Revenue Risk Mitigation Options for Toll Roads

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ABSTRACT

The major risk associated with the provision of toll facilities results from uncertain future demand/revenue generated from the facilities. In this paper, I examine various options for mitigating toll revenue risk and provide a set of recommendations as to how revenue risk mitigation should be pursued. In addition to conducting more careful traffic revenue studies and risk analyses, policy makers can provide more flexible tolling schedules, adopt advanced toll collection technology, and limit the non-compete clause included in many toll road deals with private operators.

Keywords – Risk mitigation; revenue risk; pricing method; toll collection technology; non-compete clause.

INTRODUCTION

Before committing to large and costly transport projects, both the public sector and the private sector must develop a better understanding of the potential risks associated with alternative options. Revenues associated with toll road projects can be very risky due to high initial investment costs and construction risks, high operating and maintenance costs, and lengthy service periods.

Road infrastructure project risks can be classified into two broad categories: common risks and project-specific risks (Checherita and Gifford, 2007). Major common risks include those associated with (1) design failure; (2) cost and time overruns; (3) construction risks (most important for new facilities, including unexpected geological challenges, and construction hazards); (4) changes in the cost of repair and renovation; (5) force majeure risks (i.e., risks associated with exogenous events such as earthquakes, wars, floods, and tidal waves); (6) macroeconomic risks (i.e., population growth, inflation rate, exchange rate, interest rate, etc.); (7) risks from requirements for environmental permits related to facility construction or expansion; (8) legal and institutional risks; and (9) various revenue risks (Czerwinski and Geddes, 2010).

I first address the question of which risks are best borne by investors and which by the public sector. Investors may be better able to manage some risks (that is, to bear them at lower cost), while others may be more efficiently borne by government. Perhaps the major risk associated with toll facilities stems from uncertain future demand/revenue generated by transportation facilities. The financial failure of several major public-private partnerships (P3's) (Legislative Study Committee, 2008) demonstrates the importance of employing an appropriate risk analysis and risk allocation strategy.

Next, I examine various options for mitigating toll revenue risk. The overarching goal is to provide a set of recommendations regarding how revenue risk mitigation should be accomplished. Revenue-related risks have proven to be the most important risk associated with toll road provision in the United States. From the private sector's standpoint, long-term obligations are very risky since future development patterns may not generate sustained revenues (i.e., traffic levels), and thus they profit even if toll rates are designed to be flexible and demand-responsive (Checherita and Gifford, 2007). The main risk stems from how many toll road users are expected and thus what the future income will be. This question is even more intriguing in the states with highly volatile GDP, traffic flow, users' willingness to pay tolls, or any other unstable variable that is crucial for the determination of future revenue.

Toll highways in North America have encountered major revenue-related challenges, especially during the 2008-2009 economic downturn. Table 1 shows the major financial elements for several major toll roads/facilities. As can be seen in the table, most roads could not make net profits. Note that opposite to what was expected, the most profitable facility (New Jersey Turnpike) is owned/operated by a public agency. However, several strategies could be pursued to mitigate the revenue risk. After an overview of general risk management strategies, I examine a few revenue risk mitigation strategies.

Table 1 Net profits of various toll roads (2008)

Source: http://www.barrons.com/articles/SB124183159872002803

2008 Results	Indiana Toll Road	Chicago Skyway	Dulles Greenway[1]	407 ETR Toronto[2]	Penn Turnpike	N.J. Turnpike[3]
Revenues (mil)	$155	62	64	546	620	856
Operating Income (mil)[4]	$48	30	39	342	53	376
Interest Expense (mil)	$244	97	58	257	146	240
Net Profit (mil)	–$196	–67	–19	85	–93	136
Cash Flow(mil)	$117	52	47	414	247	NA
Total Debt (bil)	$3.5	1.6	0.9	4.7	3.8	4.8
Macquarie's Stake	50%	45	100	30	None	None
Other Major Owners	Cintra 50%	Cintra 55	–	Cintra 53	Pa.	N.J.

1-2007 figures. 2-Canadian dollars. 3-Includes Garden State Parkway. 4-Before interest expense. NA–Not available.
Source: Management reports

RISK MANAGEMENT STRATEGIES

In general, the major steps for managing risk include (Figure 1): (*i*) risk identification, (*ii*) risk quantification, (*iii*) risk allocation, (*iv*) risk mitigation, and (*v*) risk monitoring and control. Note that the risk mitigation step is not separated from the other steps, and other risk management strategies can even affect the choice among various risk mitigation options and vice versa. For instance, considering a flexible tolling schedule as an effective revenue risk mitigation strategy, the private (or public) operator/owner might be able to accept full traffic revenue risk (risk allocation step) since the operator can adjust toll rates to attract more demand during low revenue periods. However, without such flexible toll schedules, the private operator usually needs revenue guarantees or payments from the public agencies to make the project less risky (Rouhani et al., 2015b). This section provides a brief description of revenue risk analysis strategies as important factors in deciding about the risk mitigation option.

Figure 1. Various stages of risk management

Source:
http://www.unece.org/fileadmin/DAM/ceci/documents/UNDA_project/1._Introduction_to_PPP.ppt

Based on another perspective, two basic risk management stages include: (1) identifying the risks by looking at similar projects and interviewing various stakeholders and end users, and (2) deciding whether to retain, manage, mitigate or control the risk (FHWA, 2012). In the case of toll roads, quantitative risk analyses are used to assess toll revenue risks. Inputs of the analysis are the information on (distributions of) a variety of individual risks/factors, including (*i*) population and economic growth (Bain, 2009), (*ii*) the pricing structure (Rouhani et al., 2013), (*iii*) the operating cost of toll collection (Rouhani, 2012), (*iv*) the costs and availability of alternative travel modes to the toll road (Rouhani and Niemeier, 2010), and (*v*) the price of fuel (Rouhani, 2010; Mirchi et al., 2012).

Quantitative risk analysis can be categorized into two approaches: (1) formula-based analysis, and (2) Monte Carlo simulation. Formula-based quantitative risk analysis uses a simple formula to calculate average risk impact with respect to the probability of occurrence and reports the minimum, maximum, and most likely impact of the risk as outputs. Monte Carlo simulation, the other major approach, requires two inputs: (1) quantifying the probability and the revenue implications of the risk type under study, and (2) selecting a distribution type according to the nature of the risk. Based on these inputs, Monte Carlo simulation provides a simulation of the expected impact of the risk and determines a range of risk impacts along with their probabilities. The analysis will result in a probability distribution of the likely revenues under different confidence intervals. Note that the public and private sectors differ in their preferences. A risk-averse public agency, for instance, may use 90 percent or 95 percent as its confidence level preference while risk-taker private entities may be willing to use a confidence level close to 50 percent (FHWA, 2012).

REVENUE RISK FACTORS

One important factor in designing different strategies for a toll road's risk management is based on the outcomes of traffic revenue studies. Traffic revenue studies forecast traffic on toll facilities under various toll rate schedules (FHWA, 2012). These studies estimate the future behavior of people and businesses with respect to land use (housing location), travel mode choice, and route choice decisions. However, these estimates are associated with many uncertainties. In addition, revenue risk can vary significantly based on the scope of the project (a new construction project, expansion of existing facility, or conversion of an existing unpriced facility to a tolled one).

The revenue risk consists of three major factors: (1) a demand risk or traffic volume risk, (2) a price risk related to toll rate settings, and (3) a risk associated with toll collection and/or operating costs. Demand risk, however, is linked to the price risk through the price elasticity of demand. Price elasticity of demand in turn is determined by the availability of travel substitutes for the toll road (Estache and Strong, 2000). One major factor that can significantly affect the availability of substitutes is a non-compete clause (Boarnet and DiMento, 2004; Ortiz et al., 2008) included in some P3 toll road contracts, whether the public sector can provide an alternative nearby or not. Demand risk is also related to the quality and the level of congestion on the facility of concern. Performance-based requirements can significantly impact the demand (revenue) from toll roads as well as the related operating costs.

Forecasting traffic demand is the major factor in analyzing revenue from P3 toll roads since travel demand influences both costs (through toll collection expenditures) and project revenues (through directly charging traffic), especially if tolls are the main revenue source for the P3 company (European Investment Bank, 2015). In addition, estimating the value of time can have important implications for toll revenues in the future (Rouhani, 2015).

One very common issue (bias) in demand projections is the overestimation of traffic. In one prominent example, the Camino Columbia Toll Road (CCTR) in Laredo, Texas (Legislative Study Committee, 2008) was opened to traffic in October 2000. The initial traffic forecasts predicted 300 cars and 1,500 trucks per day. Although the number of cars was slightly under-predicted, the estimated number of trucks never materialized, resulting in annual revenue of only $500 thousand rather than the estimated revenue of $9 million. As a result, the CCTR was sold at a foreclosure auction in 2004. Another example of the overestimation of traffic is the Dulles Greenway in Virginia. Despite the use of two independent consultants' projections, the initial traffic was below 30 percent of the projected flow. Even after reducing tolls from $1.75 to $1, the traffic level was around 70 percent of the projection (Estache and Strong, 2000).

The estimation of the future traffic level is biased for two reasons: (1) the so-called "optimism bias" (Lemp and Kockelman, 2009; Welde and Odeck, 2011): traffic forecasts are prone to private sector prejudice (when they bid) because that they want to get the deal done, and (2) inflated traffic forecasts are also related to traffic modeling flaws (Bain, 2009). Figure 2 depicts this systematic bias in the demand forecasts of toll roads.

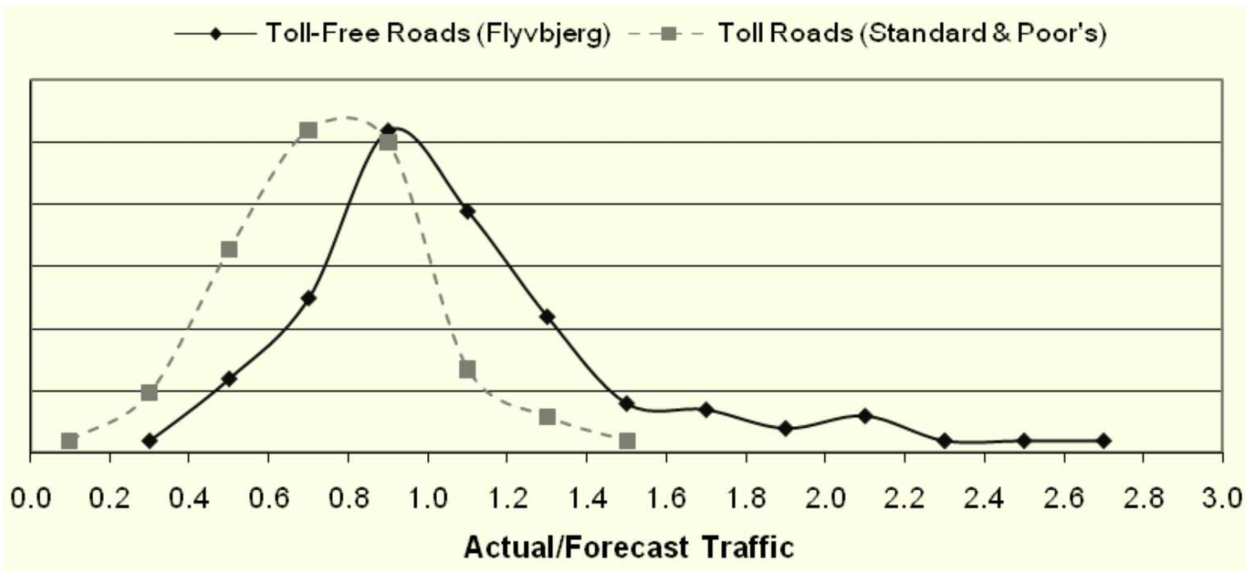

Figure 2. Distribution of actual-to-forecast traffic tolled (solid) and non-tolled (dashed).
(Source: Bain and Plantagie 2004, Chart 3)

For P3 projects, the revenue risk is particularly effective for greenfield P3s since expected traffic flows can only be inferred using statistical or travel demand modeling, while current traffic flows on brownfield P3s are known, and the future traffic flow estimations are more certain.

Traffic forecasting is not the only major model affecting the analysis. Financial model and risk matrix can be very important in determining and controlling for revenue risk. Risks are identified and quantified in a risk matrix, considering a sensitivity analysis conducted along with the financial model and the value for money (VfM) analysis. Figure 3 shows how these tools are interrelated.

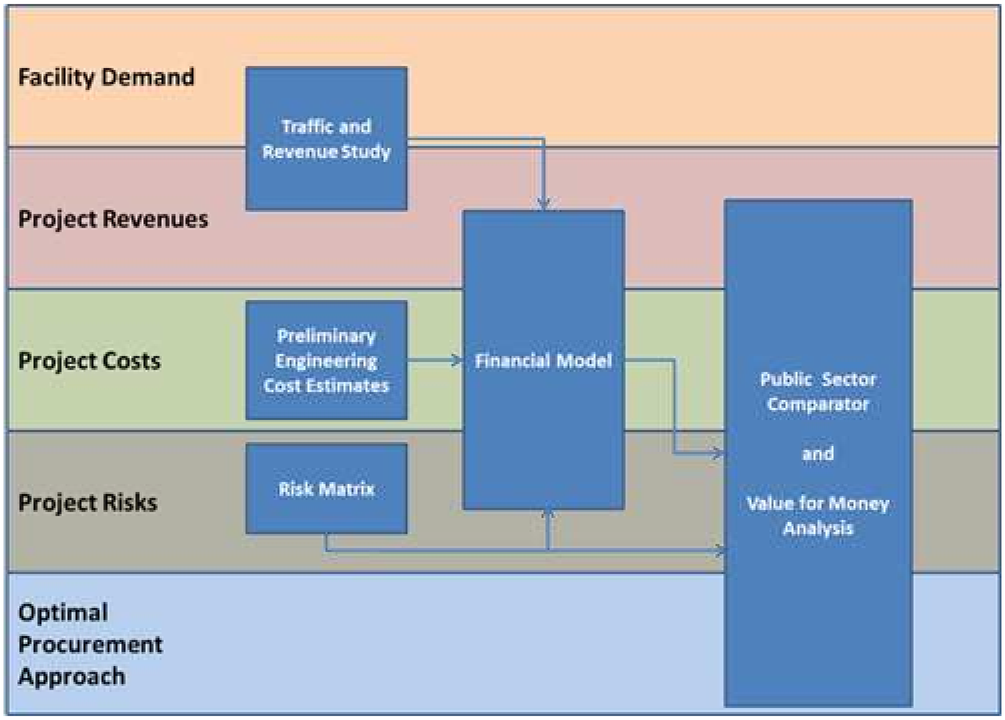

Figure 3 Revenue/cost analysis during project phases.

Source: https://www.fhwa.dot.gov/ipd/forum/challenges_and_opportunities/decisionmaking.aspx

Another important element of revenue risk is the price risk. Price risk arises from political opposition to increasing the toll rate, and the inability to impose dynamic pricing and price differentiation across various vehicle types. The price risk has smaller effects than the demand risk; however, its potential cannot be underestimated. Providing an advanced technology along with a flexible pricing scheme can resolve most issues related to the price risk. Finally, the enforcement risks are associated with the type of toll collection system to be used (i.e., toll booths versus various automatic toll collection systems) since new toll collection systems can significantly decrease tolling costs and consequently improve the profitability of toll roads (Rouhani, 2014; Vats et al., 2014).

A broad consensus among economists is that ideally the revenue risk should be borne by the private sector. The rationale is that private partners can influence key factors related to the risk such as the road quality, the congestion level, and the toll rate, which can in turn impact revenue (Engel et al., 1997). However, in many cases, the private sector is not willing to take on the risk because the risk seems to be immense. Therefore, public agencies should specifically search for various approaches to mitigate the revenue risk for private/public operators.

Revenue Risk Mitigation Options

Along with other risk management strategies, public agencies should explore options that could mitigate revenue risks for toll road P3 projects. Following are several factors that could mitigate such risks:

1) *Pricing structure:*

One of the most critical policy issues facing potential private sponsors under P3 agreements and also for several public operators is related to the market power potentially held by the toll collection agency. The operator of a facility, whether public or private, possesses market power if there are few alternatives to a particular road, bridge, or tunnel—that is, when competition from other modes of travel and facilities is weak (Rouhani, 2009). If a bridge provides one of only a few ways to get to a certain destination, for example, then the toll collection firm can raise tolls above those that would be set in a competitive market (Rouhani and Gao, 2015). This leads to an inefficient equilibrium, where a small number of vehicles use the facility. The appropriate policy goal should be to create a set of institutional arrangements that achieves the best or optimal toll level/system (Rouhani et al., 2015c), and thus results in the correct number (from the social perspective) of vehicles using the facility (Geddes, 2011; Rouhani et al., 2014a), which might require very complex modeling and algorithms (Poorzahedy and Rouhani, 2007; Madani et al., 2011; Madani et al., 2014).

To increase the possibility of higher profits and/or properly managing congestion (Rouhani et al., 2014b), public authorities should provide the private operator with a flexible (temporal and spatial) tolling scheme. The toll rates should be allowed to vary spatially (geographically) and temporally. Flexible tolls could be significantly effective in increasing profits, specifically in improving transportation system performance and congestion (Rouhani and Niemeier, 2014a). Tolls can vary based on time-of-day schedules (Chew, 2008) as is the case of Singapore, which is based on responsive tolls adjusted according to actual travel conditions (Bonsall et al., 2007), and from one road segment to another for a single toll road (Rouhani and Niemeier, 2014b). On the other hand, restrictions on toll levels (toll ceilings) can also significantly impact the revenue (Rouhani et al., 2015a). However, the structure provided (by the regulations) to collect tolls can be an extremely important leverage to reduce toll revenue risk. Nevertheless, this option is closely related to option 3, which will be discussed later in this section.

2) *Non-Compete Clauses:*

Non-compete clauses under P3 contracts have been a contentious issue in the United States, in part because of the controversy that arose about the California 91 Express Lanes non-compete clause (Boarnet and DiMento, 2004). A non-compete clause is a security offered by the public partner ensuring that it will not build a competing transportation facility within a specified distance of the privately operated toll facility. This clause may allow the public partner to construct a competing facility but must use a predetermined formula to compensate the private partner for lost revenues resulting from the unexpected competition (National Surface Transportation Infrastructure Financing Commission, 2009).

For instance, the Indiana Toll Road concession agreement requires the state of Indiana to compensate the private concessionaire if the state constructs a new interstate-quality highway of twenty or more continuous miles, within ten miles of the Indiana Toll Road. On the other hand, in some countries, “compensation clauses” are complementary, under which the private partner compensates the relevant public sponsor for increased revenue generated by an unplanned facility such as a new interchange or access road (Czerwinski and Geddes, 2010). However, non-compete clauses play an important role in affecting both the amount of toll revenues and the risks associated with them. Clear statements should be included in P3 contracts, clarifying the potential of capacity enhancements and their revenue implications. The goal should be to find a balance between the project’s delivery objectives and the long-term sustainability of transportation systems (which may require adding capacity). The bankruptcies of many private partners have been directly or indirectly attributed to the associated non-compete clauses (Ortiz et al., 2008).

3) Toll collections system:

Another important issue that can mitigate revenue risk is related to toll collection costs. Victoria Transport Policy Institute (2014) estimated the toll costs in a range from 10 percent (for electronic tolls) to up to 40 percent (for toll booths) of toll revenue. Nevertheless, many toll roads have negative net profits (as shown in Table 1) because of other transaction-related costs. In another comprehensive study on North American toll roads, Balducci et al. (2011) calculated the operating and capital costs of collecting tolls. For major private toll roads like Toronto 407 and Dulles Greenway, the operating cost is estimated at $0.2 per transaction (for private systems). The study estimated an operating cost of $0.24 per transaction for more costly publicly-run systems. The difference between the public and private toll collection costs and management (Geddes et al., 2015) exists despite the fact that some studies have shown that private provision does not systematically result in lower costs (Bel and Warner, 2008; Bel et al., 2010). Nevertheless, scale or learning economies that cannot be reached by government could ensure lower unit costs of private services (De Bettignies and Ross, 2004).

However, the choice among various toll collection systems has very important consequences on the costs, and as a result, on the profits of a toll road. To provide a less risky environment for toll collection agencies, regulations should aim for advanced technologies (Rouhani and Gao, 2014) to collect/manage tolls. Not only can advanced technologies increase revenue, they can provide better system performance (no queuing) and reduce social costs associated with toll booth operations; e.g., very high rates of suicide among toll booth employees (New Jersey On-Line LLC, 2012).

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