TITLE Regional Economic Impacts of a Toll Road in West Virginia: A *REMI* Model Approach

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ABSTRACT

Tolling has been emphasized as an alternative financing option for transportation projects in the United States. Toll roads offer many advantages in terms of the promise of repayment and user fairness. However, there is little information on regional economic effects of a toll road using various toll rate scenarios. This paper explores the economic impacts of a toll road with different toll rate scenarios by using REMI model. Using a potential toll plaza in West Virginia, the paper forecasts annual toll transactions and revenue estimations for the 2009-2030 period and measures positive and negative economic impacts of toll revenues on state employment, income, and gross state product. The results show that the positive effects of increased government spending on highway infrastructure are greater than the negative effects of increased personal consumption and industry costs on transportation. Positive net economic impacts are found for all toll rate scenarios. The direct, indirect, and induced effects of government spending on a new toll road may lead to greater multiplier effects in West Virginia.

INTRODUCTION

Roadways have been financed a number of different ways in the United States. The original Interstate Highway System was largely financed using the Highway Trust Fund. The Highway Trust Fund receives its funding from several taxes, but gasoline taxes are the largest contributor. Since the 1970s, the Highway Trust Fund has not been able to sufficiently cover the costs of the Interstate Highway System. Alternatively, state roads are often financed through gasoline taxes and vehicle registrations. With higher government standards and market forces that have increased average fuel economy, gasoline taxes no longer provide the necessary funds.[1] Many states have begun turning to tolling as an alternative. Toll roads offer many benefits: toll roads can be built using loans and the sale of bonds with the promise of repayment from future toll. Additionally, a toll is superior to a gas tax in terms of fairness. Toll users pay for tolls in proportion to their use. Toll roads can also charge varying rates by vehicle type to compensate for the different costs incurred by various-types and sizes of vehicles. Innovative tolling techniques allow toll roads to mitigate congestion through time-of-day pricing. This allows toll roads to offer faster travel times even at peak hours, as long as the traveler is willing to pay the toll. No other financing option at this time carries these benefits.

Although tolling has promise to improve mobility, finance transportation investment, and provide fairness to drivers, there are challenges to receiving public support to implement tolling. The public and political leaders are likely to be opposed to a toll project. According to a GAO study (2006), the negative public and political opinions are based largely on arguments that 1) tolling is a form of double taxation; 2) tolls often do not cover the costs of a project; and 3) applying tolls can produce regional, income, and other inequities. Such challenges increase the need for comprehensive feasibility studies to justify new toll projects to the public. A feasibility study should seek to estimate toll revenue for the new road using various toll rates and evaluate the impact of placing a toll on a new or existing road in the region. Such a study would allow policymakers to provide information regarding the potential regional economic impacts of tolling to the public and political leaders where tolling is being considered and applied.

Previous literature deals with various socio-economic impacts of toll roads. DeCorla-Souza and Kane (1992) discuss regional economic benefits associated with toll roads, examining delay costs and trends affecting congestion pricing on toll roads. They conclude that peak period pricing shortens travel times, increases production efficiency, and creates new jobs. Boarnet and Chalermpong (2001) examine the impact of toll roads on housing prices. Hedonic models and multiple sales techniques measure homebuyers' willingness to pay for improved access. They show that toll roads have a positive impact on housing prices, and such willingness to pay affects traffic development patterns. Parasibu (2005) examines regional development in Jabotabek, Indonesia. He finds that areas surrounding toll roads experience more noticeable expansion and development in industrial, environmental, and residential sectors. He also finds that toll roads increase regional private investment and socio-economic growth. Seitz (1993) uses a generalized cost function and duality theory to estimate the impact of public roads on productivity. Seitz examines panel data for 31 German industries to estimate the cost savings. He finds that public roads increase productivity in the 31 manufacturing industries, but the magnitude of the impact varies among industries. Kalmanje and Kockelman (2005) use traffic demand models to measure the impact of toll roads in three regions of Texas. Panel data is used for the Austin, Dallas/Fort Worth, and El Paso metropolitan areas in the models. They found that the welfare of the areas surrounding the toll roads increased, but this increase diminished as the distance from the toll road grew.

The use of Input-Output (IO) models is another approach to assessing toll road impacts. The University of North Carolina–Charlotte (1991) estimates economic impacts for highway construction between Wilmington and Raleigh using an IO model. The findings show the impacts are temporary but significant for the rural area of North Carolina through which the interstate runs through. Burgess and Niple, Ltd. (1998) uses the IO approach to estimate alternative investment impacts for I-71 on jobs and wages in Ohio, Kentucky, and Indiana. Thompson et al. (1997) use an IO model and an earnings growth model to determine the impacts of investment in the I-66 corridor. The earnings growth model is used to calculate inputs for the IO model, which estimates the number of jobs created in different industries by the highway investment. Clower and Weinstein (2006) use metrics for rural, urban, and suburban areas to estimate toll road impacts on regional economies. This method measures population change, changes in property value, and impacts during and after construction.

The linkage of toll roads and economic consequences is well explained in existing literature. However, information on the quantified regional economic impacts of a new toll facility with toll rate scenarios is scarce. If the regional economic impacts are quantified for potential tolling scenarios, this can clarify the economic benefits of toll projects in a region and encourage adequate toll planning. In particular, policymakers and researchers need to estimate the expansion of jobs, income, and regional gross product from a specific transportation infrastructure project. Estimates can be used to publically and politically justify the needs for the projects. The objective of this report is therefore to conduct a case study that estimates the regional economic effects of implementing a new toll road. We employ Regional Economic Models (*REMI*): to measure positive and negative effects of toll revenue and to evaluate alternative toll scenarios by using the net effects for the period of 2009-2030. We use six toll rate scenarios for a potential toll plaza on US-35 in West Virginia to estimate their impacts on state employment, state personal income, and Gross State Product (GSP).

The rest of this paper is organized as follows. The second section presents a proposed toll facility on US-35 in West Virginia. The third section provides an overview of *REMI* model with a discussion of direct and indirect impacts of toll roads on regional economy. It details the model description, input variables, and potential outputs. The fourth section then describes the data and model hypothesis used in this paper. The fifth section shows the results of the *REMI* model for a toll plaza by emphasizing changes in employment, income and GSP. Finally, the sixth section concludes the paper.

CASE STUDY: US-35 in WEST VIRGINIA

The West Virginia Department of Transportation (WVDOT) proposes to create the West Virginia Parkways Authority using an organizational structure similar to that used in Florida. The objective of the West Virginia Parkways Authority is to manage the designated toll facilities and collect user fees to be deposited into a fund to maintain and expand the system. The toll facilities, designated as Parkway Routes, would be maintained by the West Virginia Division of Highways. Highway construction cost for a single lane-mile is approximately $1.57 millions in West Virginia with right of way variability of 11-20% and environmental variability of 0-10% (Washington State DOT, 2002).

The US-35 corridor, one of the proposed toll roads, is a multi-lane and partial access-control facility. US-35 refers to the road being built from Henderson in Mason County to I-64 in Putnam County (Figure 1). The corridor will replace a two-lane road that connected Henderson to US-60 in St. Albans, in Kanawha County, that carries heavy commercial traffic. In 2006, 147 accidents, including one fatality, occurred on the two-lane US-35. The new US-35 is being built to provide a safer route. Eighteen miles of the corridor will be in Mason County and sixteen miles in Putnam County. The road has been funded primarily by federal appropriations up to this point. Currently, thirteen miles of the project remain unfunded and the construction period has not been determined.

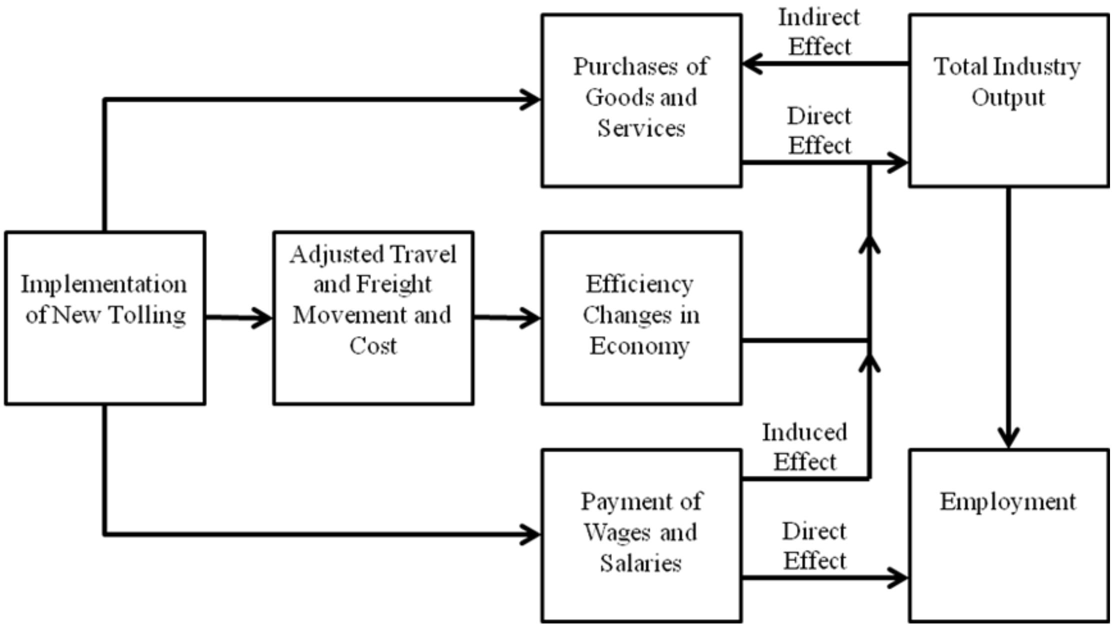
Figure 1. US-35 in Putnam and Mason Counties (RITA, 2008).

Therefore, the WVDOT needs information on the amount of toll traffic volume and revenues this road could be anticipated to generate for different toll rate scenarios. This information is essential to guide a plan that will be developed to borrow against future toll revenues. In addition, economic impacts from this toll project needs to be estimated to evaluate net benefits of this toll project in West Virginia. In 2008, West Virginia's population is approximately 1.8 millions, which takes account of 0.5% of nation's population. The state has $55 billions of state personal income, $46 billions of GSP, and 928 thousands of jobs.[2] Regional economic effects of implementing a new toll road can be measured by changes in state personal income, GSP and state employment.

METHOD

Economic development impacts from a new West Virginia toll facility are explored by a regional economic model in this paper. This approach can be employed to assess the economic effects of a specific toll project on the regional economy. The results show the cause and effect relationship between the toll project and the levels of state employment and income. The inter-sector relationships and sensitivity of the industry sector to the employment and income levels are also considered to determine economic impacts of a toll project. The economic effects include direct, indirect, and induced effects of the policy initiative. MacroSys Research and Technology (2003) defines a direct effect as the vector of goods and services on which the initial spending is made; indirect effect as the sum of total commodity multipliers for industries minus the direct effect; and induced effect as the sum of total commodity multipliers for households. Figure 2 demonstrates these direct, indirect, and induced effects of new toll roads on employment. The implementation of new toll roads affects passenger and freight traffic movements and costs, which in turn leads to efficiency changes. This further influences industry outputs and additional employment of labor. The direct economic effects include direct purchase of goods and services and the direct hire of labor to construct and maintain the toll road. The indirect effects can be measured by the output required to support the toll road construction, maintenance, and operation (e.g., pavement materials). In addition, induced effects can be estimated by the output required to satisfy new demand created by the toll project (e.g., retail jobs).

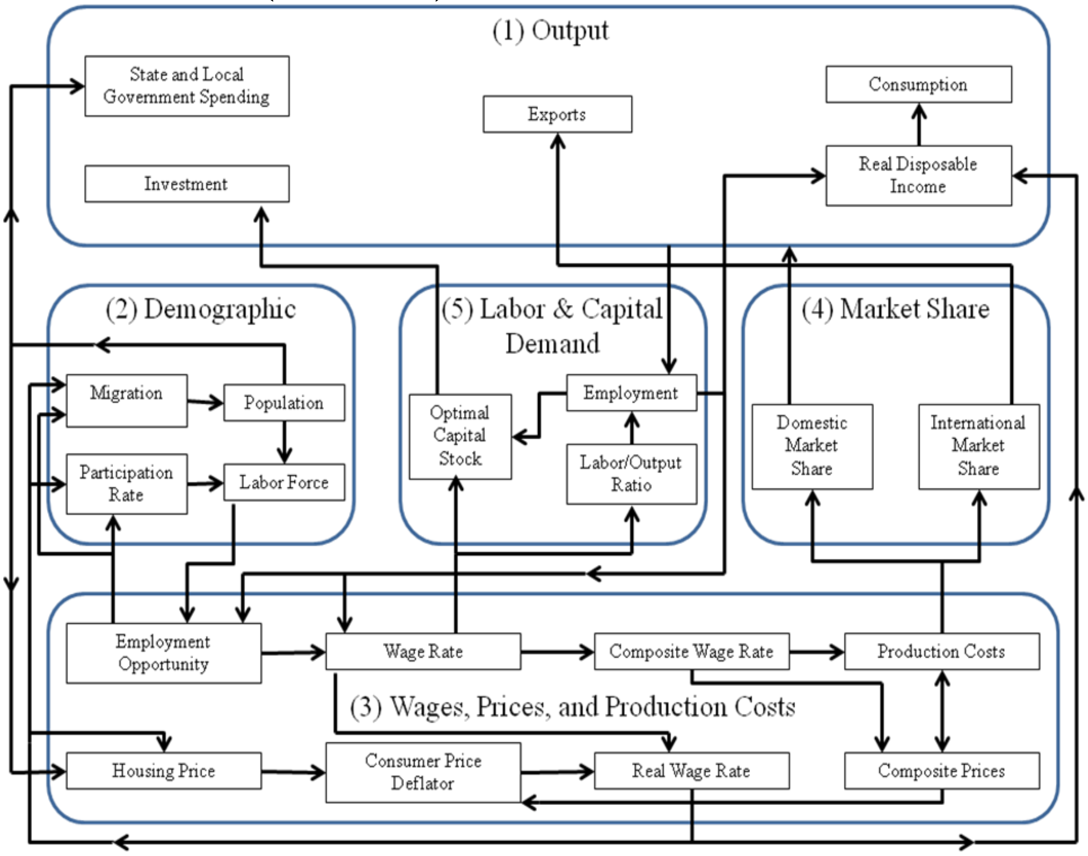
Figure 2. Economic Effects of Implementation of New Toll Roads.
This figure is adopted and modified from MacroSys Research and Technology (2003).



The *REMI* model is a structural economic forecasting model. It integrates an IO model with a general equilibrium model, econometric, and economic geography methodologies. Several regional economic models are currently available, such as *REMI, IMPLAN, RIMS II,* and *PC IO.* Unlike other models, the *REMI* model is dynamic, generating year-by-year estimates of the total regional effects of any particular policy initiative. This shows how producers and consumers change their behaviors in response to changing transportation infrastructure conditions. The *REMI* model allows the prediction of dynamic economic changes up to the year 2050 and shows how the changes differ from a baseline forecast. In addition, *REMI* can be calibrated to single- and multi-regions for forecasting. Thus, this paper employs the *REMI* to estimate dynamic regional economic impacts (2009-2030) of constructing a new West Virginia toll facility and evaluate the statewide impacts (single-region) with various toll rate scenarios.

The *REMI* can measure total regional economic impacts as a result of changes in one industry sector, which influences other sectors and in turn feeds back to the original sector.[3] The *REMI* model includes many simultaneous equations, such as supply and demand equations. Key cause-and-effect relationships in the *REMI* model can be seen in Figure 3. As shown in the figure, there are five model blocks: output, demographic, labor and capital demand, wage, prices, and production costs, and market shares. The economic elements in each block contain several equations examining employment, prices, income, revenues, and many other economic variables.

Figure 3. REMI Model Blocks and Linkages.
Source: (REMI, 2008)



A new toll system affects the regional economy through changes in transportation costs, which lead to changes in consumer spending, production costs, and other industry outputs. First, the *REMI* model shows that new toll roads may lead to negative economic impacts in West Virginia. Toll revenue collected from commercial vehicles may result in an increase in production costs (block 3), which affects market share and industry outputs (blocks 4 & 1). This change could further negatively influence employment (block 5) and other economic elements in other blocks shown in Figure 3. Thus, the *REMI* model can demonstrate a reduction in West Virginia's 928 thousand jobs in 2008 throughout these linkages.

Similarly, toll revenue collected from passenger vehicles increases consumer prices (block 3), which could reduce real disposable income and consumption (block 1). Low disposable income and consumption can negatively affect West Virginia's $55 billions of state personal income and $46 billions of GSP in 2008. However, there are positive economic impacts associated with a new toll facility, such as increased government funding from the toll revenue. This increases government spending (block 1) on transportation infrastructure and efficiency improvements. The *REMI* uses a baseline of $1.2 billions of West Virginia's government spending in 2008.

Implementation of a new toll facility creates new hire of labor and employment opportunity (blocks 2 & 3) to construct and maintain the toll road. This direct effect could lead to indirect and induced effects, which create additional jobs near the toll project area.

Although toll roads result in both positive and negative regional economic impacts, positive net economic effects can be anticipated through greater multiplier effects from increased government spending on the transportation project. Implementation of a new toll facility leads to changed access to existing businesses, increased business activity near points of access, potential increase in tourist activity resulting from gains in accessibility, and benefits attributable to project induced growth (Transportation Research Board, 2002). Additional effects of a new toll road include the alteration of traffic patterns and the relocation of homes and businesses. These effects include temporary or permanent alterations to neighborhood cohesion, neighborhood stability, travel patterns of commuters and shoppers, and recreational patterns. The potential for improved safety of four-lane roads over two-lane alternatives is another important socioeconomic impact.[4] The *REMI* model incorporates safety costs, operating costs, fuel efficiency, and emission costs for transportation models. Predicted vehicle-miles are used to calculate these costs. For example, the safety costs are estimated by using accident values and accident rates per vehicle-mile (fatalities, injuries, and property damage) in a region.

Therefore, this paper uses the *REMI* model to quantify both positive and negative economic effects of a potential toll plaza in West Virginia. The net economic effects can be used as decision criterion for a toll project.

DATA AND MODEL ASSUMPTIONS

This paper employs the Annual Average Daily Traffic (AADT) projections to forecast the annual traffic volume for US-35. The AADT data were obtained from the West Virginia Department of Highways. For the traffic forecasts in this paper, current toll rates from the West Virginia Turnpike are used for US-35 ($2.00 for two-axle passenger vehicles, and $6.75 for five-axle commercial vehicles).[5]

The traffic volume and toll revenues are examined for six alternative toll rate scenarios. The assumption is that toll rates will be used in September 2009 and annually adjusted by Personal Consumption Expenditures Price Index (PCEPI), excluding Scenario 1. The following scenarios are simulated to measure the marginal impacts of additional 20% increases relative to the estimated impact of the baseline scenario (Scenario 1):

- Scenario 1: The West Virginia Turnpike Mainline toll rate ("per-mile" based rate) in 2009 and no annual adjustment thereafter
- Scenarios 2,3,4,5,6: The toll rate is increased by 20,40,60,80,100%, respectively, in 2009 and adjusted by inflation thereafter

For Scenarios 2 through 6, the PCEPI is adopted as an inflation adjustment factor. The PCEPI, like the CPI, indexes consumer prices. The PCEPI takes into account substitution effect of goods and has historically risen 0.33 percent less than the CPI.[6] Therefore, the PCEPI can provide greater stability and predictability than the CPI for long-run forecasts. In addition, PCEPI projection data are available through 2050 with *REMI*, which allows longer term projections that can be used to prepare long-term plans more efficiently and accurately.

This paper reviews existing literature to determine the toll price elasticity of demand, which measures how much the traffic volume responds to a change in toll prices. Demand for traffic volume is said to be elastic if the traffic demand responds substantially to changes in the toll prices; it is inelastic if the traffic demand responds only slightly to changes in the prices. In other words, when the demand for traffic volume is elastic (inelastic), the percentage change in traffic demanded is greater (smaller) than that in toll price. Table 1 gathers calculated elasticities for six toll facilities. The table shows that all six of the toll facilities have inelastic demand. In the West Virginia Turnpike, the toll price elasticity of demand is -0.16, indicating that a 1 percent increase in toll price will cause a 0.16 percent decrease in traffic volume (Wilbur Smith, 2005). This implies that traffic volume is relatively unresponsive to a change in price. Furthermore, the toll price elasticity of demand is likely to be small if alternative routes are not available.

Table 1. Toll Price Elasticity of Demand, Comparison of Previous Study Results.

Facility/ Area	Demand Elasticity	Closest Alternative Route	Rural or Urban Highway	Year of Data Collection	Source
West Virginia Turnpike	-0.16	More than 1 hour	Largely rural	2005	Wilbur Smith
New Jersey Turnpike	-0.2 to -0.3	Varies by section; in some places parallel	Largely urban	2005	Steer Davies Gleave
Coleman Bridge in VA	-0.16 (short-term) to -0.33 (long-term): -0.25 on average	2 to 7.5 miles (3.5 to 9 minutes)	Largely urban	2002-2004	Charles River Associates
San Francisco Bay Bridge	< -0.05	*	Urban	1996	Gifford & Talkington
Verrazano Narrows Bridge in NYC	-0.05	*	Urban	1995	Wilbur Smith
Richmond, VA Pike	-0.34	*	Urban	1995	Wilbur Smith

*Information could not be obtained.

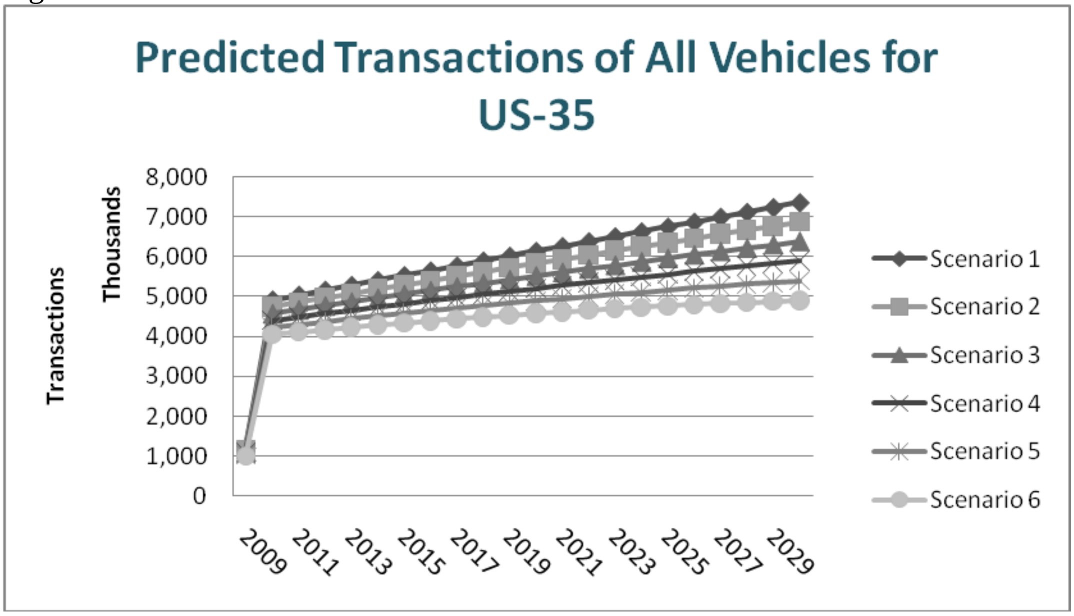
In this paper, US-35 does not have easily accessible alternative routes and therefore highly inelastic demand for traffic volume is assumed. An additional assumption is a difference between short-run and long-run elasticities of demand. In the short-run, toll road users can switch to a higher occupancy mode, alter their routes, or abandon their trips. In the long-run, users may change their origins and destinations (e.g., their residence or office location) to avoid the routes with the higher toll rates (Burris, 2003). Consequently, long-run elasticities are generally greater than short-run (Lee, Klein, and Camus, 1999; Oum, Waters, and Yong, 1992). Therefore, based on the literature review, we use the elasticity of demand of -0.16 for a short-run effect (2009) and the elasticity of demand of -0.33 in 2030 to incorporate a long-run effect.[7]

The toll revenue is then estimated by multiplying the predicted traffic volume by the actual weighted average rates for passenger and commercial vehicles in 2008. Forecasted revenues are used as input variables to estimate negative and positive economic impacts of the toll revenue from the proposed US-35 toll plaza. For negative effects, the forecasted toll revenue collected from commercial vehicles is used as an increase in production cost, whereas the forecasted toll revenue from passenger vehicles is used as an increase in consumer price in transportation. For positive effects, the total forecasted toll revenue is treated as an increase in government funding, which will be spent on building and maintaining a new toll facility. Therefore, total net economic impacts on employment, income, and GSP are estimated from negative and positive effects.

RESULTS

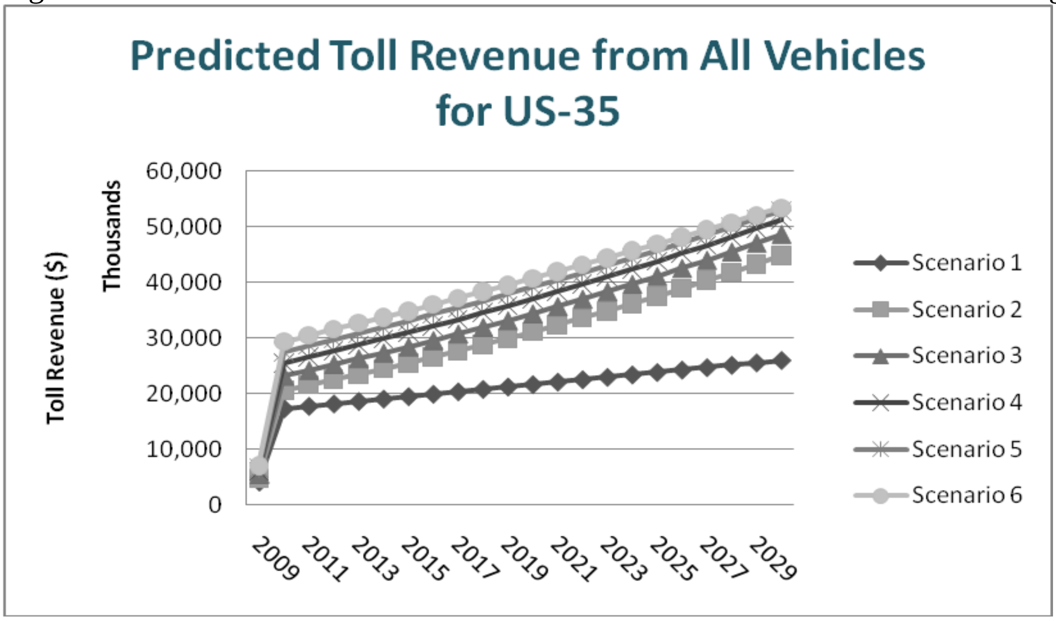
This section provides the results of toll transaction and revenue forecasts, which are used as input variables for *REMI* model. Figure 4 reports predicted traffic volume for the US-35 toll plaza for the 2009-2030. Using six toll rate scenarios, the results demonstrate that the toll rate increases are likely to reduce traffic volume of the proposed roads and bridges. For example, the forecasted transactions of Scenario 1 (no toll increase) substantially increase from 4.9 million vehicles in 2010 to 7.3 million in 2030. However, Scenario 6 (100 percent toll increase in 2009 and PCEPI adjustment thereafter) shows a relatively slight increase in transactions from 2010 (4.0 million) to 2030 (4.9 million).

Figure 4. Predicted Transactions of All Vehicles for the US-35 Toll Plaza in West Virginia.



Using the predicted transactions, the toll revenue is estimated for the period of 2009-2030 in Figure 5. The results show that marginal toll revenue of 20 percentage increments tends to be larger for lower toll rates because of the smaller offsetting effect of the toll increase (reduced traffic volume). Marginal benefits of 20 percentage toll increases are measured as the differences in revenues between the scenarios. For the 2030 predicted revenue from the US-35 toll plaza, the marginal benefits are $3.6 million from the 20 percent to 40 percent toll increase (Scenario 2 to 3); $2.6 million from the 40 percent to 60 percent increase (Scenario 3 to 4); $1.5 million from the 60 percent to 80 percent increase (Scenario 4 to 5); and $0.5 million from the 80 percent to 100 percent increase (Scenario 5 to 6), respectively. This provides evidence that the initial 20 percent increase is likely to have the largest marginal toll revenue for a long term.

Figure 5. Predicted Revenue of All Vehicles for the US-35 Toll Plaza in West Virginia.



The net economic impacts of the US-35 toll plaza are simulated by the *REMI* model. The forecasted transactions and toll revenues are used as inputs for the *REMI* approach. This paper reports the results in the following major regional economic impacts: state total employment, state personal income, and GSP. Appendix includes positive and negative effects of the US-35 toll plaza separately and Figures 6-8 provide the net impacts of the toll plaza. Figure 6 presents the changes in state total employment for each scenario. As the necessary infrastructure is put in place to collect tolls, there is an initial surge in job creation within the state. A slight drop follows as some of the initial jobs created are no longer needed. Ultimately, a positive trend sets in that results in more jobs created in the long run than in just the initial surge. The projected total change in employment varies from 300 jobs created (Scenario 1) to over 600 jobs (Scenario 6) by 2030.

Figure 6. Estimated Economic Impacts of the US-35 Toll Plaza on West Virginia State Total Employment.

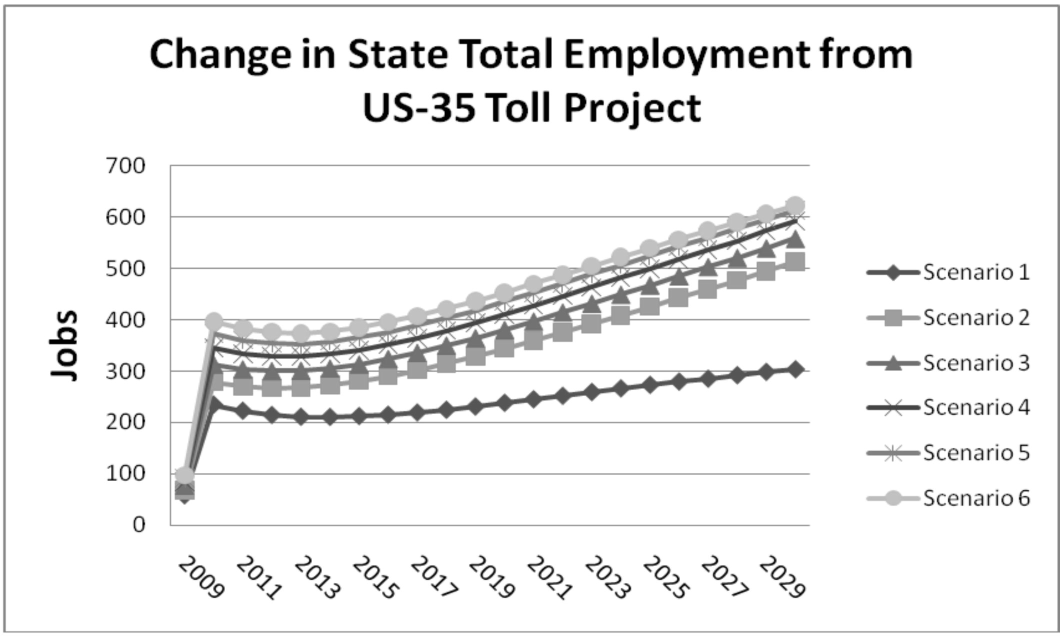


Figure 7 shows the change for state personal income for the six scenarios. Similarly to the state total employment, state personal income is forecasted to experience an initial jump as the infrastructure is created. However, unlike employment, state personal income is not projected to decrease after the initial surge. State personal income is shown to rise for all scenarios. The largest increase is an approximate rise of $34 million by 2030 (Scenario 6) while the smallest increase is approximately $16 million (Scenario 1).

Figure 7. Estimated Economic Impacts of the US-35 Toll Plaza on West Virginia State Personal Income.

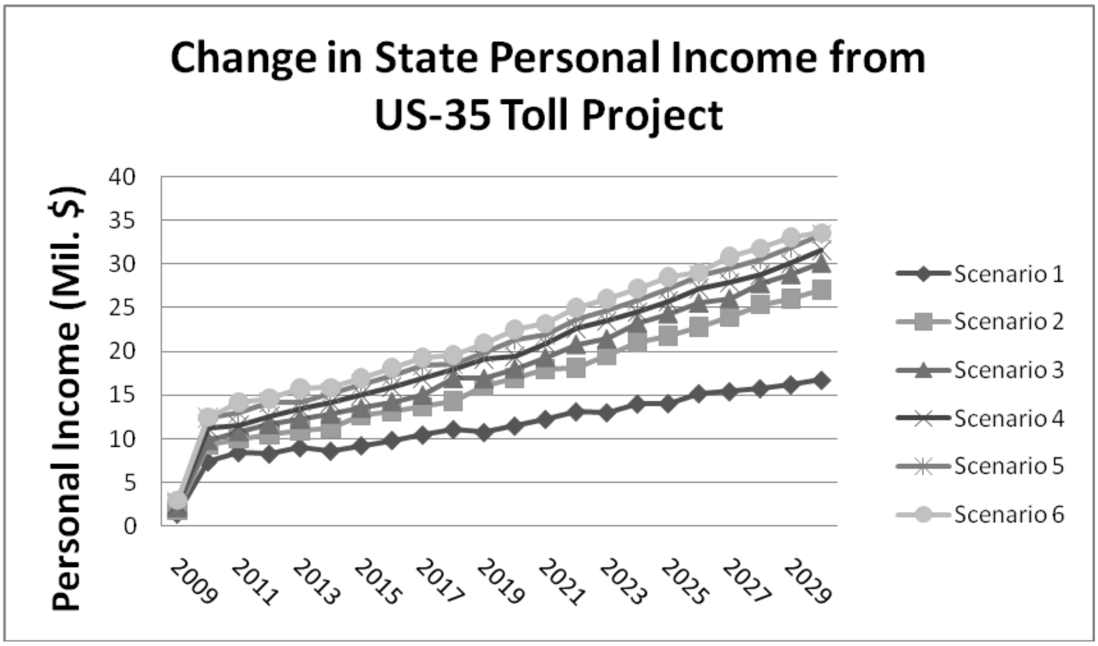
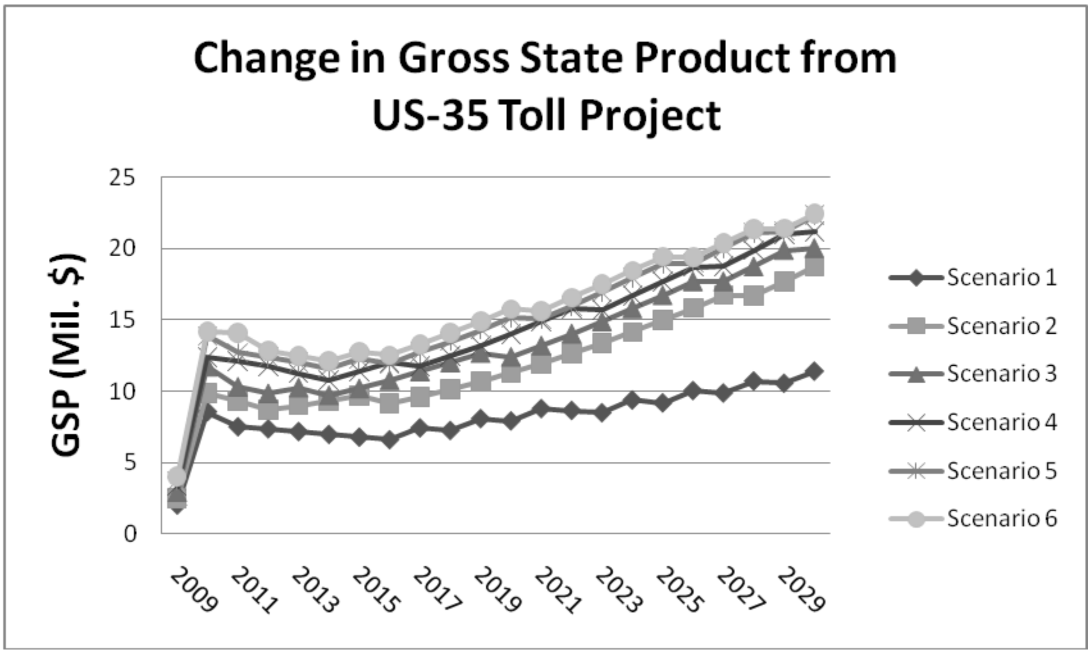


Figure 8 shows the gross state product (GSP) for each scenario. This figure is similar to the figure for state total employment (Figure 6) in that, after the initial surge, there is a slight decrease before GSP begins rising again. The graph shows a trend of greater benefits for the higher toll rates but lower marginal increases. Scenario 1 offers the least impact in the long run, with a projected increase of approximately $12 million by 2030. In contrast, Scenario 6 is projected to increase GSP by approximately $23 million by 2030.

Figure 8. Estimated Economic Impacts of the US-35 Toll Plaza on Gross West Virginia State Product.



SUMMARY AND CONCLUSIONS

This paper investigates regional economic impacts of a toll road with various toll rate scenarios by using *REMI* model. We predict toll traffic and revenue for a potential toll plaza on US-35 in West Virginia and estimate annual economic impacts from 2009 to 2030. The regional economic effects are measured as changes in state employment, personal income and GSP. In particular, this paper employs six toll rate scenarios to estimate the net economic impacts of the toll plaza. Heterogeneous toll price elasticities of demand are adopted for short- and long-run toll price elasticities. The empirical findings for a potential toll plaza in West Virginia can be summarized as follows.

First, the forecasted toll traffic and revenues are used as input variables for *REMI* model. The estimation results of toll traffic show that toll rate increases generally lead to smaller transactions of vehicles, and higher toll rates result in a larger reduction in traffic volume especially in a long-term. For the revenue analysis, marginal toll revenue of an additional toll increment of 20 percent is smaller for higher toll rates due to larger offsetting effects of toll increases.

Second, positive net economic impacts are found for all toll rate scenarios on state employment, income and GSP. This suggests that the benefits of the tolling largely overshadow the costs for a region. This further indicates that the positive effects of increased government spending on highway infrastructure are greater than the negative effects of increased personal consumption and industry costs on transportation. The direct, indirect, and induced effects of government spending on a new toll road may lead to greater multiplier effects of a toll project.

Third, economic impacts for the long-term tend to be larger than those for the short-term. In assessing annual economic changes, impacts of tolling are substantially larger for all scenarios in 2030, compared to those in 2010. For example, state personal income has risen to more than $30 million in 2030, from $13 million in 2010. This implies that a toll project can be an effective financing option for a long-term transportation project. Given that the gasoline taxes are less and less effective due to the higher fuel economy of vehicles, tolling should be considered as an alternative to support transportation infrastructure investment.

Fourth, marginal economic benefits of 20 percentage increments appear to be smaller for higher toll rates due to a greater offsetting effect of the toll increase. This paper provides evidence that as a toll increases substantially, transactions of vehicles decrease on a toll road, which results in smaller toll revenue increases and economic benefits. This effect is more noticeable for a long-term project. For instance, employment, personal income and GSP benefits from Scenario 5 to Scenario 6 are found to be much smaller than those from Scenario 2 to Scenario 3. This suggests that larger toll rates may not be optimal in terms of marginal economic benefits in a region.

Therefore, information from this paper can be used to advance the understanding of potential regional economic impacts of a toll road and help policymakers justify the implementation of a toll project or toll increase to the public.

ACKNOWLEDGEMENTS

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ENDNOTES

1. In 1975, the average vehicle could drive 13.5 miles per gallon of gasoline. That number rose to 22.6 miles per gallon in 1995. In addition, President Obama announced new Corporate Average Fuel Economy (CAFE) standards in May 2009, which would force automakers to build vehicles with increased fuel efficiency. By 2016, the auto industry will be required to get an average 35.5 miles per gallon for new cars and light trucks.

2. State personal income, GSP, and employment data are obtained from Bureau of Economic Analysis, U.S. Department of Commerce and state population data is collected from U.S. Census Bureau.

3. The REMI model includes updated disaggregated industry data: the least detailed data for the 23-sector model, an intermediate amount of detail for the 70-sector model, and the most detailed data for the 169-sector model.

4. According to Samuel and Poole (2000), toll roads could provide greater safety because of better maintenance and traffic management (time-variable tolls). In 2006, 147 accidents occurred on US-35 in West Virginia, resulting in a single fatality. According to estimates computed by the National Safety Council (2007), the total economic cost of these accidents is $2,232,500. The economic cost was found by adding the estimated cost per death ($1,130,000) to the cost of 147 crashes ($1,102,500=147 * $7,500). This assumes that no one suffered a disabling injury in any of the accidents, each disabling injury adds $61,600 of economic cost (NSC 2007).

5. The West Virginia Turnpike, a current West Virginia toll road, runs 88 miles from Charleston to Princeton. The Turnpike carries I-77 for the entire length of the turnpike and I-64 from Charleston to Beckley. It collects tolls at three main plazas along the turnpike as well as at ramp plazas at the North Beckley exit. The Turnpike provides an important North-South Corridor through which Virginia and North Carolina are connected to Ohio and Pennsylvania.

6. CPI uses a fixed basket of goods.

7. An alternative of estimating short- and long-run toll price elasticities is a regression analysis. However, time-series datasets are not available to adequately explain the variation in traffic (West Virginia toll rates have been fixed since 1981 and only recently changed in August, 2009).

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APPENDIX

Figure 9. Estimated Positive Economic Impacts of the US-35 Toll Plaza on West Virginia State Total Employment.

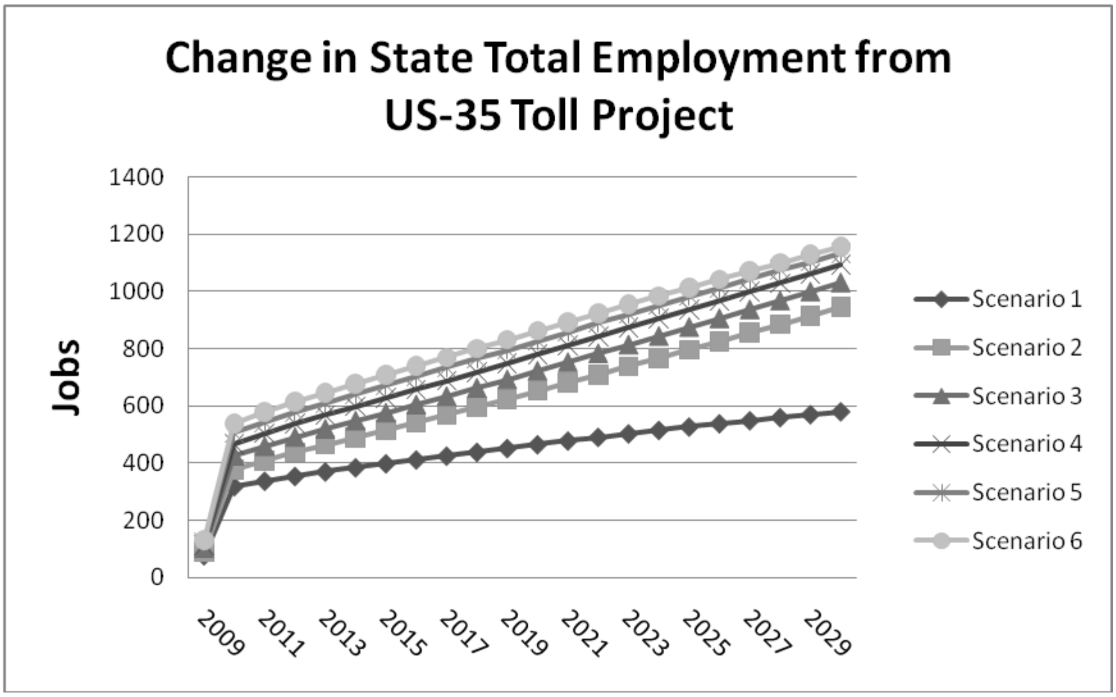

Figure 10. Estimated Negative Economic Impacts of the US-35 Toll Plaza on West Virginia State Total Employment.

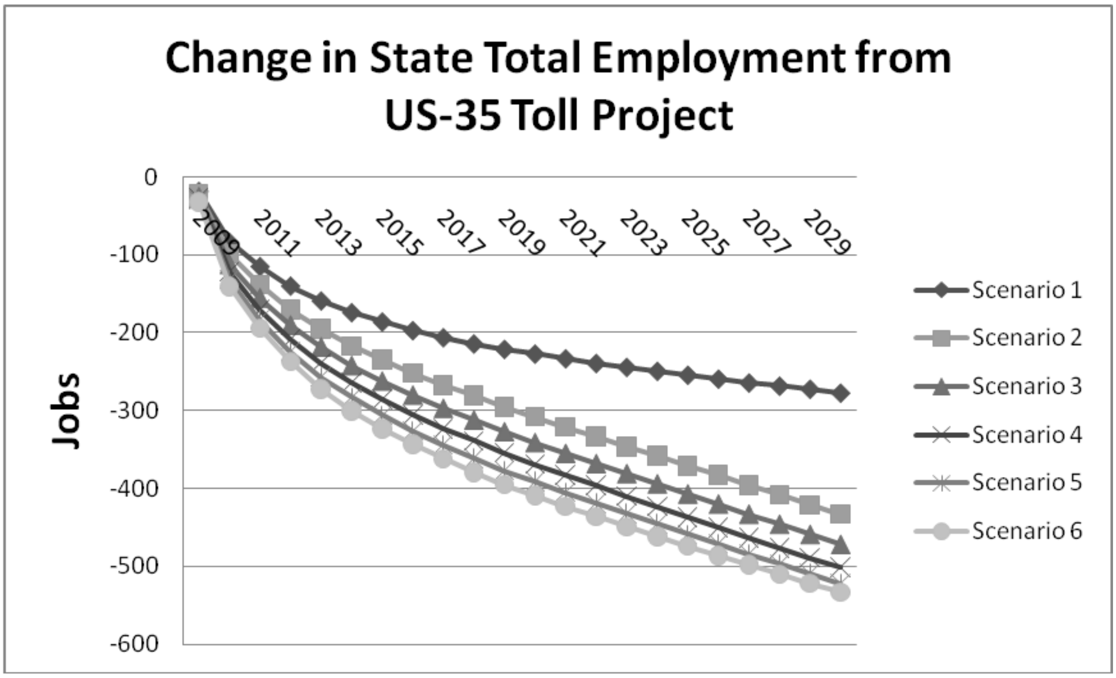

Figure 11. Estimated Positive Economic Impacts of the US-35 Toll Plaza on West Virginia State Personal Income.

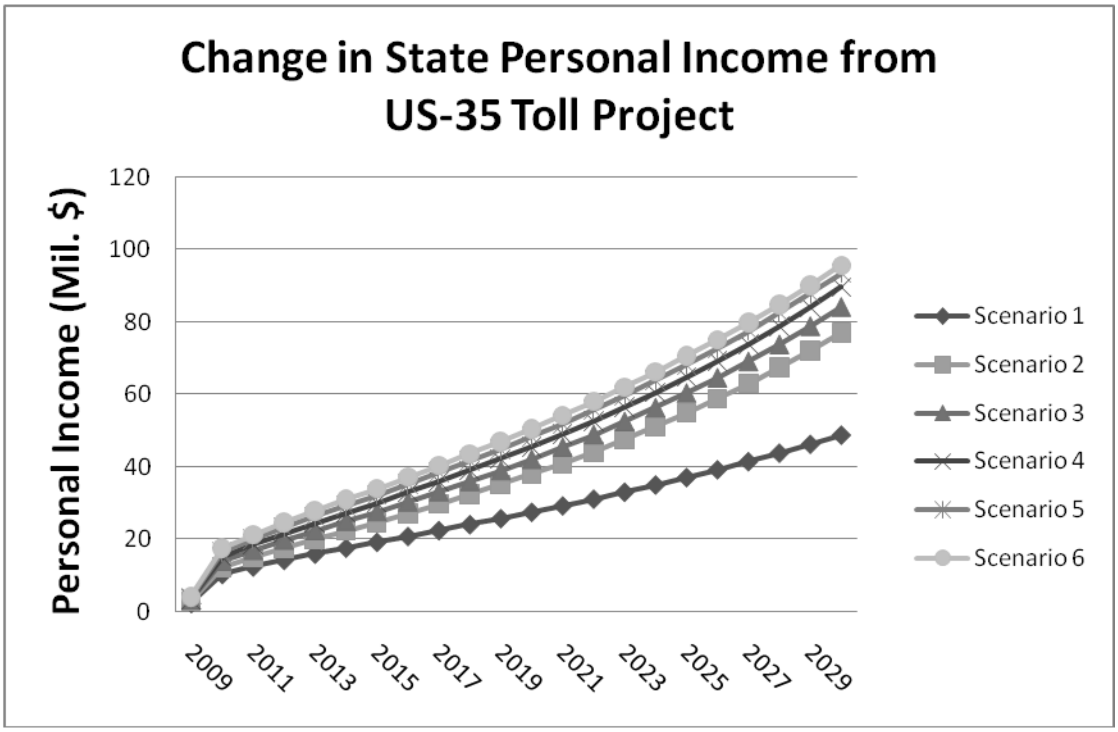

Figure 12. Estimated Negative Economic Impacts of the US-35 Toll Plaza on West Virginia State Personal Income.

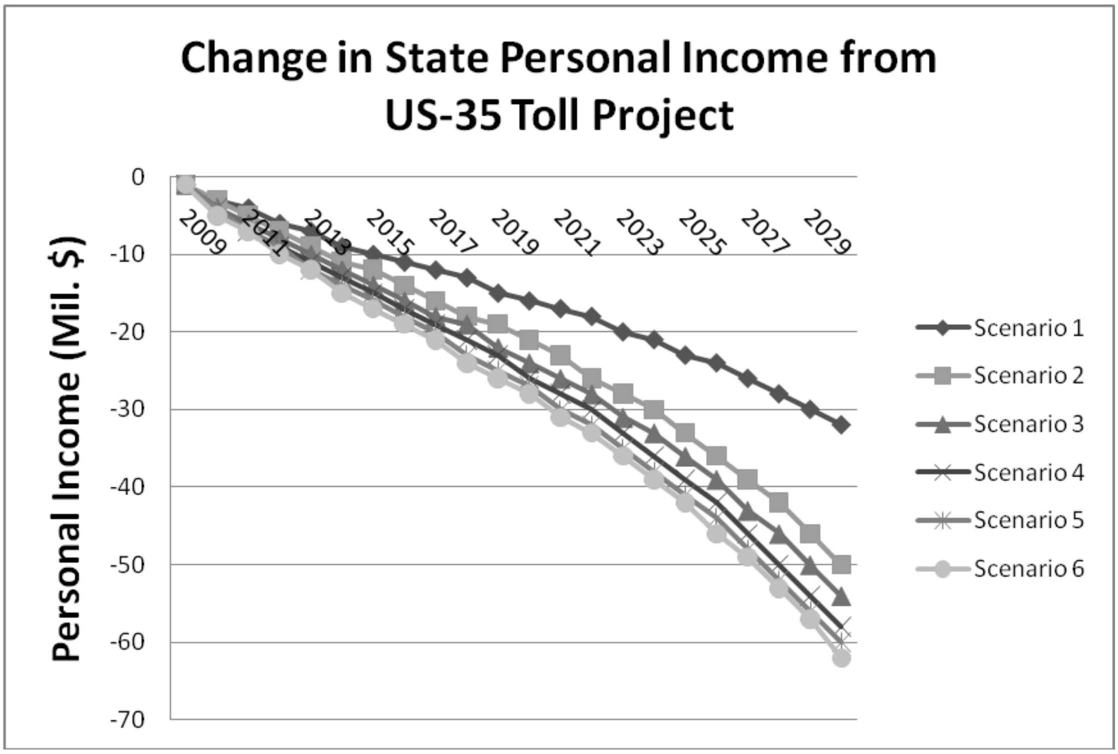

Figure 13. Estimated Positive Economic Impacts of the US-35 Toll Plaza on Gross West Virginia State Product.

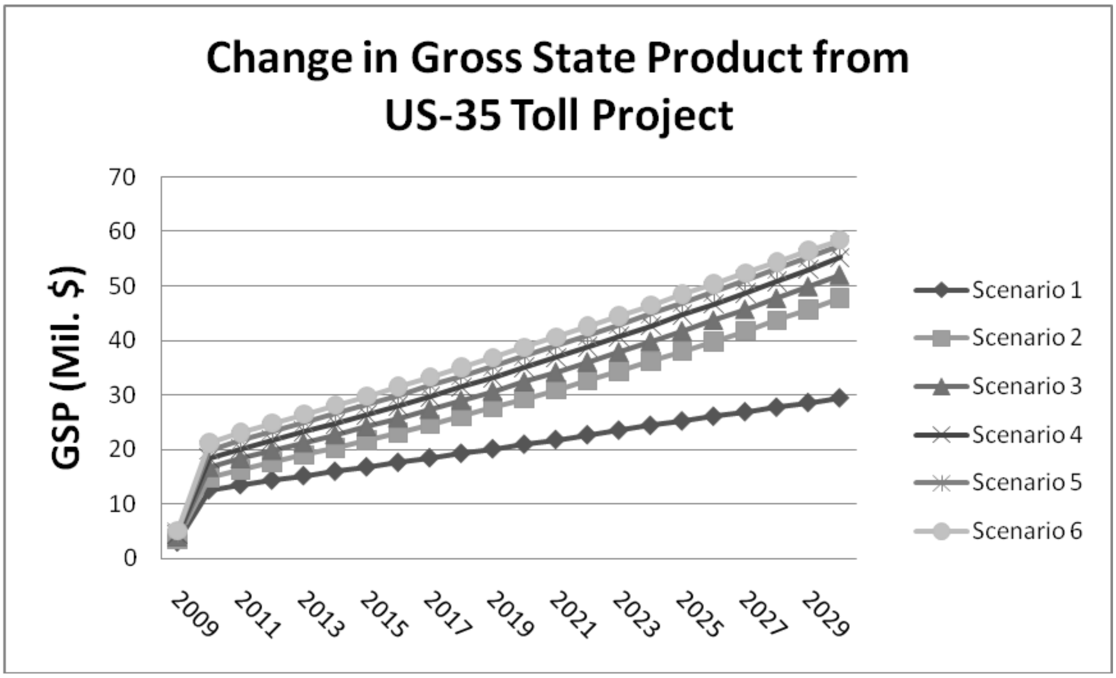

Figure 14. Estimated Negative Economic Impacts of the US-35 Toll Plaza on Gross West Virginia State Product.