The Inefficiency of Toll Collection as a Means of Taxation: Evidence from the Garden State Parkway

In this paper, we calculate the cost of toll collection on New Jersey's Garden State Parkway by extending an existing model to include pollution and fuel costs. The results show that tolls are a very inefficient method of taxation versus fuel and income taxes. We also show that the pollution costs of toll collection are significant. Therefore, when no mass transit alternative exists, and there is no compelling need for congestion pricing, the cost of taxation and pollution can be greatly reduced by replacing tolls with either an income or fuel tax. Also, when tolls are used, the toll road operators should be required to purchase pollution tax credits; otherwise, they are not accounting for a major cost of the toll collection process and are likely to make sub-optimal policy decisions.

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Tolls are one of the oldest forms of taxation and they have been proposed as a solution to a number of society's problems including road congestion, air pollution, and crumbling infrastructure.[1] For example, Ferrari (2002) notes that tolls are instituted to collect revenue for a given road network and/or encourage "optimal" usage.

However, while tolls can help eliminate congestion by varying the toll in response to road demand, this will be most equitable and effective in areas where quality mass transit systems serve as a substitute for road travel. Many toll roads utilize the only existing right-of-way for highways in a particular region. As such, these toll roads are a substitute for nontoll highways. Such monopoly control of a particular corridor allows the toll authority to collect revenue from users that have not been provided with a suitable alternative. There are numerous monopoly-controlled corridors—two examples are the Pennsylvania Turnpike and the Garden State Parkway.

A wide range of social policy groups (e.g., the Sierra Club and the Heritage Foundation) believe that tolls are a way of improving air quality by encouraging mass transit alternatives that produce fewer greenhouse gas emissions. However, if the goal of instituting a toll is to reduce pollution, is a road-specific toll more effective than a gasoline tax that discourages the use of fuel-inefficient (and high polluting) vehicles on all roads?

Also, when there are no mass transit alternatives, monopolistic operators can use tolls to exact economic rents. In some cases, these tolls are collected from one group of individuals and the benefits accrue to a completely different group. Ross (1993) reports how The Port Authority of New York and New Jersey provides funding for economic development projects such as industrial parks. Tolls that expropriate revenue are especially

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troubling since numerous studies have shown that tolls are a regressive tax (Nakamura and Kockelman 2002).[2]

The literature on toll collection is extensive in terms of the analysis of alternative forms of toll collection, pricing models, and traffic flow improvements. But, little research has been done to quantify the impact of toll collection on society as a whole. This paper helps to fill that gap by examining the costs of toll collection on the Garden State Parkway (GSP) in New Jersey. We examine the cost of the toll authority itself, the costs imposed on users, and the cost imposed on society as an externality in the form of pollution. The results show that toll collection is a very inefficient means of taxation.

Literature Review

Many researchers have measured the impact of automated toll collection (ATC) on air quality and optimal road use. Papers such as May and Milne (2000) focus on toll methods as a way to optimize road user fees and social benefit. Barht and Norbeck (1995) and Saka et al. (2000) focus on the impact of changing vehicle speed and operation on pollution output. Other researchers such as Friedman and Waldfogel (1995) and Burris and Hildebrand (1996) focus their attention on the administrative and compliance costs of toll collection. Friedman and Waldfogel (1995) measure these costs using a case study of a Massachusetts Turnpike toll plaza and data from the New Jersey Turnpike Authority. However, none of these studies have measured compliance, administrative, and pollution costs together in one study.

In this study, the Friedman and Waldfogel (1995) model is extended by adding variables that measure the environmental impact of toll collection. This model is then used to calculate the total societal cost (TSC) of toll collection on the Garden State Parkway (GSP) in New Jersey using Sisson's (1995) estimates for automobile emissions and the New Jersey Department of Transportation's traffic volume estimates. The results show that toll collection is a very inefficient means of taxation versus alternative methods. We also show that the environmental cost of toll collection is significant and that any proposed change to, or implementation of, a toll collection system should be accompanied by an environmental impact assessment.

Method

The total cost of toll collection is equal to the sum of the administrative, compliance, and environmental costs. The Friedman and Waldfogel (1995) model measures the administrative and compliance costs. According to their model, administrative costs (AC) incurred during time t are equal to:

(1) $AC_t = w_T L_t + u_t K$

Where w_T equals the cost of operating a tollbooth per time period, L_t is the number of tollbooths staffed and operational during time period t, u_t includes the user cost of toll collection capital (including both borrowing and depreciation) per time period, and K equals the value of toll collection capital. Therefore, over any extended period of time, administrative costs equal:

(2) $$AC = w_T \sum_{t=0}^{T} L_t + K \sum_{t=0}^{T} u_t$$

Compliance costs (CC) are measured as wQ, where w is the value of the road user's time and Q is the total amount of time the driver (assuming no passengers) is delayed in compliance[3]:

(3) $$Q = \sum_{t=0}^{T} \left(fd + \frac{q_t}{L_t \alpha} \right) a_t$$

where fd equals the fixed delay, qt equals the number of vehicles in the queue at time t, L_t equals the number of lanes staffed at time t, α equals the number of vehicles that can be processed per lane, per time period, or the throughput rate, and a_t is the number of vehicles arriving per time period. Therefore, according to this model, total collection costs (TC) equal:

(4) TC = AC + CC

Sisson (1995) points out that the process of toll collection creates a significant amount of additional pollution as compared to transit at highway speeds. This is not accounted for in Equation 4. To calculate the pollution cost per pollutant x (PC_x), the following equation was used:

(5) $PC_x = (fp + (vd\ r_x))p_x$

where fp equals the fixed acceleration pollution of pollutant x per toll collection, vd equals the amount of time spent waiting in the queue to pay the toll, r_x is the average rate of production of pollutant x per time period, and p_x is the cost of pollutant x to society on a per unit basis. Total pollution cost (PC) is equal to:

(6) $$PC = \sum_{x=1}^{m} PC_x$$

where m is the total number of pollutants being measured.

Equation 4 is also extended to account for the additional fuel consumption caused by queuing, decelerating, and reaccelerating during the toll collection process.[4] Fuel consumption is estimated based on the following equation:

(7) $C = (fd\ r_i + vd\ r_f)p_f\ n$

Where

fd = fixed delay (seconds)

r_i = idle speed fuel consumption (gallons per second)

vd = variable delay (seconds)

r_f = fuel consumption in queue (gallons per second)

p_f = price of fuel (gallon)

n = number of vehicles passing through toll plaza

These variables were added to the right-hand side of Equation 4 and arrive at the total societal cost of toll collection (TSC):

(8) TSC = AC + (CC + FC)+ PC

The toll authority pays the administrative costs (AC), road users pay compliance and fuel costs (CC + FC), and society bears the cost of pollution (PC).

Case Study: The Garden State Parkway

New Jersey's Garden State Parkway (GSP) is 173 miles long and has 11 major toll barriers, and 20 ramp toll plazas. Based on data collected from the New Jersey Highway Authority (and other sources as noted), the total societal cost of toll collection on the GSP for the year 2000 was calculated, using the model outlined above. The focus was on the volume of travel that occurred in the year 2000, because it was the last full year that travel data from the GSP was not disrupted by the events of September 11, 2001. Since a large portion of the Garden State Parkway is located in the New York metropolitan area, significant travel pattern changes occurred on the GSP because of damage to and closures of sections of the New York metropolitan transportation network after September 11, 2001.

Administrative Costs (AC)

The New Jersey Highway Authority (NJHA) reports that administrative costs on the GSP (including the cost of capital and the labor costs of toll collectors and administrators) were $0.07 per toll collection in the year 2000.[5] They also report 436,161,722 toll collections at the major toll barriers for the same year. Therefore, administrative costs are $30,531,321 for the year 2000.[6]

Automated toll collection has been proposed as a way to improve the efficiency of the toll collection process. However, implementing the ATC program in New Jersey has resulted in a significant increase in administrative costs related to the E-Z Pass system. A consortium of six different toll authorities operates the New Jersey E-Z Pass system. The consortium financed the construction of the ATC system using $300 million in funding from the New Jersey Economic Development Authority. Because of cost overruns and other implementation problems, the current liability for the E-Z Pass system in New Jersey is $469 million (The Port Authority of New York and New Jersey 2001). Based on a cost sharing agreement among the consortium members, the GSP was allocated 32% of the costs and is currently budgeting $100 million dollars for this expense.[7] The US Department of Transportation estimates a 10-year life span for ATC equipment. Therefore, the GSP is incurring capital costs of $10 million per year on the fixed infrastructure of low speed ATC. The State of New Jersey's annual cost is $46.9 million. This cost alone equals approximately 92% of what the US Treasury spends to collect all federal gasoline taxes in all states (IRS 1996).

In addition to the fixed infrastructure costs, a transponder must be installed in every vehicle. The Metropolitan Transit Authority of New York City (MTA) initially deployed its ATC system on MTA Bridges in 1996. It has since discovered that it is necessary to replace the transponders after seven years of service. The MTA is currently planning to spend $60 million to replace its 2.6 million transponders by 2004. This represents an annual average transponder cost of $3.31 per vehicle, per year (URS Greiner et al. 2002: 48). In the year 2000, New Jersey had 6,390,031 registered motor vehicles. To maintain a working transponder in all of these vehicles (as would be necessary to replace the gasoline tax with tolls) would result in an additional annual cost of $21.151 million per year.

Therefore, if New Jersey eliminated gasoline taxes and migrated to ATC for the collection of road taxes, based on capital costs alone (not including operational costs), it would have to spend more than $68 million per year. This is significantly more than the $51 million of administrative costs the IRS spent to collect the federal gasoline tax in the year 1996 (IRS 1996). This level of spending would still be inadequate to fully deploy ATC because existing facilities cover only a small portion of the New Jersey road network.

Compliance Costs (CC)

Friedman and Waldfogel (1995) designed their model for use on a two-stop toll road where the driver stops once to pick up a ticket and then again to pay the toll. While this is consistent with many toll collection systems such as the New Jersey Turnpike, on the Garden State Parkway, drivers stop repeatedly for the duration of the trip with a maximum distance of 24.76 miles and a minimum of 5.79 miles between major toll barriers. A driver following the whole route of the GSP would stop at 11 barriers along the route. Therefore, we modify Friedman and Waldfogel's (1995) compliance cost function so that it calculates costs on a per stop basis:

(9) $CC_t = (fd+vd_t)w$

where CC_t equals the compliance cost at time t (per stop), fd equals the fixed delay, vd_t is the variable delay at time period t, and w equals the value of the road user's time.

To fully understand compliance costs and to determine whether any significant queuing exists on the GSP, the theoretical capacity of the NJHA toll collection system was calculated. The NJHA's estimates of the theoretical maximum throughput, and the average hourly processing rates for their current methods of toll collection (cash, tokens, and E-Z Pass), are presented in Table 1.

Based on these estimates and data regarding the mix of payment methods chosen by users, the weighted average fixed delay for users was calculated. The average fixed delay is 5.402 seconds per transaction based upon the average mix of users in the year 2000 (see Table 2). Some people might not consider five seconds to be significant. However, we believe that time is valuable and that it should be considered as one of the costs of a toll collection system. This is especially true in light of the enormous number of transactions that occur on the GSP. One of the authors of this paper is a regular user of the GSP and believes that these costs are significant in his daily commute.

Table 1: Hourly Processing Rates

Hourly Processing Rates By Collection Method		
	Average	**Maximum**
Cash	350-400	500
Tokens	750-800	900
E-Z Pass	1,200	1,400

Valuing users' time in the collection process is always difficult. Some researchers feel that time should be valued at approximately 50% of the road user's wage rate. Others argue that the value of commuting time should be as low as 20% or as high at 100% of a user's current wage rate. Recent papers by Brownstone and Small (2002), Lam and Small (2001), Ghosh (2001), and Steimetz and Brownstone (2002) report varying time costs. Brownstone and Small (2002) use both the revealed preference (the willingness of users to pay a toll when road alternatives exist) and the same users' stated preferences from surveys. They report a revealed preference value of time that is between $20 and $40 per hour for users of Interstate 15 and State Route 91 in California. They also report the same users' stated preference as $12.35 per hour.

In Table 3, a number of alternative valuations for the fixed time delay on the GSP are presented. An average wage rate of $20.07 per hour[8] for GSP road users was used. The results indicate a total compliance cost (CC) that ranges from $7,294,804 for full ATC at three-second fixed delay up to a full manual system with compliance costs of $23,343,375 for the year 2000.

To measure the variable delay, hourly data were collected on toll collection on the GSP for the Raritan Toll Plaza (RTP) from the New Jersey Highway Authority (NJHA) printed reports.[9] The RTP is the largest collection point on the GSP with 20 tollbooths in each direction. The RTP is subject to heavy seasonal travel in the summer months

Table 2: Average Collection Time

	Transactions per Minute (1)	**Seconds per Transaction (2)**	**Payment Method (3)**	**Average Collection Time per Transaction**
Cash	6.3	9.6	33.6%	
Tokens	12.9	4.6	11.5%	
E-Z Pass	20	3	54.9%	
Average Collection Time = Σ(2)*(3)				5.402

Table 3: Alternative Valuations of Fixed Delay Cost

	Collection Method	GSP Tolls Collected (2000)	Fixed Delay (seconds)	Compliance Cost (hours)	Compliance Cost ($)
GSP	100% Manual	436,161,722	9.6	1,163,098	23,343,375
GSP	Current Mix	436,161,722	5.402	654,484	13,135,512
GSP	100% ATC	436,161,722	3.0	363,468	7,294,804

and also heavy daily commuting. Approximately 81 million tolls were collected at the RTP in the year 2000. This represents 18.75% of all transactions on the GSP.

The theoretical capacity of the RTP was calculated based on the current mix of payment methods available to users (Table 4). Both north and southbound toll plazas were studied to understand the variations in demand.

Figure 1 presents a sample chart of one day of toll collection, by hour, at the RTP. Based on the maximum vs. actual throughput rates of the various toll collection methods, the RTP experiences no significant queuing problems. For all of the days that were studied, the capacity of the current mix of collection methods exceeds the total hourly transactions by a minimum of about 1,000 cars per hour. Therefore, the GSP is delivering a service in excess of demand if the users are utilizing the various methods in proportion to their availability. Since there is no significant queuing, the compliance cost is equal to the fixed delay cost of $13,135,512.[10]

Table 4: Capacity of the Raritan Toll Plaza

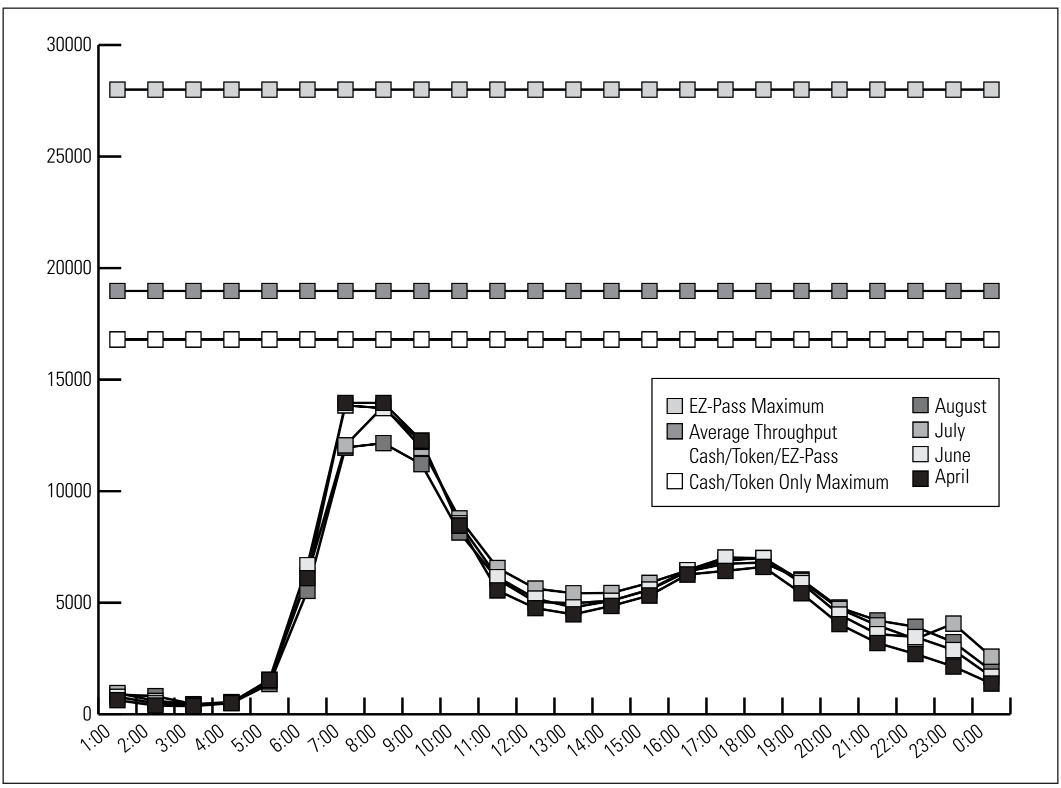
Throughput and Booth Utilization Rates—2002 Raritan Toll Plaza			
°	Throughput Rate Per Hour (average)	Toll Booths Utilized	Vehicles Processed Per Hour
Current Mix:			
Cash	375	3	1,125
Tokens	775	6	4,650
E-Z Pass	1,200	11	13,200
Total Hourly Throughput			18,975
Alternative 1: All Booths E-Z Pass and 100% E-Z Pass Utilization			
E-Z Pass	1,200	20	24,000
°			
Total Hourly Throughput			24,000
Alternative 2: All E-Z Pass Booths Converted to Token Booths			
Cash	375	3	1,125
Tokens	775	17	13,175
°			
Total Hourly Throughput			14,300

Pollution Costs (PC)

We estimate the pollution costs related to toll collection on the GSP using Sisson's (1995) estimates of pollution production from decelerating an automobile to zero miles per hour and then reaccelerating to the normal operating speed. Sisson (1995) examines three vehicle classes (pre-1979, 1980-1988, and 1989-1994) in his study and their corresponding production of Nitrous Oxide (NOx), Hydrocarbons (VOC), and Carbon Monoxide (CO). While this was representative of the automobile population in 1995, the estimates of pollution production in 2000 are taken from the most recent period.[11] The fleet average output of pollutants from this cohort, per acceleration, net of what would be created by a quarter mile transit at 65mph, are given in row two of Table 5. Based on these estimates, the cost per kg of pollutant, and the total number of toll collections on the GSP during the year 2000, it is estimated that the total cost of pollution from toll collection at $12,702,011. With toll collection revenue on the GSP reported to be $152,656,602 for the year 2000, pollution costs represent 8.3% of revenue collected.

As an alternative valuation method, Cantor-Fitzgerald's Environmental Brokerage Service, Market Price Index (MPI) for emission trading credits to value GSP pollution output was used. Cantor-Fitzgerald provides cost estimates for NOx, VOC and CO per ton. By converting the pollution output estimates to tons per year, the cost of the pollu-

Figure 1: Garden State Parkway—Theoretical Maximum Collection Rate and Actual Rate—Raritan North Tuesday (April 2002, June 2002, July 2002, August 2001)



tion produced during the toll collection process was calculated. The cost of credits for New York and New Jersey was used since these are the appropriate market values for pollution created on the GSP. Obviously, different regions would result in different valuations for the same amount of pollution. For comparison purposes, the San Joaquin Valley Unified Air Pollution Control District prices were included to explore the variation in valuation that would result if the pollution occurred in an area with greater air quality problems than New York and New Jersey. The results are presented in Table 6.

The results using the Cantor-Fitzgerald Market Price Indices are consistent with those utilizing Sisson's (1995) prices. The price of NOx and VOC show a somewhat higher price in the Cantor-Fitzgerald data, while CO has a somewhat lower price.

Table 5: Calculation of the Total Pollution Cost Resulting from Toll Collection on the Garden State Parkway (2000)

	Nitrous Oxide (NOx)	**Hydrocarbons (VOC)**	**Carbon Monoxide (CO)**
Grams emitted per 0-65 acceleration net of continuous 65mph transit	0.625	0.85	32.25
Number of accelerations on the GSP	436,161,722	436,161,722	436,161,722
Total grams emitted on the GSP	272,601,077	370,737,464	14,066,215,548
Pollution cost per kg (Sisson 1995)	$11.81	$4.71	$0.55
Total pollution cost (PC) on the GSP	$3,219,419	$1,746,173	$7,736,419

Table 6: Alternative Valuations of Pollution Created on the GSP

Cantor-Fitzgerald Environmental Brokerage Service, Market Price IndexDollars Per Ton, Per Year—April 2002			
Pollutant	**New Jersey ($)**	**New York ($)**	**California-San Joaquin ($)**
NOx	15,650	15,650	30,000
VOC	5,500	6,158	8,667
CO**	440	440	490
Pollution Produced by Toll Collection on the GSP (tons per year)			
°	**NOx**	**VOC**	**CO**
Production - GSP	300	408	15,473
Value of GSP Pollution in Alternative Markets			
Pollutant	**New Jersey ($)**	**New York ($)**	**California-San Joaquin ($)**
NOx	4,692,828	4,692,828	8,995,836
VOC	2,242,962	2,511,301	3,534,500
CO**	6,808,048	6,808,048	7,581,690
Total	13,743,838	14,012,177	20,112,025

***Note:* New Jersey and New York CO Price based on McCubbin and Delucchi (1999) as Cantor-Fitzgerald does not estimate a Market Price Index (MPI) for CO in NJ and NY.

Fuel Costs (FC)

Fuel consumption cost was calculated using the results of a study conducted by Wilbur Smith Associates (2001) for the New Jersey Turnpike Authority (NJTA). They estimate that the implementation of the E-Z Pass system on the New Jersey Turnpike saved 1.8 million hours of road user time. They also report fuel savings of 917,000 gallons. These results imply a fuel consumption estimate of 0.509 gallons per hour for automobiles engaged in the toll collection process.

Since road users spend 654,484 hours per year (see Table 3) paying tolls on the GSP, 333,877 additional gallons of fuel are consumed as a result of the toll collection process. The national retail average price per gallon of gasoline was $1.635 in the year 2000 (US Department of Energy). Therefore, the fuel cost of toll collection on the GSP is $545,888.[12]

Total Societal Cost (TSC)

From Equation 7, total societal cost represents the sum of administrative, compliance, fuel and pollution costs. In the case of the GSP for the year 2000, the total societal cost of toll collection is estimated to be $56,914,732 or 37.3% of revenue collected (see Table 7). Pollution costs alone represent 8.3% of revenue collected, only slightly less than compliance costs.

It is important to note that this analysis is conducted after the implementation of the E-Z Pass system on the GSP. If the significant amount of queuing that occurred prior to the implementation of the E-Z Pass system had to be accounted, the pollution cost estimates would have been significantly higher.

Alternative Methods of Revenue Collection

Income Tax

In cases where taxing authorities are not looking to alter patterns of usage, there are several methods of raising revenue for transportation infrastructure that are much less costly than toll collection. The first is an income tax. The Internal Revenue Service (IRS 2001) reports that the total cost of operating the IRS in 2001 was $8.772 billion. This administrative cost represents 0.41% of the $2.129 trillion collected by the IRS. The IRS estimates in its 2004 budget proposal (IRS 2003a), that consumer compliance cost[13] equals eight times the IRS budget, or 3.28% of the tax collected. Therefore, the total cost of an income tax totals approximately 3.69% of revenue collected (vs. 37.3% for toll collection).

Table 7: Component Costs as a Percent of Total Collections

Component	Revenue/Cost	Percent of Revenue	Percent of TSC
Revenue Collected	$152,656,602	100%	-----
Costs:			
Administrative Costs (AC)	$30,531,321	20.0%	53.6%
Compliance Costs (CC)	$13,135,512	8.6%	23.1%
Pollution Costs (PC)	$12,702,011	8.3%	22.3%
Additional Fuel Costs (FC)	$ 545,888	0.4%	1.0%
Total Societal Cost (TSC)	$56,914,732	37.3%	100%
Net Revenue	$95,741,870	62.7%	—

Another feature of an income tax is that it can be designed to be income neutral or progressive. Nakamura and Kockelman (2002) show that tolls are by nature regressive, shifting the burden of taxation disproportionately to the poor and middle classes.

Fuel Tax

A second alternative to tolls is a fuel tax. Road users already pay an 18.4-cent per gallon federal tax on all motor fuel. New Jersey residents currently pay 10.5-cents per gallon in state fuel taxes. The revenue from federal and state fuel taxes provide 78% of the revenue (Kulash 2001) used to fund highway and mass transit systems around the country. Either the importation terminal or the distributor of the motor fuel collects the gasoline tax.[14]

The IRS, in response to a question from the US Senate (US Senate 1997), reported that the cost of collecting federal fuel taxes was $51 million in 1996 or 0.2% of revenue collected (IRS 1996). All states also collect their own state gasoline tax (from 8-cents to 36-cents a gallon) and most have an administrative cost of about 1% of revenue collected and a 2% compliance cost (FHWA 2002) for a total cost of 3% (vs. 37.3% for toll collection on the GSP).[15]

Like tolls, gasoline taxes are inherently regressive. Chernick and Reschovsky (1997) show that gasoline taxes burden the poor and middle classes at roughly twice the rate of the top 10% of households. They attribute this to the fact that the poor often have less fuel-efficient cars because of a lack of resources. One opportunity presented by a gasoline tax is that it gives consumers an incentive to purchase fuel-efficient vehicles, unlike tolls which charge the same rate for a hybrid vehicle that gets 50 miles per gallon as a sport utility vehicle (SUV) that gets 10 miles per gallon.

Triple Taxation

Another problem with toll collection as a means of taxation is that toll roads are ineligible for Federal Highway Trust Funds. Therefore, the user of a toll road is subject to triple taxation. First, they pay a federal gasoline tax to fund the Federal Highway Trust Fund (which the toll road is ineligible to receive); second, they pay a state gasoline tax; and third, they pay the toll itself.[16]

As an example of the effect of triple taxation, we present the following scenarios comparing the GSP toll collection method with a gasoline tax raising the same number of dollars. In Table 8, the current situation is outlined for the three participants in the toll collection process—the highway authority, road users, and society.

Then, as an alternative, the gasoline tax method is examined, assuming the exact same number of dollars—$152.66 million—are collected from road users (Table 9). Note that there is a significant reduction in compliance cost, no pollution cost, and that additional revenue would now be available from the Federal Highway Trust Fund (HTF). We estimate that the GSP would have received $30.08 million in 2000 based on the HTF's standard cost sharing rule (80% federal dollars and 20% state/local) and the GSP's capital improvement budget of $37.6 million. The people of New Jersey would have saved $82.42 million dollars in the year 2000 if revenue had been collected via a fuel tax rather than a toll.

Conclusion

The analysis of the cost of toll collection on the GSP indicates that it is a very inefficient means of taxation. A significant issue that has not been addressed in previous studies is the cost of pollution created during the toll collection process. By examining the pollution costs on the Garden State Parkway, it is shown that pollution costs constitute 22.3%

Table 8: Cost of Toll Collection to New Jersey

	Winners and Losers in Toll Collection Major Toll Barriers on Garden State Parkway		
	Highway Authority	**Road Users**	**Society**
Gross Revenue	$152,656,603		
Administrative Cost	($30,531,321)		
Pollution Cost			($12,702,011)
Compliance Cost		($13,135,512)	
Fuel Cost		($545,888)	
Total Cost/Revenue	$122,125,282	($13,681,400)	($12,702,011)
Net For New Jersey	$95,741,871		

Table 9: Gasoline Taxes as a Substitute for Tolls on Garden State Parkway

	An Alternative to Toll Collection—A Gasoline Tax Major Toll Barriers on Garden State Parkway		
	NJ Government	**Road Users**	**Society**
Revenue—Federal HTF Revenue–Gas Tax Gross Revenue	$ 30,080,000 $152,656,603 $182,736,603		
Administrative and Compliance Expense, 3% of Gas Revenue	($4,579,698)		
Net Revenue	$178,156,905		
Pollution Cost			$0
User Time Cost	$0		
Fuel Consumption	$0		
Total Cost or Revenue	$178,156,905	$0	$0
Net for New Jersey	$178,156,905		

of the total societal cost of toll collection, or 8.3% of revenue collected. Some people argue that with ATC, pollution is no longer an important consideration. However, these findings are based on current operating practices at most toll facilities in the Northeastern United States.[17] If high-speed ATC were implemented, or if tolls were partially or completely eliminated and replaced by a fuel tax, pollution costs would decline significantly.

However, these types of public policy issues can only be properly analyzed if all costs are accounted for, including those regarding the environment. Currently, toll road operators do not have to purchase pollution tax credits to offset pollution costs created by the toll collection process. Because of this, they are not accounting for all of the costs of toll collection and are, therefore, making sub-optimal policy choices.

Endnotes

1. Some people consider tolls to be a user fee, while others consider them a tax. We believe that any funds collected by a government or governmental agency, which are not fully dedicated to the provision of the actual service used, are taxes.

2. Most toll roads exist in largely unregulated environments. If toll authorities were regulated as natural monopolies, like electric utilities, then toll prices would have to be set at a level that only allowed a "fair" rate of return.

3. Friedman and Waldfogel (1995) study a ticket-type highway system that uses two stops to collect a toll—one to pick up a ticket and one to pay the toll. We have slightly modified their equation to reflect a system where one pays a toll by stopping once at a tollbooth (typically a bridge or single collection point).

4. Most of the toll authorities in the Northeastern United States continue to use low-speed automated toll collection. While this technology has been shown to reduce queuing, it does not allow drivers to maintain highway speed. This results in additional fuel consumption caused by deceleration and reacceleration.

5. There is a bit of controversy over the correct assignment of costs to the toll collection process. Some of the areas of concern relate to other than direct toll collection costs such as capital expenditures on buildings, additional paving necessitated by wide toll plazas and road maintenance, and snow removal on toll plazas. Toll opponents would argue that the stated collection costs understate the true cost to the New Jersey Highway Authority. The seven-cent number reflects the Authority's own estimate of collection costs.

6. The estimates are based on the 11 major toll barriers because, if these were not present, traffic would flow freely. Ramp toll plazas are excluded since they may or may not impede traffic flow, as most exit/entry ramps require deceleration/acceleration regardless of whether or not there is a tollbooth present. We also assume that the user does not experience any congestion at major toll barriers for reasons other than toll collection. While this is a broad assumption, the current toll collection systems on the GSP require all vehicles to decelerate to pay the toll.

7. The cost estimates have been revised three times since 2000. In 2000, this liability was estimated at $21.8 million; in 2001, at $51.8 million; and in 2002, $100 million. The authors have based their analysis on the most recent cost estimates (NJ Highway Authority Independent Auditors Report 2000-2002).

8. The estimated wage rate is from the US Census Bureau's 2000 Census. The Census reports median earnings per worker in New Jersey as $40,141 per year. Dividing this number by 2,000 hours worked per year results in an average hourly wage of $20.07.

9. The authors and their research assistants chronicled over 2,100 observations of hourly toll collection by day and month for the analysis of this one toll plaza.

10. In spite of these results, we remain concerned that the toll collection process is resulting in queuing. This may be why actual usage flattens out during peak periods (Figure 1). If any queuing were occurring, it would increase the cost of toll collection, thereby making our estimates of the total societal cost of toll collection on the conservative side.

11. Emission standards for Hydrocarbons (VOC), Carbon Monoxide (CO), and Nitrous Oxide (NOx) have remained constant for automobiles and light trucks since 1994. In fact, the Corporate Average Fuel Economy has been frozen since 1986.

12. We utilize the national average fuel price to estimate fuel costs in the year 2000. If we were confining our analysis only to the state of New Jersey, then the average fuel price would be about 1.64% less than the national average price.

13. This compliance cost represents the taxpayer's time spent filling out tax forms, collecting information for their tax forms, and paying a tax preparer or educating themselves about the tax forms.

14. The motor fuel tax is interesting with respect to compliance cost estimation since many states allow the terminal (refinery or importer) or distributor to retain a portion of the tax collected as a fee for the service of collecting the tax for the state. In Texas, gasoline distributors collect the tax and the fee; the distributors are allowed to retain 2% of the tax revenue collected. There is currently a proposal in Texas to move the collection point to the terminal and the motor fuel distributors are actively fighting this proposal. This is a strong indication that the current 2% payment for collecting the tax is quite adequate as a measure of compliance cost—in fact, it is most likely too high an estimate.

15. The FHWA reports that the administrative cost for most states is approximately 1% of the state gasoline tax and many pay about 2% as a compliance fee to distributors/producers. As an example, in 2002, the Texas Highway Administration collected $2.832 billion in motor fuel taxes and paid $57 million (2%) to the distributors of motor fuel to collect this tax.

16. They may, in fact, be overpaying for the infrastructure. Many toll authorities divert a significant amount of revenue from toll facilities to other purposes. For example, the GSP used to make a $10 million a year payment to the State of New Jersey.

17. The GSP is currently only using a low speed collection method, which our research indicates results in almost the same amount of pollution as manual toll collection.

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