difference-in-differences with variation in treatment timing. *Journal of Econometrics*, 225(2):254–277, 2021.

T. A. Hartshorn and P. O. Muller. Suburban downtowns and the transformation of metropolitan atlanta's business landscape. *Urban Geography*, 10(4):375–395, 1989.

T. R. Lakshmanan. The broader economic consequences of transport infrastructure investments. *Journal of Transport Geography*, 19:1–12, 1 2011.

L. Sun and S. Abraham. Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics*, 225(2):175–199, 2021.

N. Wexler and Y. Fan. Commercial gentrification along twin cities transitway corridors, 2022.

K. A. Wink, S. F. Eller, G. Abney, R. Feiock, A. Fletschmann, J. Garand, E. Lewis, and C. Scavo. The effects of local economic development efforts an empirical assessment of expenditures on income growth in north carolina counties, 1998.

J. Yu and Y. Liu. Prioritizing highway safety improvement projects: A multi-criteria model and case study with safetyanalyst. *Safety Science*, 50(4):1085–1092, 2012.

T. Zhou and J. M. Clapp. The location of new anchor stores within metropolitan areas. *Regional Science and Urban Economics*, 50:87–107, 1 2015.