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Updates to Indiana Fuel Tax and Registration Revenue Projections

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JOINT TRANSPORTATION RESEARCH PROGRAM

INDIANA DEPARTMENT OF TRANSPORTATION
AND PURDUE UNIVERSITY

UPDATES TO INDIANA FUEL TAX AND REGISTRATION REVENUE PROJECTIONS

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16. Abstract

Highway revenues both at the federal and state levels have failed to keep up with expected investments required for infrastructure preservation and improvement. The reasons for this trend include the increasing fuel efficiency of vehicles, slowing of the growth in vehicle-miles of travel, and the erosion of the purchasing power of the dollar due to inflation.

Past studies on the issue of highway revenue forecasting for Indiana highways were conducted under different economic conditions than what exists today. The present study updates the revenue projections of particularly with the recognition of new CAFE Standards. The present study also updates the equations for estimating vehicle miles of travel. Impacts of alternative options for changing the fuel tax rate structure are also investigated.

The present study predicted fuel tax revenues from 2012 to 2025 under the existing fuel tax rate structure and also considered possible options for changes in fuel tax rates. Fuel tax revenue from existing rate structure indicated a continuous annual decrease from 2012 to 2025 by 2.96% to 3.49% in real terms. Adopting one of the four fuel tax rate modifications would provide additional short- term revenue for a variable number of years. A 1-cent increase would offset the decline in the total fuel tax revenue only for a year after which it will continually decline every year. A 3-cent increase would provide a substantial increase in revenue in the short term but will continually decline, however, the 2025 revenue from 3-cent increase would be a little higher than the 2012 revenue level. Both inflation indexing and an ad valorem tax would also provide substantial increase in fuel tax revenue.

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EXECUTIVE SUMMARY

UPDATES TO INDIANA FUEL TAX AND REGISTRATION REVENUE PROJECTIONS

Introduction

The current and imminent revenue shortfall of the highway financing system, which is primarily based on motor fuel taxes, has been widely diagnosed both at the national and state levels. Under the current fuel-tax-based system, it is estimated that the shortfall would grow larger in the future, primarily because the current fuel tax rate is fixed per gallon while vehicle fuel economy is improving and the use of alternative fuels is increasing.

Findings

Models to estimate expected highway revenues from the existing sources, indicate that, if no change is made to the tax rate, fuel revenue will continue to decline.

The present study predicted fuel tax revenues from 2012 to 2025 under the existing fuel tax rate structure and also considered possible options for changes in fuel tax rates. Fuel tax revenue from existing rate structure indicated a continuous annual decrease from 2012 to 2025 by 2.96% to 3.49% in real terms. Adopting one of the four fuel tax rate modifications would provide additional short- term revenue for a variable number of years. A 1-cent increase would offset the decline in the total fuel tax revenue only for a year after which it will continually decline every year. A 3-cent increase would provide a substantial increase in revenue in the short term but will continually decline, however, the 2025 revenue from 3-cent increase would be a little higher than the 2012 revenue level. Both inflation indexing and an ad valorem tax would also provide substantial increase in fuel tax revenue.

Implementation

The study was conducted for the Finance Department of the Indiana Department of Transportation. It is expected that the results will be used for budgetary purposes.

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1. INTRODUCTION

The current and imminent revenue shortfall of the highway financing system, which is primarily based on motor fuel taxes, has been widely diagnosed both at the national and state levels. Under the current fuel-tax-based system, it is estimated that the shortfall would grow larger in the future, primarily because the current fuel tax rate is fixed per gallon while vehicle fuel economy is improving and the use of alternative fuels is increasing. The growing funding gap lends urgency to the need for improving the current structure of the highway financing mechanism or for developing a new financing strategy that satisfactorily attain finance-related goals such as adequacy in revenue, efficiency of the highway system, equity between highway users, and technological and financial feasibility. In 2008, a JTRP study on alternatives to fuel tax by Oh and Sinha (*1*) investigated alternatives to the current fuel-tax-based state highway funding system, and examined several types of user charging schemes and developed a methodological framework for evaluating alternative user charging schemes. The most recent JTRP study on forecasting of highway revenues (*2*) indicated if no change is made to the tax rate, fuel revenue would continue to decline. The past studies on the issue of highway revenue forecasting for Indiana highways were conducted under different economic conditions than what exists today. It is necessary therefore to update the underlying models primarily for fleet fuel efficiency and vehicle miles of travel. The present study updates the revenue projections particularly with the recognition of new CAFE standards. The equations for estimating vehicle miles of travel are also updated and Impacts of alternative options for changing the fuel tax rate structure are investigated.

2. MODELING FRAMEWORK

Socio-economic indicators, demography, technological advancement in vehicle fuel efficiency, travel demand and legislative instruments are factors that affect expected highway revenues. The need for personal mobility and commodity transportation drives travel demand which can be predicted based on economic factors such as state per capita income (PCI) and gross domestic product (GDP).

Driving age population within the state determines passenger vehicle registration, while economic climate determines commercial vehicle registration. Increasing vehicle fuel efficiency through technological advancement adversely affects highway revenue. Changing travel and Corporate Average Fuel Economy (CAFE) standards are expected to continue to have adverse impacts on highway revenue.

Fuel tax rates and disbursement ratios are the prerogative of the legislature. Highway revenue sources are broadly disaggregated in the present study, as shown in Figure 2.1. Fuel revenue (gasoline tax, special fuel tax, motor carrier surcharge tax (MCST), motor carrier fuel use tax (MCFUT) is estimated with prediction models for VMT and fleet fuel efficiency factors. Vehicle registration revenue includes registration, driving license and transfer fees and it is estimated from population and income models. Other revenues in the present study include international registration plan and permit fees.

3. FUEL TAX REVENUE

3.1 Vehicle Miles of Travel (VMT) Estimation

Vehicle miles of travel models were based on four independent variables; Indiana per capita income, gross state product, gross domestic product of the United States, in 2004 dollar and driving age population in Indiana. The data on VMT came from Indiana Department of Transportation while the data on gross state product and per capita income was from US Bureau of Economic Analysis (*2*) under the US Department of Commerce. Driving age population came from the Indiana Bureau of Motor Vehicles. Models developed were specific to six vehicle categories, automobiles, motorcycles, light duty trucks, single unit trucks, buses and combination trucks. The VMT equations are presented in Table 3.1. To facilitate the

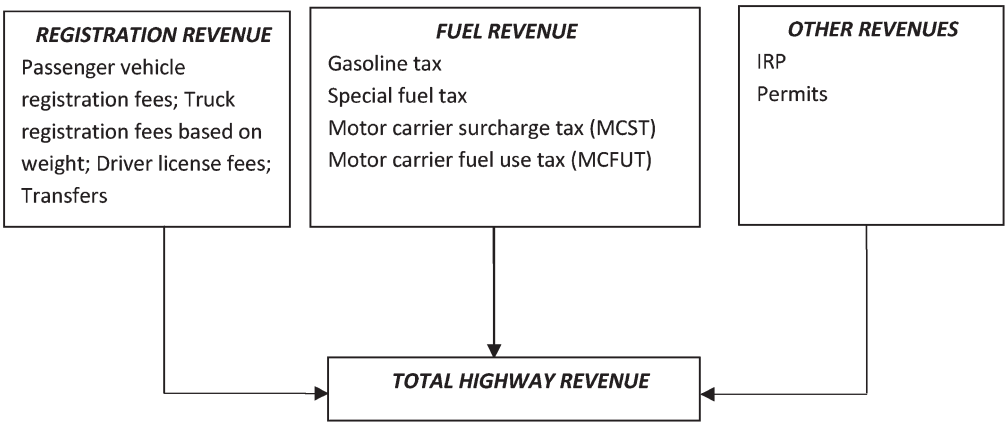

Figure 2.1 Components of existing highway revenue.

TABLE 3.1
VMT Estimation Equations

Vehicle Category	VMT Equation	Variable	R^2	t-Statistic
Automobile	AutoVMT= 25113 + 0.71 (PCI)	Intercept	0.76	3.92
		PCI		3.59
Combination Truck	CTVMT = −44577 + 11898 (LogGDP)	Intercept	0.80	2.79
		LogGDP		5.84
Light Duty Truck	LDTVMT = −14787 + 0.85 (PCI)	Intercept	0.75	−3.46
		PCI		4.61
Single Unit Truck	SUTVMT = 1962 + 0.00204(GSP)	Intercept	0.80	15.44
		IGDP		3.43
Bus	BusVMT = 1588.6 − 0.0423 (PCI)	Intercept	0.65	4.23
		PCI		−3.36
Motorcycle	MCVMT = −1698 + 0.000483(DAP)	Intercept	0.73	−3.58
		DAP		4.32

Where,
AutoVMT: vehicle miles of travel by automobiles in millions,
CTVMT: vehicle miles of travel by combination trucks in millions,
LDTVMT: vehicle miles of travel by light duty trucks (minivans, sport utility vehicles and pick-up trucks) in millions,
SUTVMT: vehicle miles of travel by single unit trucks in millions,
MCVMT: vehicle miles of travel by motorcycles in millions,
BusVMT: vehicle miles of travel by buses in millions,
PCI: per capita income in Indiana in 2004 dollars,
GDP: gross domestic product of the USA in billions in 2004 dollars,
GSP: gross state product of Indiana in millions in 2004 dollars, and
DAP: driving age population in Indiana (population in the age group)

prediction of VMT outcomes, input parameter models were developed for per capita income, Indiana's gross state product, and Indiana driving age population, as shown in Table 3.2. For GDP projections, values projected by Global Insights (*3*) were used in order to be consistent with the practices of the Indiana DOT. The estimated input variables are presented in Table 3.3 with the estimated VMT shown in Table 3.4.

3.2 Estimation of Vehicle Fleet Fuel Efficiency

Estimation of on-the-road fleet fuel efficiency for vehicles was based on an age cohort survival approach. The age cohort survival approach involves three steps. The first step is the determination of the proportion of vehicles in each age cohort in a given year. The second step estimates the relative miles traveled by each age cohort within the year. The third step involves estimating fleet fuel efficiency for each vehicle age cohort based on the model year fuel efficiencies. For cars and light duty trucks the corporate average fuel economy (CAFE) standards were used as a basis for model year fuel efficiency values. However, because numerous studies have shown that actual observed vehicle fleet fuel efficiencies are roughly 20% less than CAFE values (see for example (*5*)), this study multiplies projected CAFE values by a factor of 0.8 to estimate actual fleet fuel efficiency. For combination trucks, single unit trucks and buses, published values from the Transportation Energy Data Book of the Oak Ridge National Laboratory were used (*6*). A detailed discussion of this approach is given in earlier reports (*2,7*).

In order to illustrate the fleet fuel efficiency methodology, an estimation of automobile fleet fuel efficiency for a given year (2012) is illustrated in Table 3.5. The i^{th} age cohort is shown in Column (a) and the percentage VMT for each age cohort is in column (b). Total VMT estimated for automobile in 2012 based on automobile VMT equation in Table 3.1 is in column (c). Calculation of automobile VMT for

TABLE 3.2
Equations to Estimate Input Variables

Description	Equation	Variable	R^2	t-Statistic
Per Capita Income	PCI = −503066 + 266 (w)	Intercept	0.88	−7.61
		w		8.06
Indiana Gross State Product	GSP = −7041044 + 3631 (w)	Intercept	0.80	−4.39
		w		4.53
Driving Age Population	DAP = −65172093+ 34681(w)	Intercept	0.92	−9.55
		w		10.18

Where,
w: prediction year.

TABLE 3.3
Input Variables Estimation, 2012–2025

Year	PCI	GDP	GSP	DAP
2012	32,126	15,165	264,528	4,606,079
2013	32,392	15,551	268,159	4,640,760
2014	32,658	15,948	271,790	4,675,441
2015	32,924	16,355	275,421	4,710,122
2016	33,190	16,772	279,052	4,744,803
2017	33,456	17,199	282,683	4,779,484
2018	33,722	17,638	286,314	4,814,165
2019	33,988	18,088	289,945	4,848,846
2020	34,254	18,549	293,576	4,883,527
2021	34,520	19,022	297,207	4,918,208
2022	34,786	19,507	300,838	4,952,889
2023	35,052	20,004	304,469	4,987,570
2024	35,318	20,515	308,100	5,022,251
2025	35,584	21,038	311,731	5,056,932

Where,
PCI: per capita income in Indiana in 2004 dollars,
GDP: gross domestic product of the USA in billions in 2004 dollars,
GSP: gross state product of Indiana in millions in 2004 dollars, and
DAP: driving age population in Indiana (population in the age group ≥ 16).

2012 is as follows: $PCI_{2008} = -503066 + 266\ (2012) = 32{,}126$ (equation from Table 3.2). Automobile VMT (Table 3.1) is calculated as AutoVMT = 25113 + 0.71 (32,126) = 47,922.46 (in millions). The proportion of VMT for each automobile age cohort is computed by the product of column (b) and (c). The model year automobile fuel efficiency for the i^{th} age cohort is then established based on CAFE. For example, the established CAFE for automobiles in year 2012 was 33.6 mpg and 30.4 mpg in year 2011. Therefore, the effective CAFE value for automobile in year 2012 was 33.6 x 0.8 = 26.88 mpg and 30.4 x 0.8 = 24.32 mpg in year 2011. This approach is repeated for the other age cohorts. Estimation of fuel efficiency is based on the harmonic mean approach; hence in column (f), the estimated VMT for the i^{th} age cohort is divided by the fuel efficiency for the i^{th} age cohort. For example, for the 1 year old age cohort, the value in column (f) is calculated as 4,619.31 / 24.32 = 189.94. Finally, the fuel efficiency for vehicle category k (in this case automobile) is found by dividing the total VMT for automobile in 2012 (VMTK), in column (c), by the summation of column

TABLE 3.4
VMT Prediction by Vehicle Type, 2012–2025

	VMT (in millions)						
Year	AutoVMT	MCVMT	BUSVMT	LDTVMT	SUTVMT	CTVMT	TotalVMT
2012	47,922	527	230	12,520	2,502	5,167	68,867
2013	48,111	543	218	12,746	2,509	5,301	69,429
2014	48,300	560	207	12,972	2,516	5,485	70,042
2015	48,489	577	196	13,198	2,524	5,639	70,623
2016	48,678	594	185	13,425	2,531	5,785	71,197
2017	48,867	610	173	13,651	2,539	5,917	71,757
2018	49,056	627	162	13,877	2,546	6,042	72,310
2019	49,244	644	151	14,103	2,553	6,170	72,866
2020	49,433	661	140	14,329	2,561	6,297	73,421
2021	49,622	677	128	14,555	2,568	6,413	73,965
2022	49,811	694	117	14,781	2,576	6,507	74,486
2023	50,000	711	106	15,007	2,583	6,600	75,007
2024	50,189	728	95	15,233	2,591	6,693	75,528
2025	50,378	744	83	15,459	2,598	6,786	76,049

TABLE 3.5
Estimation of Automobile Fleet Fuel Efficiency for Year 2012

Age Cohort(i^{th})(a)	Age Cohort VMT %(b)	VMT_k (millions)(c)	VMT_{ik} (millions)(d)=(b) x (c)	FE_{ik} (mpg)(e)	VMT_{ik}/FE_{ik} (f)=(d)/(e)	FFE_k(mpg) (g)=(c)/Σ(f)
Under 1	7.77	47,922.46	3,725.40	26.88	138.59	21.93
1	9.64	47,922.46	4,619.31	24.32	189.94	21.93
2	9.15	47,922.46	4,386.44	22.00	199.38	21.93
3	8.43	47,922.46	4,039.52	22.00	183.61	21.93
4	7.59	47,922.46	3,635.56	22.00	165.25	21.93
5	7.13	47,922.46	3,416.96	22.00	155.32	21.93
6	6.54	47,922.46	3,131.81	22.00	142.36	21.93
7	6.12	47,922.46	2,932.21	22.00	133.28	21.93
8	5.89	47,922.46	2,822.91	22.00	128.31	21.93
9	5.30	47,922.46	2,537.77	22.00	115.35	21.93
10 and older	26.45	47,922.46	12,674.58	20.00	633.73	21.93
Total	**100.00**		**47,922.46**		**2,185.13**	

TABLE 3.6
Estimated Fleet Fuel Efficiency

	Fleet Fuel Efficiencies (mpg)					
Year	Auto	MC	Bus	LDT	SUT	CT
2012	21.93	56.93	7.06	18.37	7.26	5.33
2013	22.49	57.67	7.16	18.75	7.36	5.38
2014	23.14	58.51	7.26	19.16	7.46	5.43
2015	23.89	58.72	7.36	19.63	7.56	5.46
2016	24.74	61.88	7.46	20.15	7.66	5.53
2017	25.46	62.69	7.56	20.69	7.76	5.58
2018	26.20	63.16	7.61	21.23	7.81	5.63
2019	26.98	64.40	7.77	21.79	7.97	5.69
2020	27.87	65.65	7.87	22.40	8.07	5.74
2021	28.71	66.99	7.97	23.06	8.17	5.79
2022	29.74	68.40	8.08	23.79	8.28	5.84
2023	30.77	69.82	8.18	24.53	8.38	5.89
2024	31.76	71.19	8.28	25.24	8.48	5.94
2025	32.72	72.54	8.38	25.93	8.58	5.99

TABLE 3.8
Predicted Gasoline Tax Revenue

	Revenue (Current $ x 10^6)					
Year	Auto	MC	Bus	LDT	SUT	'Total
2012	393.32	1.67	0.23	122.66	14.26	532.14
2013	385.11	1.70	0.22	122.39	14.11	523.53
2014	375.77	1.72	0.21	121.86	13.97	513.52
2015	365.31	1.77	0.19	121.00	13.82	502.10
2016	354.20	1.73	0.18	119.92	13.68	489.70
2017	345.48	1.75	0.17	118.77	13.54	479.71
2018	337.05	1.79	0.15	117.67	13.50	470.16
2019	328.50	1.80	0.14	116.51	13.27	460.22
2020	319.28	1.81	0.13	115.16	13.14	449.51
2021	311.07	1.82	0.12	113.61	13.01	439.63
2022	301.47	1.83	0.10	111.83	12.89	428.12
2023	292.46	1.83	0.09	110.14	12.76	417.29
2024	284.42	1.84	0.08	108.65	12.65	407.63
2025	277.12	1.85	0.07	107.31	12.53	398.88

(f). The calculation for automobile fleet fuel efficiency for 2012 is computed as (47,922.46 / 2,185.13) = 21.93 mpg. Fleet fuel efficiency computation for selected years for automobiles and light duty trucks are shown in the Appendix. The estimated fleet fuel efficiencies for the six vehicle types are presented in Table 3.6.

Annual fuel consumption was estimated by dividing VMT for each vehicle category by the respective estimated fleet fuel efficiency in that year. The amount of fuel consumed by automobiles, light duty trucks and motorcycles were considered 100% from gasoline, while 23% of single unit trucks and 4% of buses were considered to use gasoline. This assumption was based on the relative consumptions of these two fuel types by vehicle category in United States, as given in Table 3.5 of the 30th edition of the Transportation Energy Data Book (Davis et al., 2011). Fuel consumed by commercial tractors was considered to be 100% special fuel (diesel). The volumes of consumption (in gallons) for different vehicle categories within the prediction period are shown in Table 3.7. Predicted fuel tax revenues for gasoline tax, diesel tax, motor carrier fuel use tax (MCFUT), motor carrier surcharge tax (MCST) and total fuel tax revenue are presented in Tables 3.8 to 3.11. Predicted percent of 2012 base year gasoline, diesel and total fuel tax revenues are provided in the Appendix. Validation of fuel tax revenues by fuel type and total fuel revenues are shown in Tables 3.12 to 3.13. Predicted fuel tax revenues are shown graphically in Figures 3.1 to 3.3. Historical gasoline, diesel and total fuel tax revenue are shown in the Appendix.

TABLE 3.7
Predicted Fuel Consumption

	Gallons (in millions)					
Year	Auto	MC	Bus	LDT	SUT	CT
2012	2,185	9	33	681	344	969
2013	2,140	9	31	680	341	985
2014	2,088	10	29	677	337	1,010
2015	2,029	10	27	672	334	1,032
2016	1,968	10	25	666	331	1,046
2017	1,919	10	23	660	327	1,060
2018	1,872	10	21	654	326	1,072
2019	1,825	10	19	647	321	1,085
2020	1,774	10	18	640	317	1,098
2021	1,728	10	16	631	314	1,108
2022	1,675	10	15	621	311	1,114
2023	1,625	10	13	612	308	1,120
2024	1,580	10	11	604	305	1,126
2025	1,540	10	10	596	303	1,132

TABLE 3.9
Predicted Diesel Tax Revenue

	Revenue (Current $ x 10^6)			
Year	Bus	SUT	CT	Total
2012	5.00	42.44	154.97	202.41
2013	4.69	42.00	157.56	204.24
2014	4.38	41.56	161.57	207.52
2015	4.09	41.14	165.13	210.35
2016	3.80	40.72	167.33	211.85
2017	3.52	40.30	169.59	213.42
2018	3.27	40.18	171.59	215.05
2019	2.98	39.49	173.65	216.12
2020	2.73	39.10	175.63	217.46
2021	2.47	38.72	177.27	218.46
2022	2.23	38.34	178.26	218.83
2023	1.99	37.98	179.24	219.21
2024	1.76	37.64	180.21	219.60
2025	1.53	37.30	181.18	220.01

TABLE 3.10
Predicted MCFUT and MCST Revenue

	Revenue (Current $ x 10^6)		
Year	**MCFUT**	**MCST**	**Total**
2012	0.550	95.50	96.05
2013	0.560	96.32	96.88
2014	0.574	97.60	98.17
2015	0.586	98.73	99.31
2016	0.594	99.43	100.02
2017	0.602	100.15	100.75
2018	0.609	100.79	101.39
2019	0.617	101.44	102.05
2020	0.624	102.07	102.69
2021	0.630	102.59	103.22
2022	0.633	102.91	103.54
2023	0.637	103.22	103.85
2024	0.640	103.53	104.17
2025	0.643	103.84	104.48

TABLE 3.11
Predicted Fuel Tax Revenue by Fuel Type

	Revenue (Current $ x 10^6)			
Year	**Gasoline Tax**	**Diesel Tax**	**MCFUT + MCST**	**Total**
2012	532.14	202.41	96.05	830.59
2013	523.53	204.24	96.88	824.65
2014	513.52	207.52	98.17	819.21
2015	502.10	210.35	99.31	811.76
2016	489.70	211.85	100.02	801.57
2017	479.71	213.42	100.75	793.88
2018	470.16	215.05	101.39	786.61
2019	460.22	216.12	102.05	778.40
2020	449.51	217.46	102.69	769.66
2021	439.63	218.46	103.22	761.31
2022	428.12	218.83	103.54	750.49
2023	417.29	219.21	103.85	740.35
2024	407.63	219.60	104.17	731.40
2025	398.88	220.01	104.48	723.37

TABLE 3.12
Validation of Fuel Tax Revenue Projections by Type

	*Gasoline Tax Revenue ($M)			*Diesel Tax Revenue ($M) (incl. MCST & MCFUT)		
Year	**Actual**	**Predicted**	**% Difference**	**Actual**	**Predicted**	**% Difference**
2009	540.50	555.83	2.84	283.40	292.20	3.10
2010	536.50	549.59	2.44	279.40	296.03	5.95
2011	547.60	542.69	−0.90	291.60	296.70	1.75
2012	533.20	532.14	−0.20	298.60	298.45	−0.05

*Actual and predicted values are in millions of current dollars.

TABLE 3.13
Validation of Total Fuel Tax Revenue Projections

Year	Actual Rev. ($M)	Predicted Rev. ($M)	% Difference
2009	823.90	848.03	2.93
2010	815.90	845.61	3.64
2011	839.20	839.40	0.02
2012	831.80	830.59	−0.14

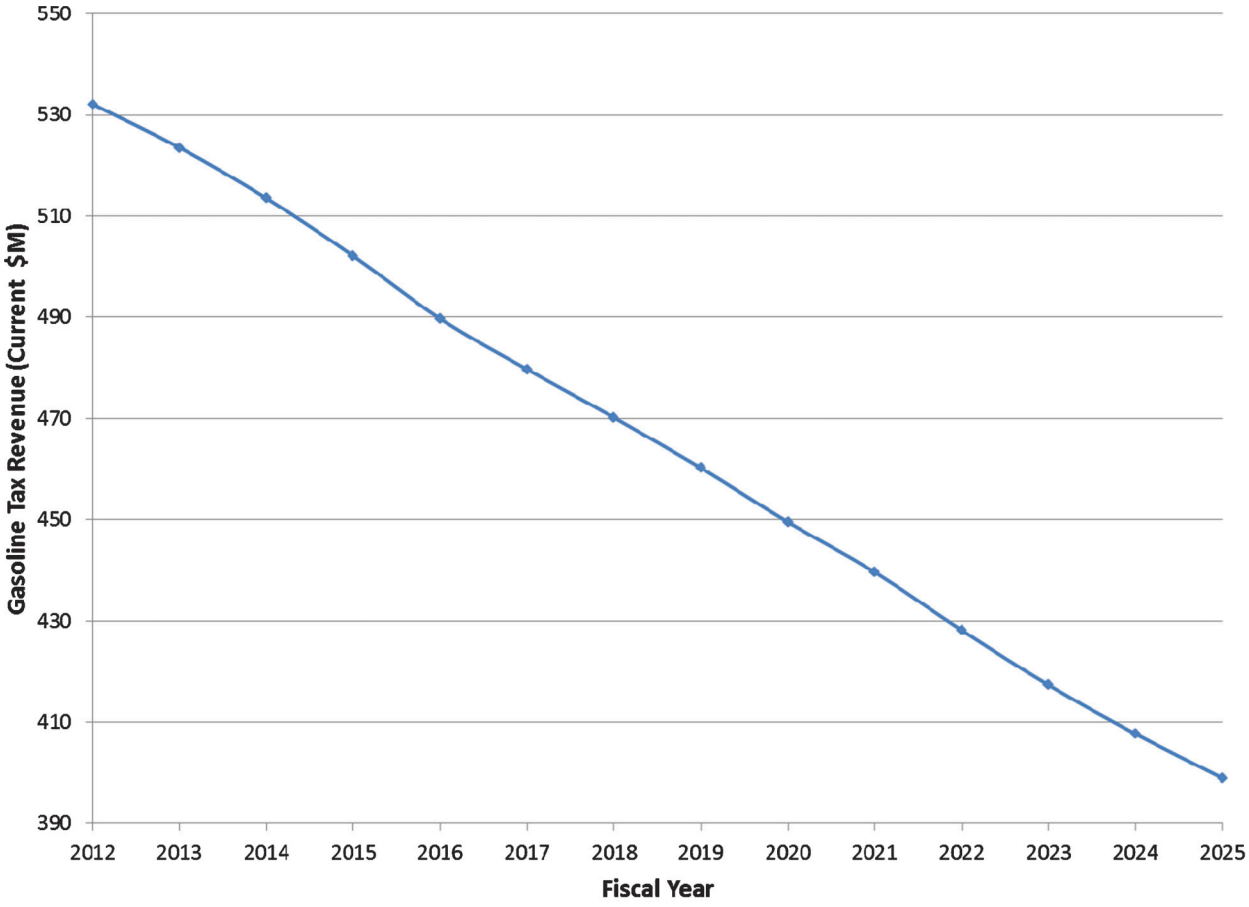

Figure 3.1 Predicted gasoline tax revenue (current $).

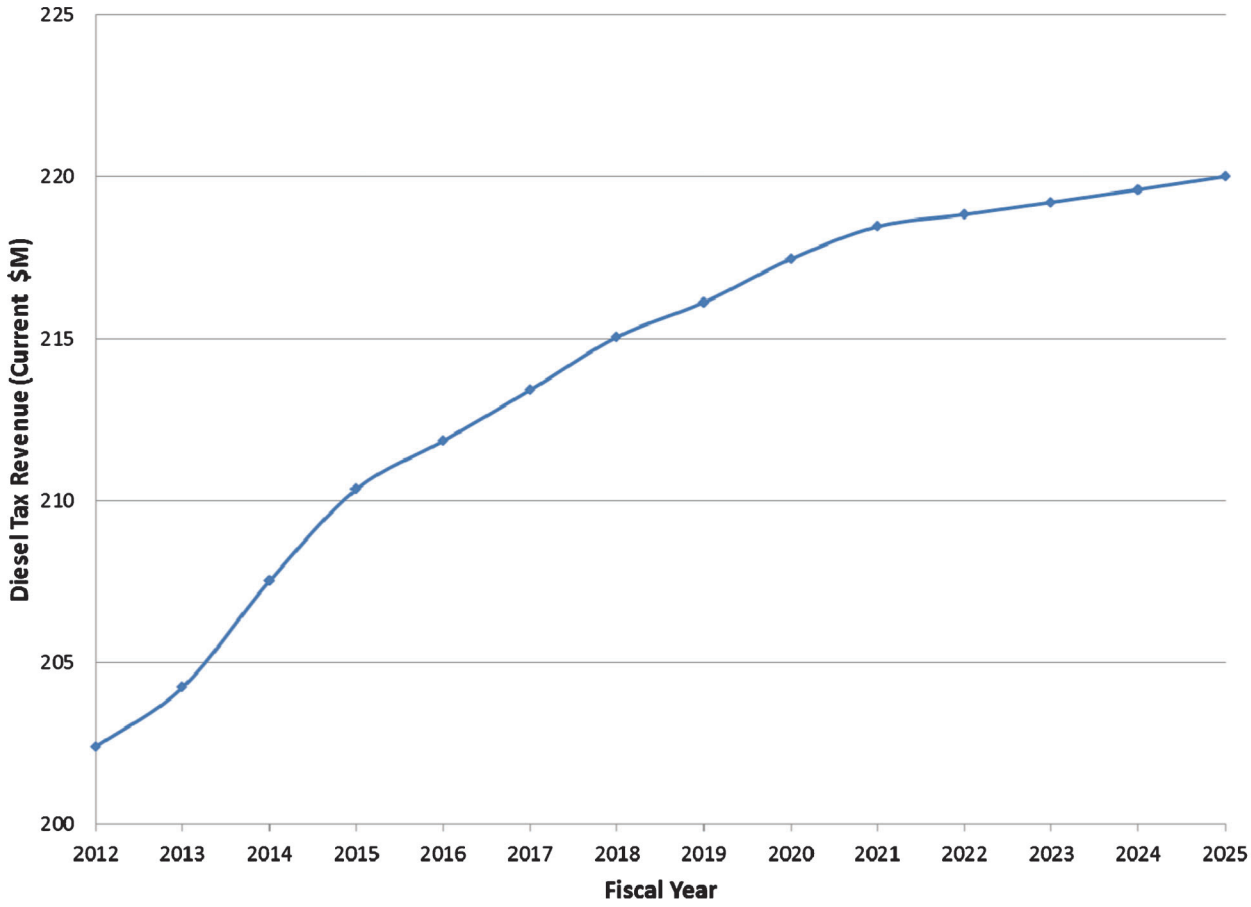

Figure 3.2 Predicted diesel tax revenue (current $).

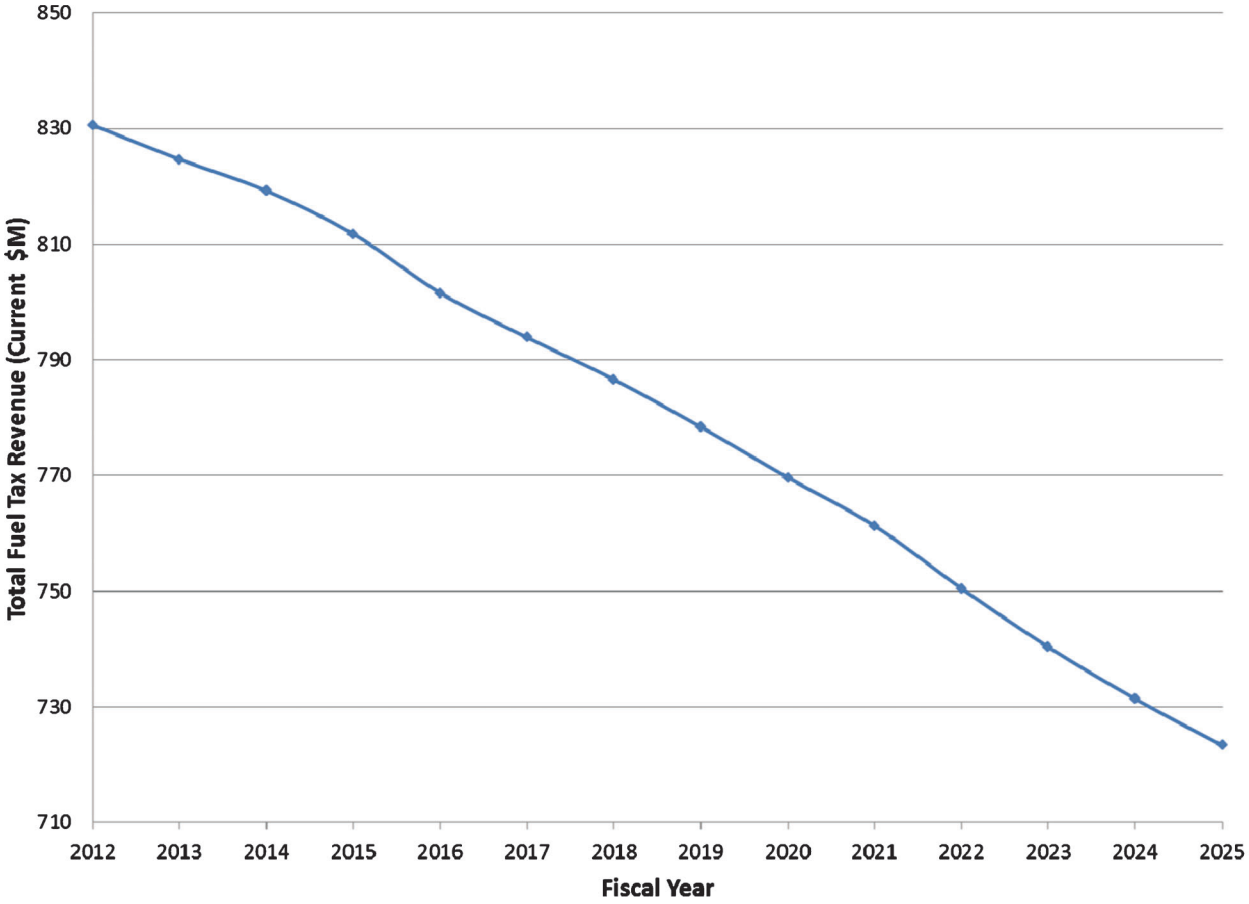

Figure 3.3 Predicted total fuel tax revenue (current $).

4. REGISTRATION AND "OTHER" REVENUES

Registration models were grouped into passenger car, motorcycles, trucks, tractors, trailers (including semi-trailers) and miscellaneous (buses, special machinery, watercraft, driving licenses, title registrations miscellaneous items, recovery and recreational vehicles) as shown in Table 4.1 and the predicted registration revenue is presented in Table 4.2 and Figure 4.1. The other revenues (international registration plan (IRP) and permit fee) models are shown in Table 4.3 with the predicted other revenues presented in Table 4.4 and Figure 4.2. The historical registration and other revenue data came from Indiana Department of Transportation. Predicted percent of 2012 base year registration and other revenues are provided in the Appendix. The predicted total revenue by revenue type is presented in Table 4.5 and Figure 4.3.

TABLE 4.1
Equations to Estimate Registration and Other Related Items

Equation	Variable	t-Statistic	R^2
PCReg = 1181253 + 73.2 (PCI)	Intercept	1.92	0.60
	PCI	4.04	
TruckReg = 1297326 + 3.94(GDP)	Intercept	0.77	0.62
	NGDP	4.75	
TractorReg = 9505 + 0.178 (GDP)	Intercept	2.32	0.70
	NGDP	3.08	
TrailerReg = 405808 + 9.57 (GDP)	Intercept	0.44	0.84
	GDP	6.51	
MCReg = −232220 + 0.0777(DAP)	Intercept	−9.05	0.95
	DAP	14.46	
MiscRegRev = −521869 + 75.9(GSP)	Intercept	−1.79	0.90
	DAP	14.36	

NOTE:
PCReg: Number of passenger vehicles registered.
TruckReg: Number of trucks by weight registered in Indiana. The weight ranges from 7,000 lbs to 66,000 lbs and over.
TractorReg: Number of tractors by weight (both farm and non-farm) registered in Indiana.
The weight ranges from 20,000 lbs to 78,000 lbs and over.
TrailerReg: Number of semi-trailers and trailers registered in Indiana.
MCReg: Number of motorcycles registered in Indiana.
MiscRegRev: Registration revenues from bus, titles, driving licenses, number of recovery and recreational vehicles, special machinery, watercrafts and other miscellaneous items registered in Indiana.
PCI: Per capita income in Indiana in 2004 dollars.
GDP: Gross domestic product of the USA (in billions) in 2004 dollars.
DAP: Driving age population in Indiana (population in the age group ≥ 16).

TABLE 4.2
Predicted Registration Revenues

Year	Revenue (Current $)
2012	120,911,341
2013	121,507,740
2014	122,110,530
2015	122,719,873
2016	123,335,937
2017	123,958,893
2018	124,588,916
2019	125,226,188
2020	125,870,892
2021	126,523,218
2022	127,183,362
2023	127,851,521
2024	128,527,901
2025	129,212,710

TABLE 4.3
Equations to Estimate "Other" Revenues

Equation	Variable	t-Statistic	R^2
IRP = 65550702 + 1671.6 (GDP)	Intercept	2.11	0.79
	GDP	6.08	
PR= 40939 + 1118.322 (GDP)	Intercept	0.05	0.61
	GDP	3.32	

NOTE:
w: Prediction year.
GDP: Gross domestic product of the USA (in billions) in 2004 dollars.
IRP: International Registration Plan revenue in 2004 dollars.
PR: Permits revenue in 2004 dollars.

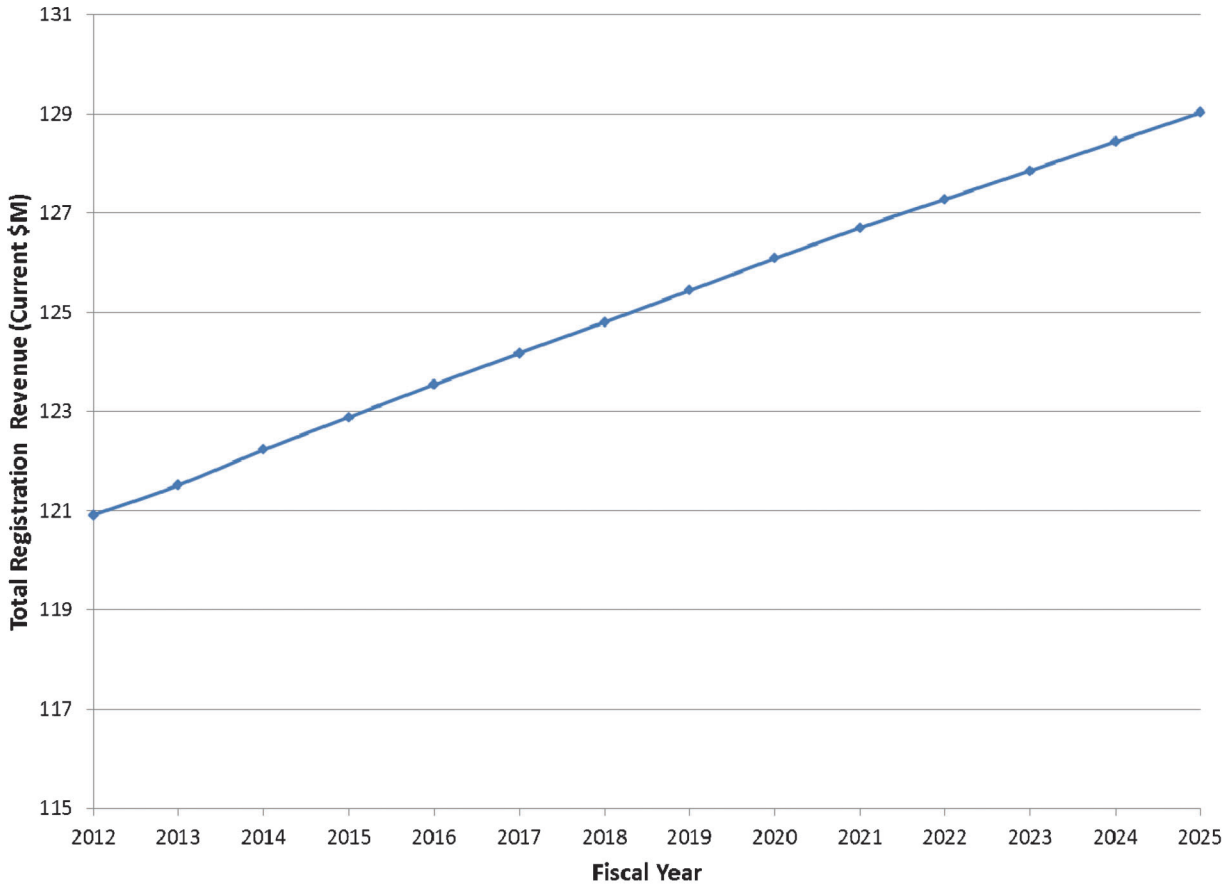

Figure 4.1 Predicted total registration revenue (current $).

TABLE 4.4
Predicted "Other" Revenues

Year	Revenue (Current $)		
	IRP	PR	Total
2012	90,900,090	17,000,007	107,900,096
2013	91,567,091	17,446,239	109,013,330
2014	92,513,872	18,079,648	110,593,521
2015	93,325,069	18,622,350	111,947,419
2016	94,124,366	19,157,089	113,281,455
2017	94,863,751	19,651,748	114,515,499
2018	95,580,204	20,131,064	115,711,267
2019	96,333,837	20,635,254	116,969,091
2020	97,101,589	21,148,890	118,250,479
2021	97,818,355	21,628,416	119,446,771
2022	98,405,284	22,021,079	120,426,364
2023	99,002,909	22,420,898	121,423,807
2024	99,611,405	22,827,989	122,439,394
2025	100,230,969	23,242,486	123,473,455

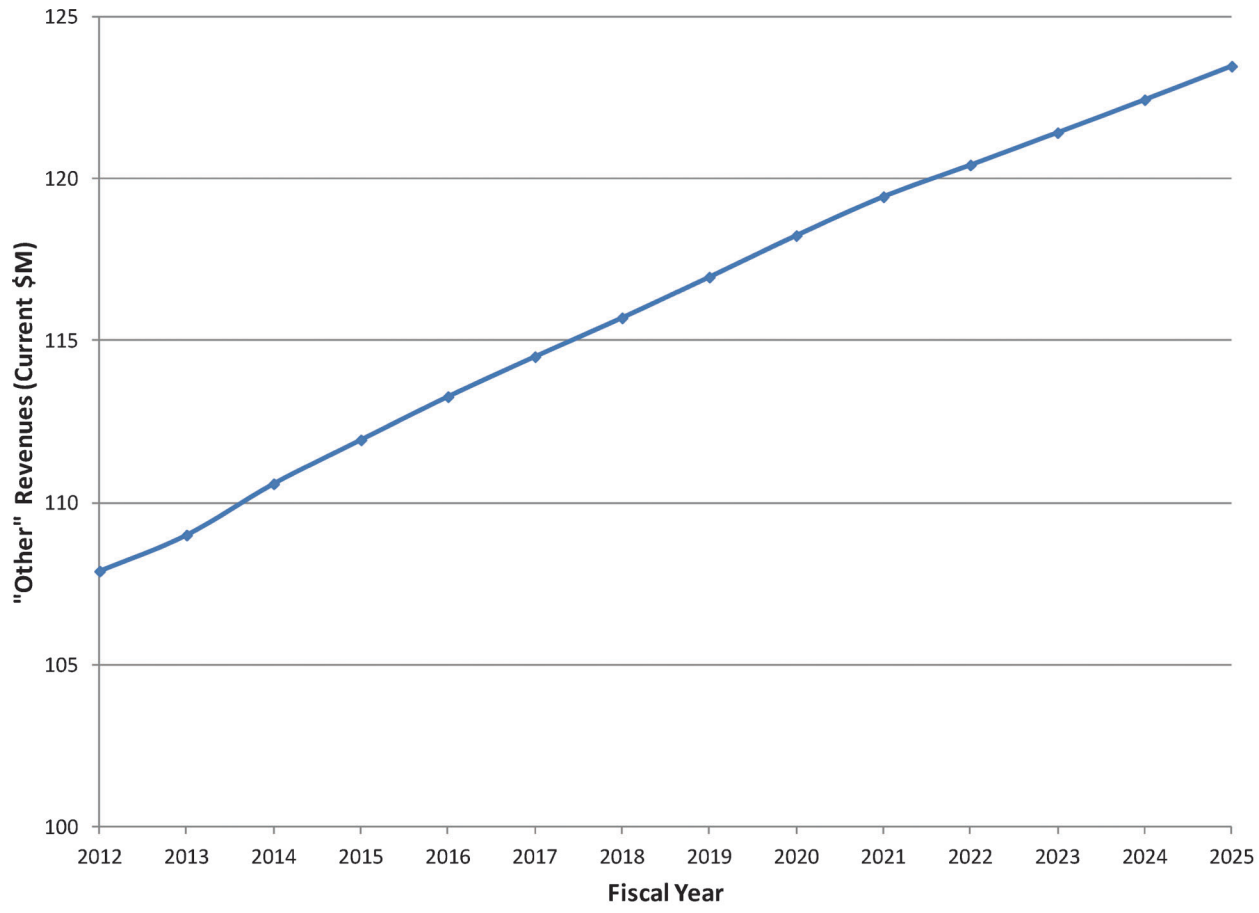

Figure 4.2 Prediction of "other" revenues (current $).

TABLE 4.5
Predicted Total Revenues by Type

	Revenue (Current $ × 10^6)			
Year	**Fuel Tax**	**Registration**	**"Other"**	**Total**
2012	830.59	120.91	107.90	1,059.41
2013	824.65	121.52	109.01	1,055.18
2014	819.21	122.23	110.59	1,052.03
2015	811.76	122.89	111.95	1,046.60
2016	801.57	123.54	113.28	1,038.39
2017	793.88	124.18	114.52	1,032.57
2018	786.61	124.80	115.71	1,027.12
2019	778.40	125.44	116.97	1,020.80
2020	769.66	126.08	118.25	1,014.00
2021	761.31	126.71	119.45	1,007.46
2022	750.49	127.28	120.43	998.20
2023	740.35	127.86	121.42	989.63
2024	731.40	128.44	122.44	982.28
2025	723.37	129.02	123.47	975.87

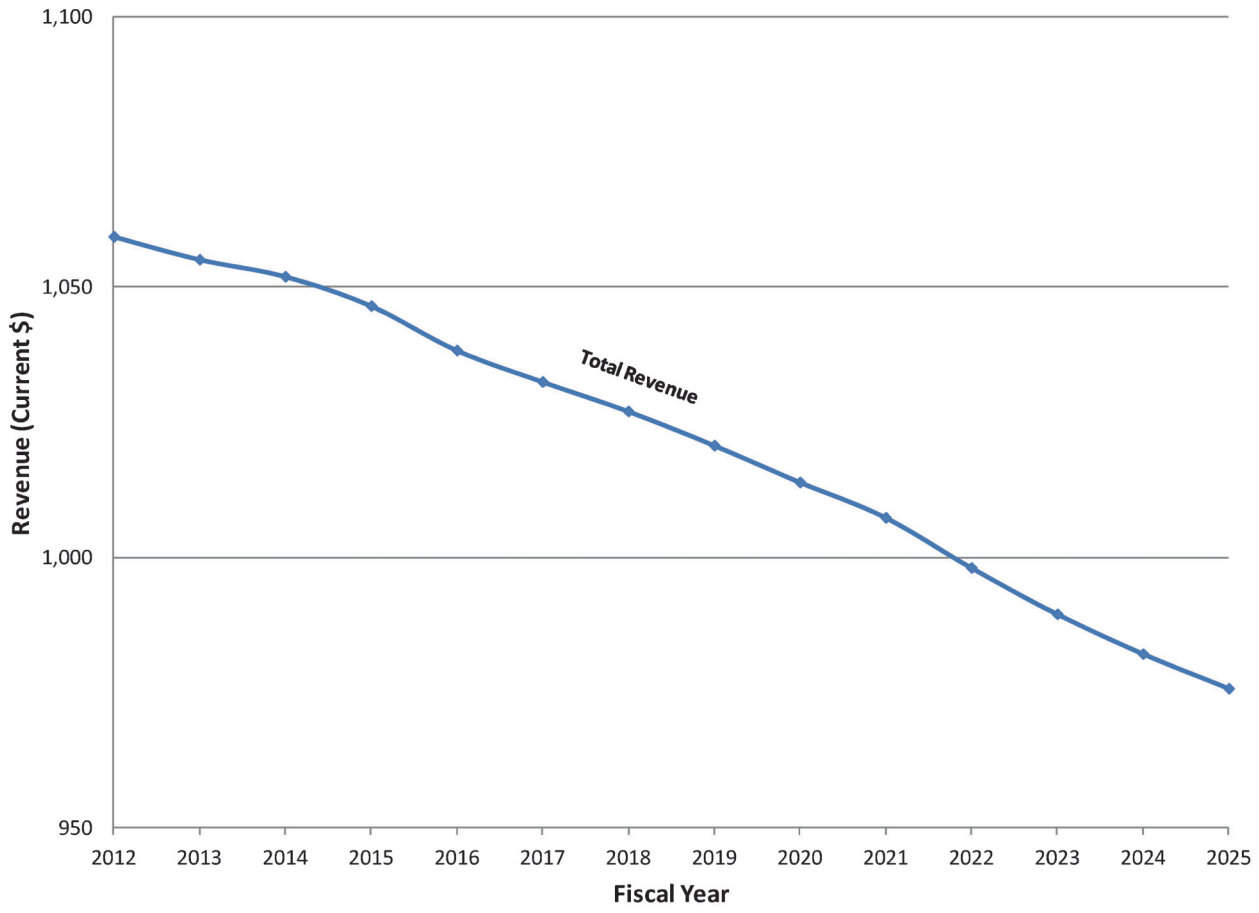

Figure 4.3 Prediction of total revenue (current $).

5. PROJECTIONS UNDER POSSIBLE OPTIONS FOR CHANGES IN FUEL TAX RATES

The possible options for changes in fuel tax rates considered in the present study include: ad valorem tax on motor fuel, inflation indexing and 1- or 3-cent increase in fuel tax rate in 2013. The ad valorem tax on motor fuel was considered using the current fuel tax rates. In order to determine ad valorem taxes, three steps were followed:

Establish the current price per gallon of gasoline and diesel fuel.

Determine the "pre-tax" current price per gallon of gasoline by subtracting sales tax and all current per-gallon taxes (federal and state fuel taxes).

Calculate a new "Ad Valorem" tax rate that would be the percentage tax needed to provide the same per-gallon tax revenue as the current fixed state per-gallon taxes (currently 18 cents per gallon on gasoline, 16 cents per gallon on diesel, etc.).

Using this process, for gasoline, the ad valorem was computed by dividing current gasoline tax rate of 18 cents per gallon by the average annual "pre-tax" gasoline price in the year 2012. The computed percentage was 5.96% and it was approximated to be 6% ad valorem tax. For diesel, the ad valorem was computed by dividing the current diesel tax rate of 16 cents per gallon by the average annual "pre-tax" diesel price in year 2012. The computed percentage was 4.98% and it was approximated to be 5% ad valorem. The ad valorem tax for diesel and motor carrier fuel use tax were same because, both have the same current tax rates. For motor carrier surcharge tax, the ad valorem was computed to be 3.4%. In order to estimate fuel revenue, annual retail gasoline and diesel prices were considered to increase annually by 3%. Therefore, gasoline would have an ad valorem value of 18 cents per gallon in 2012 and 26.4 cents per gallon in 2025. For diesel, it would be 16 cents per gallon in 2012 and 23.5 cents per gallon in 2025 and this is same for motor carrier fuel use. For motor carrier surcharge, it would be 11 cents per gallon in 2012 and 16.1 cents in 2025. In order to implement this tax structure a ceiling and a floor for equivalent per gallon rate must be considered.

The next possible option is inflation indexing as a way to keep the real value of the expected revenue from eroding due to inflation. The consumer price index was used for adjusting gasoline tax rate and producer price index was used for diesel tax rate. The third possible option can be a 1-cent or 3-cent increase in the fuel tax rate in 2013. These are all possible options to consider in the near term. The estimated revenues from the four modifications to fuel tax revenue are presented in Tables 5.1 to 5.4. The percentage changes in fuel tax revenue if any of the four fuel tax rate modifications are adopted are shown in Table 5.5. From the results, it can observed that adopting a 1-cent or 3-cent increase in gasoline and diesel tax rates would provide a 6 to 16 percent additional total fuel tax revenue in both years

TABLE 5.1
Predicted Revenues from Inflation Indexing of Fuel Tax Rates

	Revenue (Current $ x 10^6)			
Year	Gasoline Tax	Diesel Tax	MCST + MCFUT	Total
2012	532.14	202.41	96.05	830.59
2013	536.56	209.32	99.29	845.17
2014	539.08	217.85	103.06	859.99
2015	539.58	226.06	106.73	872.37
2016	538.45	232.94	109.98	881.37
2017	539.41	239.97	113.29	892.67
2018	540.37	247.17	116.54	904.07
2019	540.40	253.78	119.83	914.01
2020	539.01	260.76	123.14	922.91
2021	538.10	267.40	126.34	931.84
2022	534.67	273.30	129.31	937.27
2023	531.52	279.22	132.29	943.04
2024	529.38	285.19	135.28	949.84
2025	527.94	291.20	138.28	957.42

TABLE 5.2
Predicted Revenues from Ad Valorem Tax of Fuel Prices

	Revenue (Current $ x 10^6)			
Year	Gasoline Tax	Diesel Tax	MCST + MCFUT	Total
2012	532.14	202.41	96.05	830.59
2013	539.24	210.37	99.78	849.39
2014	544.80	220.16	104.15	869.10
2015	548.65	229.86	108.52	887.04
2016	551.16	238.44	112.57	902.17
2017	556.12	247.41	116.80	920.32
2018	561.39	256.78	121.07	939.25
2019	566.01	265.81	125.51	957.33
2020	569.43	275.47	130.09	974.99
2021	573.61	285.05	134.68	993.34
2022	575.35	294.09	139.15	1,008.60
2023	577.62	303.44	143.76	1,024.82
2024	581.19	313.10	148.52	1,042.81
2025	585.77	323.09	153.43	1,062.30

TABLE 5.3
Predicted Revenues from 1-Cent Increase in Fuel Tax Rates in 2013

	Revenue (Current $ x 10^6)			
Year	Gasoline Tax	Diesel Tax	MCST + MCFUT	Total
2012	532.14	202.41	96.05	830.59
2013	552.62	217.01	105.67	875.29
2014	542.05	220.49	107.08	869.62
2015	529.99	223.50	108.33	861.82
2016	516.91	225.09	109.10	851.09
2017	506.36	226.75	109.89	843.01
2018	496.28	228.49	110.59	835.37
2019	485.79	229.63	111.31	826.73
2020	474.48	231.05	112.01	817.55
2021	464.05	232.12	112.59	808.76
2022	451.90	232.51	112.93	797.35
2023	440.47	232.91	113.28	786.66
2024	430.28	233.33	113.62	777.23
2025	421.04	233.76	113.96	768.76

TABLE 5.4
Predicted Revenues from 3-Cent Increase in Fuel Tax Rates in 2013

	Revenue (Current $ x 10^6)			
Year	**Gasoline Tax**	**Diesel Tax**	**MCST + MCFUT**	**Total**
2012	532.14	202.41	96.05	830.59
2013	610.79	242.54	105.74	959.06
2014	599.11	246.43	107.15	952.69
2015	585.78	249.80	108.40	943.97
2016	571.32	251.57	109.17	932.06
2017	559.67	253.43	109.97	923.06
2018	548.52	255.37	110.67	914.56
2019	536.92	256.65	111.39	904.96
2020	524.43	258.23	112.09	894.75
2021	512.90	259.43	112.67	884.99
2022	499.47	259.86	113.01	872.35
2023	486.83	260.31	113.36	860.50
2024	475.57	260.78	113.70	850.05
2025	465.36	261.26	114.04	840.67

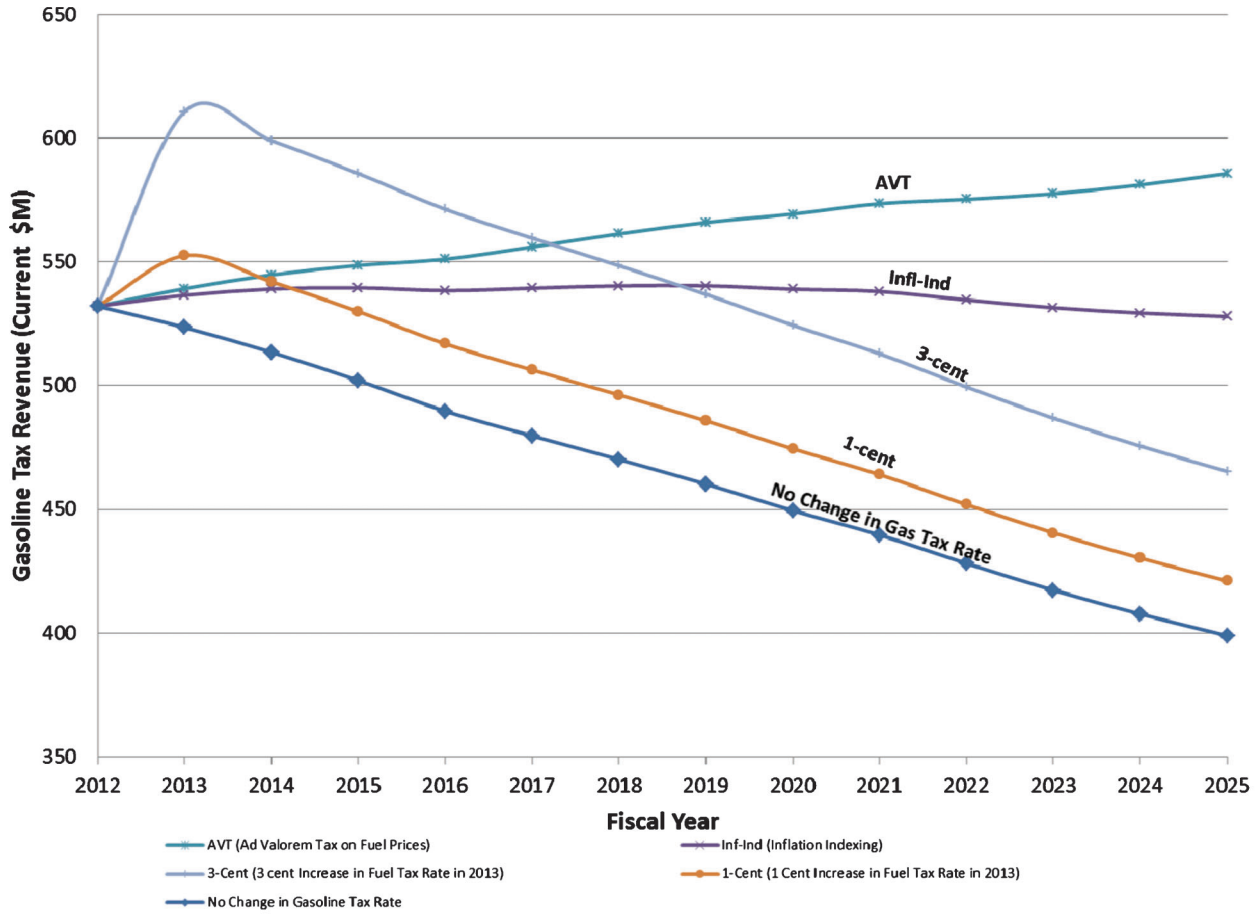

Figure 5.1 Comparisons of possible options for changes in gasoline tax rate revenue scenarios.

TABLE 5.5
Changes in Total Fuel Tax Revenue (in Current $) Under Fuel Tax Rate Modifications

	Percentage (%)			
Year	**1-Cent**	**3-Cent**	**Inflation Indexing**	**Ad Valorem Tax**
2013	6.2	16.3	24.9	40.0
2025	6.3	16.2	62.2	99.9

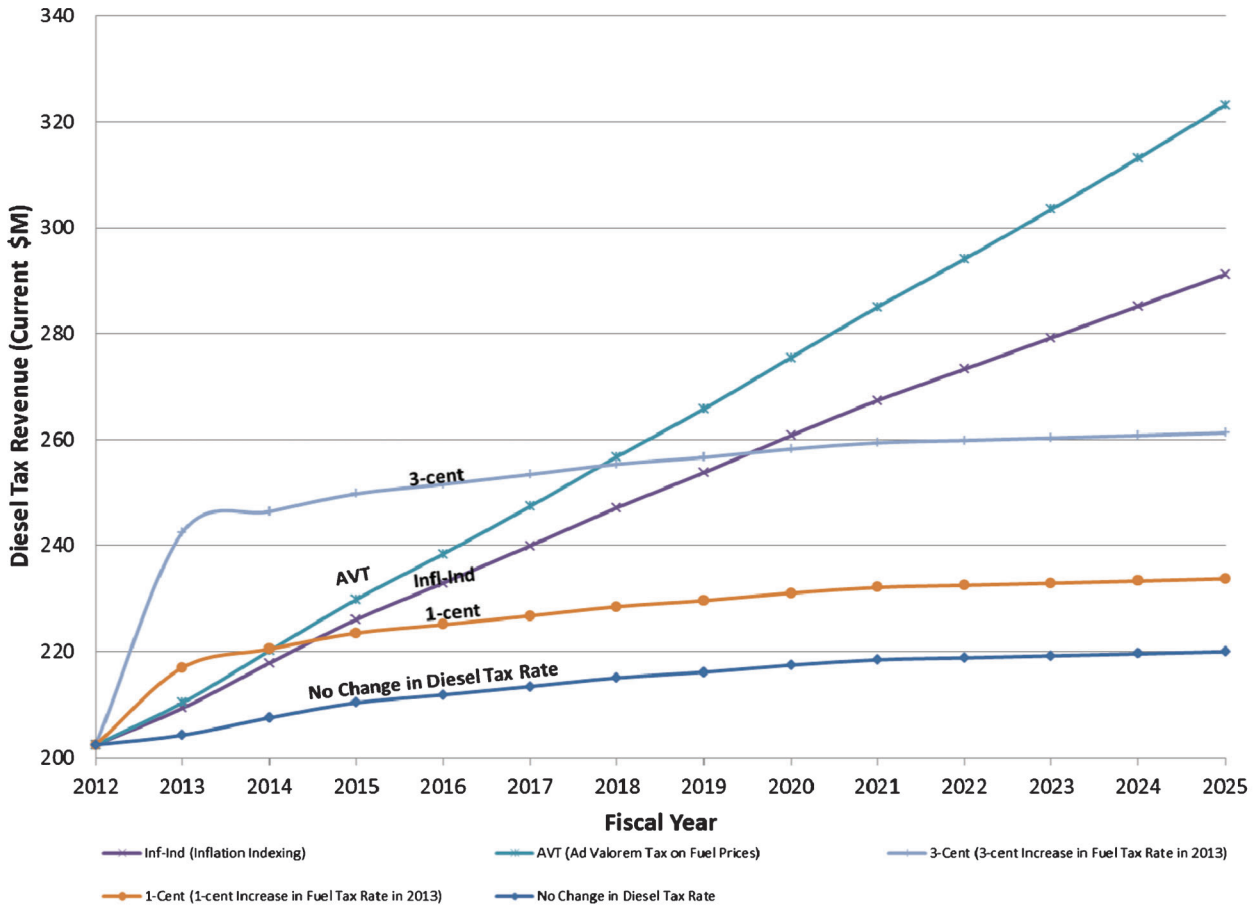

Figure 5.2 Comparisons of possible options for changes in diesel tax rate revenue scenarios.

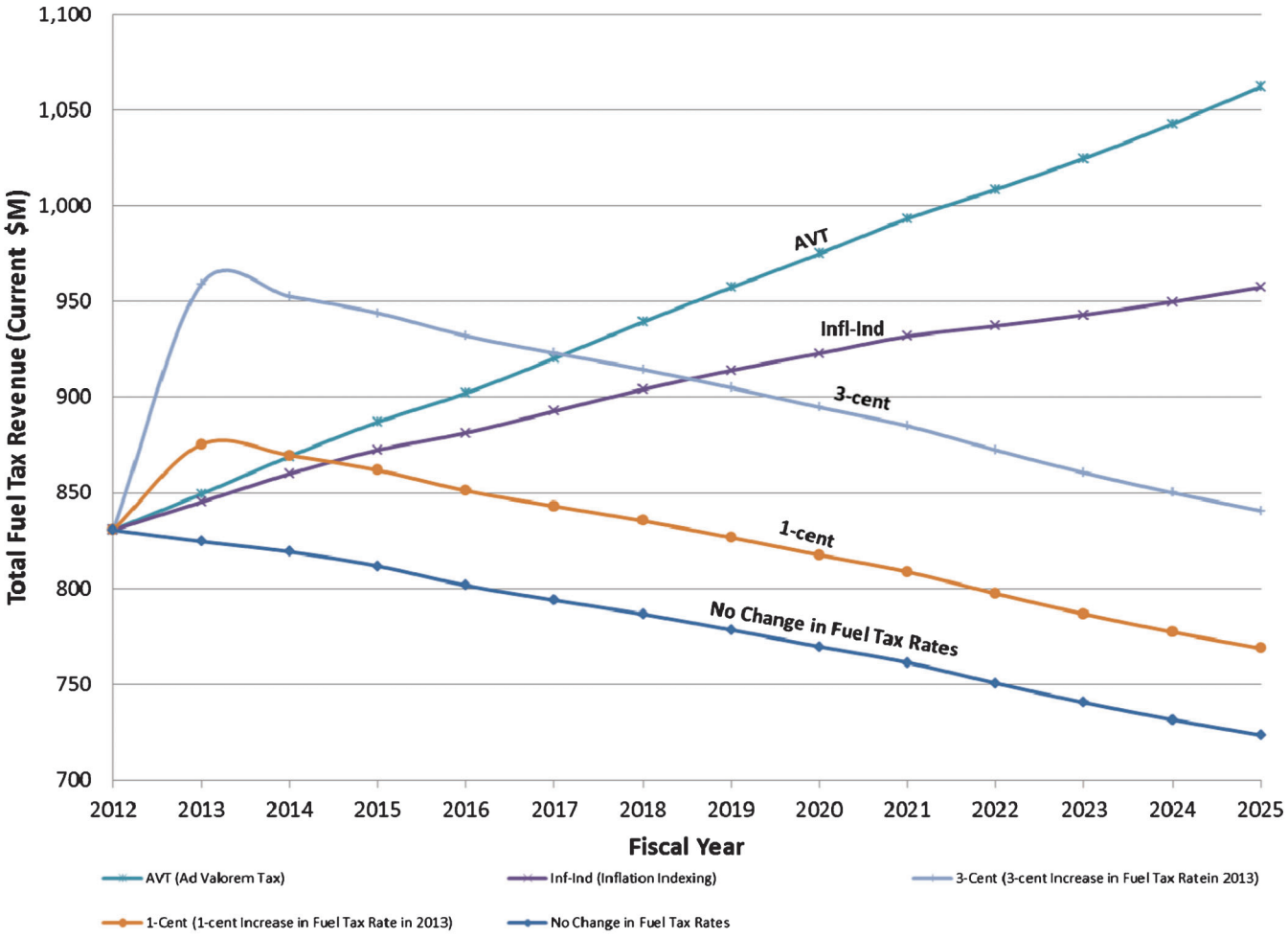

Figure 5.3 Comparisons of possible options for changes in total fuel tax rates revenue scenarios.

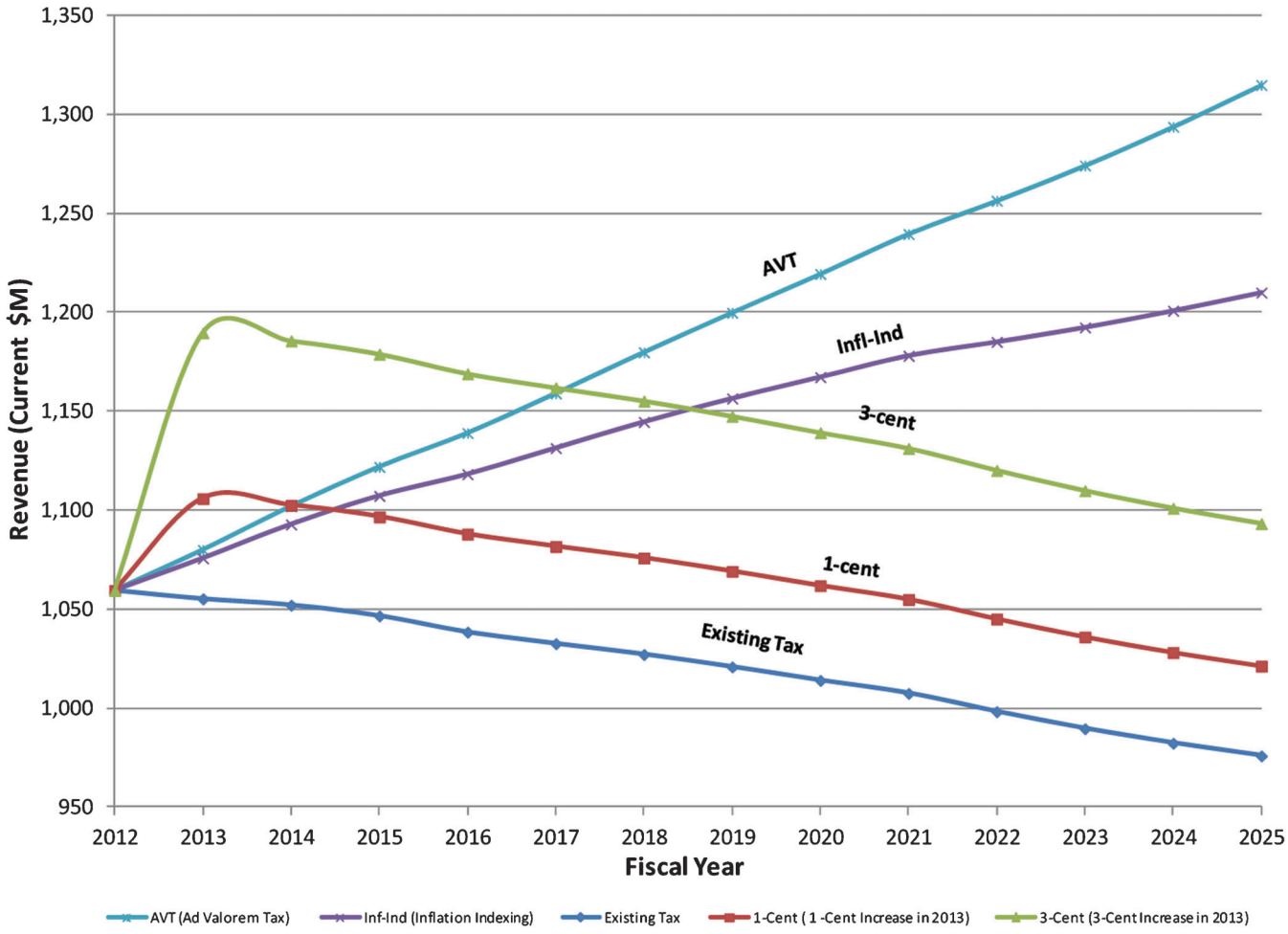

Figure 5.4 Comparisons of total revenue and possible options for changes in total fuel tax rates revenue scenarios.

2013 and 2025 while an ad valorem tax or inflation indexing of current fuel tax rates could provide substantial revenue during the period. A comparison of total revenues and total revenues from possible options for changes in fuel tax rates are presented in Figure 5.4. The relatively high sensitivity of revenues with regard to fleet fuel efficiencies underscores the need to carefully consider new funding mechanisms in light of expecting increases in fleet efficiencies from CAFE standards and other economic forces.

6. CONCLUSIONS

The present study predicted fuel tax revenues from 2012 to 2025 under the existing fuel tax rate structure and also assessed possible options for changes in fuel tax rates. Four possible options were reviewed: an increase of 1 cent or 3 cents in the current gasoline and diesel tax rates, an ad valorem tax and inflation indexing of the current fuel tax rate.

Fuel tax revenue from existing rate structure indicated a continuous annual decrease from 2012 to 2025 by 2.96% to 3.49% in real terms. Adopting one of the four fuel tax rate modifications would provide additional short-term revenue for a variable number of years. A 1-cent increase would offset the decline in the total fuel tax revenue only for a year after which it will continually decline every year. A 3-cent increase would provide a substantial increase in revenue in the short term but will continually decline, however, the 2025 revenue from 3-cent increase would be a little higher than the 2012 revenue level. Both inflation indexing and an ad valorem tax would also provide substantial increase in fuel tax revenue.

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APPENDIX

TABLE A.1
Automobile Fleet Fuel Efficiency for Year 2015

Age Cohort (i^{th})	Age Cohort VMT %	VMT_k (millions)	VMT_{ik} (millions)	FE_{ik} (mpg)	VMT_{ik}/FE_{ik}	FFE_k (mpg)
Under 1	7.30	48,489.04	3,538.75	30.16	117.34	23.9
1	9.69	48,489.04	4,698.03	29.02	161.87	23.9
2	9.20	48,489.04	4,461.20	27.93	159.72	23.9
3	8.47	48,489.04	4,108.36	26.88	152.84	23.9
4	7.63	48,489.04	3,697.52	24.32	152.04	23.9
5	7.17	48,489.04	3,475.19	22.00	157.96	23.9
6	6.57	48,489.04	3,185.19	22.00	144.78	23.9
7	6.15	48,489.04	2,982.19	22.00	135.55	23.9
8	5.92	48,489.04	2,871.02	22.00	130.50	23.9
9	5.32	48,489.04	2,581.02	22.00	117.32	23.9
10 and older	26.58	48,489.04	12,890.58	21.50	599.56	23.9

TABLE A.2
Automobile Fleet Fuel Efficiency for Year 2020

Age Cohort (i^{th})	Age Cohort VMT %	VMT_k (millions)	VMT_{ik} (millions)	FE_{ik} (mpg)	VMT_{ik}/FE_{ik}	FFE_k (mpg)
Under 1	6.67	49,433.34	3,299.65	36.53	90.32	27.9
1	9.75	49,433.34	4,821.71	35.16	137.14	27.9
2	9.26	49,433.34	4,578.64	33.84	135.32	27.9
3	8.53	49,433.34	4,216.52	32.56	129.49	27.9
4	7.68	49,433.34	3,794.87	31.34	121.10	27.9
5	7.22	49,433.34	3,566.68	30.16	118.27	27.9
6	6.61	49,433.34	3,269.04	29.02	112.64	27.9
7	6.19	49,433.34	3,060.70	27.93	109.58	27.9
8	5.96	49,433.34	2,946.60	26.88	109.62	27.9
9	5.36	49,433.34	2,648.97	24.32	108.92	27.9
10 and older	26.76	49,433.34	13,229.95	22.00	601.36	27.9

TABLE A.3
Automobile Fleet Fuel Efficiency for Year 2025

Age Cohort (i^{th})	Age Cohort VMT %	VMT_k (millions)	VMT_{ik} (millions)	FE_{ik} (mpg)	VMT_{ik}/EFE_{ik}	FFE_k (mpg)
Under 1	7.38	50,377.64	3,715.95	44.26	83.96	32.7
1	9.68	50,377.64	4,876.90	42.59	114.51	32.7
2	9.19	50,377.64	4,631.05	40.99	112.98	32.7
3	8.47	50,377.64	4,264.78	39.45	108.12	32.7
4	7.62	50,377.64	3,838.30	37.96	101.11	32.7
5	7.16	50,377.64	3,607.50	36.53	98.75	32.7
6	6.56	50,377.64	3,306.46	35.16	94.04	32.7
7	6.15	50,377.64	3,095.73	33.84	91.49	32.7
8	5.92	50,377.64	2,980.33	32.56	91.53	32.7
9	5.32	50,377.64	2,679.28	31.34	85.50	32.7
10 and older	26.56	50,377.64	13,381.37	24.00	557.56	32.7

TABLE A.4
Light Duty Truck Fleet Fuel Efficiency for Year 2015

Age Cohort (i^{th})	Age Cohort VMT %	VMT_k (millions)	VMT_{ik} (millions)	FE_{ik} (mpg)	VMT_{ik}/EFE_{ik}	FFE_k (mpg)
Under 1	7.30	13,198.40	963.22	22.86	42.13	19.6
1	9.69	13,198.40	1,278.77	22.08	57.92	19.6
2	9.20	13,198.40	1,214.31	21.32	56.96	19.6
3	8.47	13,198.40	1,118.27	20.59	54.32	19.6
4	7.63	13,198.40	1,006.44	20.25	49.71	19.6
5	7.17	13,198.40	945.92	19.56	48.35	19.6
6	6.57	13,198.40	866.99	19.22	45.10	19.6
7	6.15	13,198.40	811.73	18.88	42.99	19.6
8	5.92	13,198.40	781.47	18.54	42.15	19.6
9	5.32	13,198.40	702.54	18.20	38.60	19.6
10 and older	26.58	13,198.40	3,508.73	18.09	194.01	19.6

TABLE A.5
Light Duty Truck Fleet Fuel Efficiency for Year 2020

Age Cohort (i^{th})	Age Cohort VMT %	VMT_k (millions)	VMT_{ik} (millions)	FE_{ik} (mpg)	VMT_{ik}/EFE_{ik}	FFE_k (mpg)
Under 1	6.67	14,328.90	956.45	27.24	35.12	22.4
1	9.75	14,328.90	1,397.64	26.30	53.14	22.4
2	9.26	14,328.90	1,327.18	25.39	52.26	22.4
3	8.53	14,328.90	1,222.21	24.52	49.84	22.4
4	7.68	14,328.90	1,099.99	23.68	46.45	22.4
5	7.22	14,328.90	1,033.85	22.86	45.22	22.4
6	6.61	14,328.90	947.57	22.08	42.92	22.4
7	6.19	14,328.90	887.18	21.32	41.61	22.4
8	5.96	14,328.90	854.11	20.59	41.49	22.4
9	5.36	14,328.90	767.84	20.25	37.93	22.4
10 and older	26.76	14,328.90	3,834.87	19.79	193.78	22.4

TABLE A.6
Light Duty Truck Fleet Fuel Efficiency for Year 2025

Age Cohort (i^{th})	Age Cohort VMT %	VMT_k (millions)	VMT_{ik} (millions)	FE_{ik} (mpg)	VMT_{ik}/EFE_{ik}	FFE_k (mpg)
Under 1	7.38	15,459.40	1,140.31	32.44	35.15	25.9
1	9.68	15,459.40	1,496.58	31.33	47.78	25.9
2	9.19	15,459.40	1,421.13	30.25	46.98	25.9
3	8.47	15,459.40	1,308.73	29.21	44.81	25.9
4	7.62	15,459.40	1,177.86	28.20	41.76	25.9
5	7.16	15,459.40	1,107.03	27.24	40.65	25.9
6	6.56	15,459.40	1,014.65	26.30	38.58	25.9
7	6.15	15,459.40	949.99	25.39	37.41	25.9
8	5.92	15,459.40	914.57	24.52	37.30	25.9
9	5.32	15,459.40	822.19	23.68	34.72	25.9
10 and older	26.56	15,459.40	4,106.34	21.50	191.04	25.9

TABLE A.7
Percent of 2012 Base Year Gasoline Tax Revenue

Year	Based on Revenue (in Current $)	Based on Revenue (in 2004 $)
2012	100.00	100.00
2013	98.38	95.99
2014	96.50	91.93
2015	94.35	87.80
2016	92.02	83.69
2017	90.15	80.17
2018	88.35	76.87
2019	86.48	73.65
2020	84.47	70.45
2021	82.61	67.50
2022	80.45	64.42
2023	78.42	61.56
2024	76.60	58.99
2025	74.96	56.63

NOTE: See Table 3.11 for values of gasoline tax revenues.

TABLE A.8
Percent of 2012 Base Year Diesel Tax Revenue

Year	Based on Revenue (in Current $)	Based on Revenue (in 2004 $)
2012	100.00	100.00
2013	100.91	98.46
2014	102.53	97.67
2015	103.93	96.71
2016	104.66	95.19
2017	105.44	93.77
2018	106.25	92.44
2019	106.78	90.94
2020	107.44	89.60
2021	107.93	88.18
2022	108.12	86.57
2023	108.30	85.03
2024	108.50	83.55
2025	108.70	82.13

NOTE: See Table 3.11 for values of diesel tax revenues.

TABLE A.9
Percent of 2012 Base Year Total Fuel Tax Revenue

Year	Based on Revenue (in Current $)	Based on Revenue (in 2004 $)
2012	100.00	100.00
2013	99.28	96.87
2014	98.63	93.95
2015	97.73	90.94
2016	96.51	87.77
2017	95.58	85.00
2018	94.70	82.40
2019	93.72	79.81
2020	92.66	77.28
2021	91.66	74.88
2022	90.36	72.35
2023	89.14	69.98
2024	88.06	67.81
2025	87.09	65.80

NOTE: See Table 3.11 for values of total fuel tax revenues.

TABLE A.10
Percent of 2012 Base Year Total Registration Revenue

Year	Based on Revenue (in Current $)	Based on Revenue (in 2004 $)
2012	100.00	100.00
2013	100.50	98.06
2014	101.09	96.30
2015	101.64	94.57
2016	102.18	92.93
2017	102.70	91.34
2018	103.22	89.81
2019	103.74	88.35
2020	104.28	86.96
2021	104.79	85.62
2022	105.27	84.29
2023	105.74	83.02
2024	106.23	81.80
2025	106.71	80.62

NOTE: See Table 4.2 for values of total registration revenues.

TABLE A.11
Percent of 2012 Base Year "Other" Revenues

Year	Based on Revenue (in Current $)	Based on Revenue (in 2004 $)
2012	100.00	100.00
2013	101.08	98.63
2014	102.62	97.76
2015	103.94	96.72
2016	105.24	95.71
2017	106.44	94.66
2018	107.60	93.62
2019	108.83	92.68
2020	110.07	91.80
2021	111.24	90.88
2022	112.19	89.83
2023	113.16	88.84
2024	114.15	87.90
2025	115.16	87.01

NOTE: See Table 4.4 for values of "other" revenues.

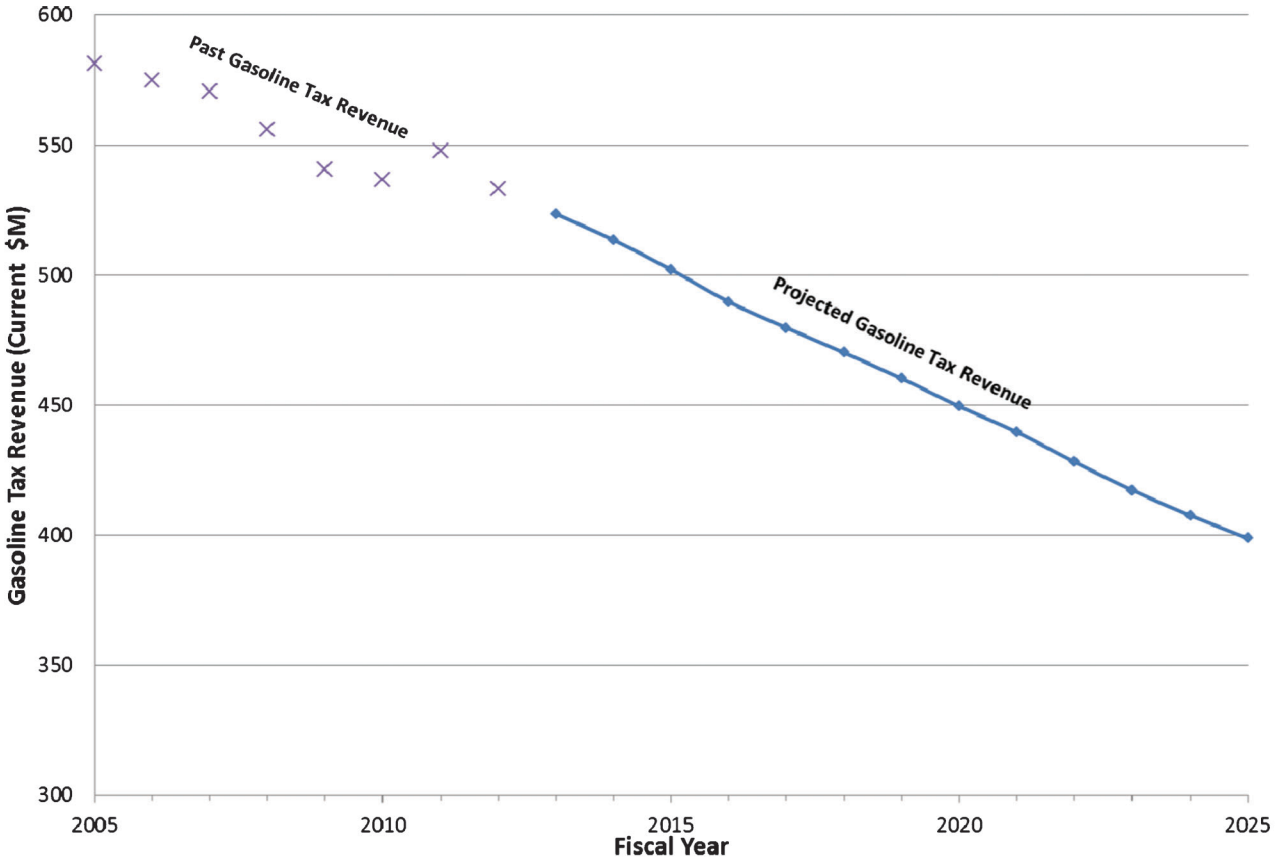

Figure A.1 Comparisons of historical and projected gasoline tax revenue.

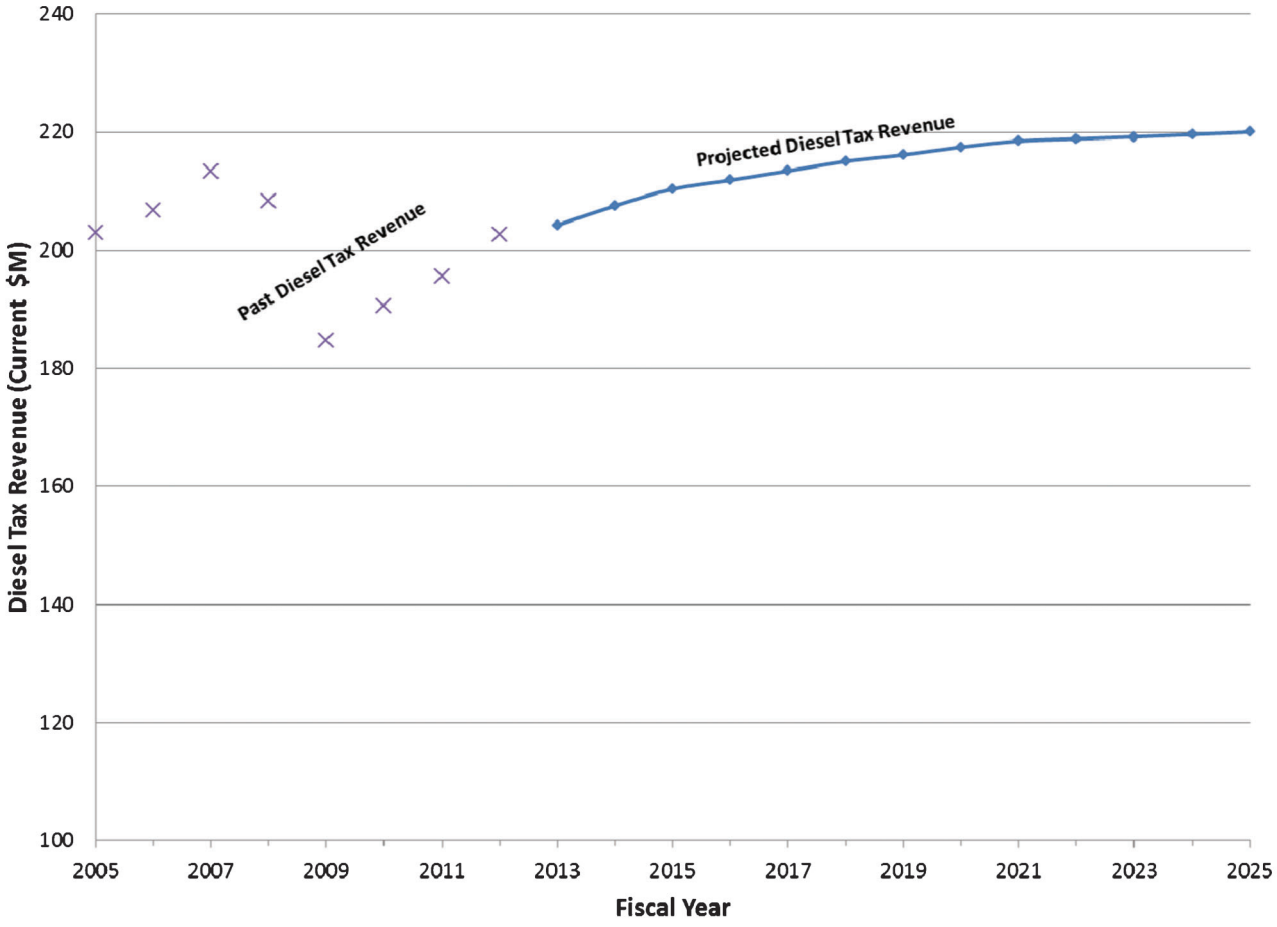

Figure A.2 Comparisons of historical and projected diesel tax revenue.

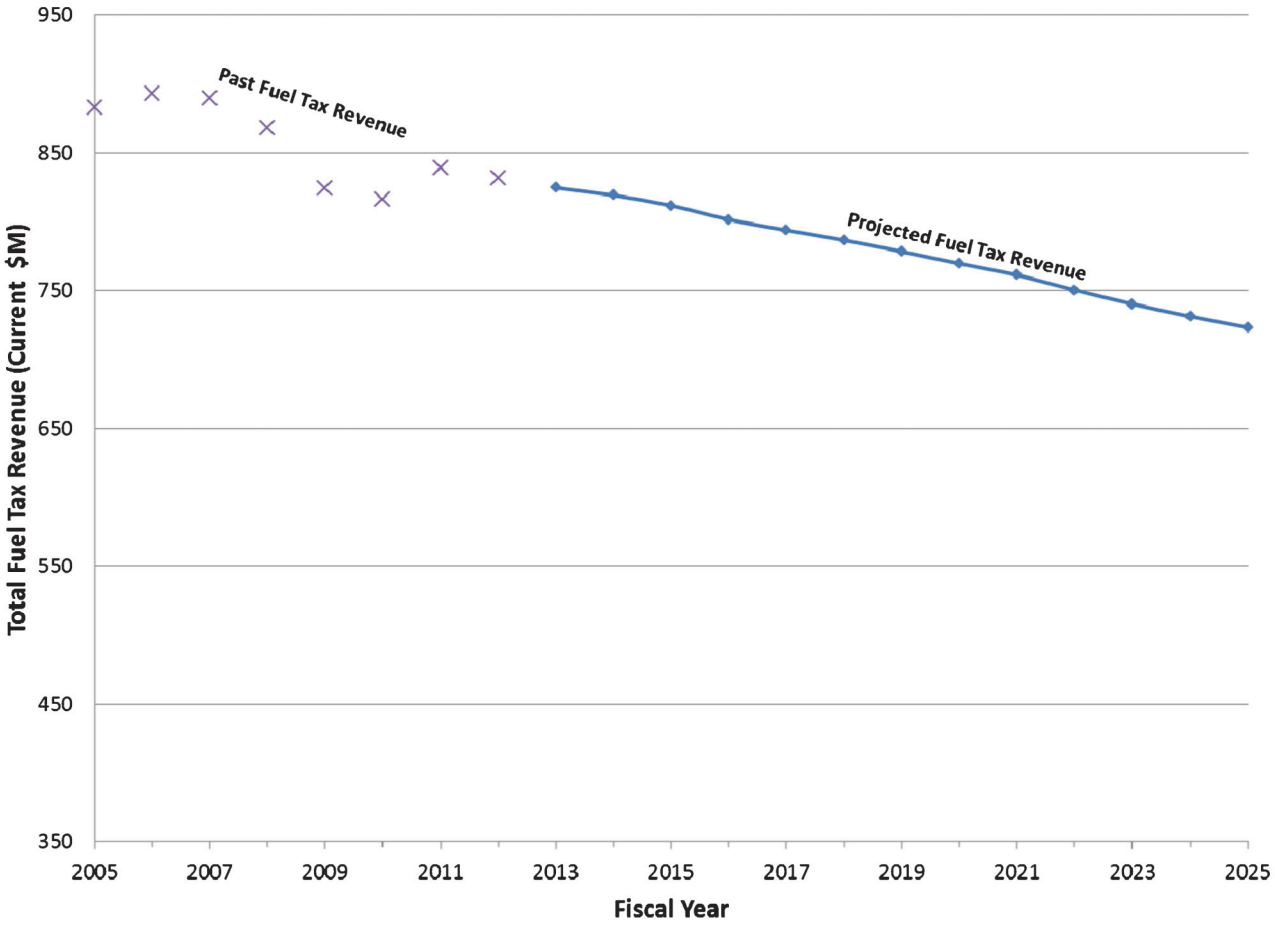

Figure A.3 Comparisons of historical and projected total fuel tax revenue.