



Project Summary

Texas Department of Transportation

0-5881: Quantifying the Effects of Network Improvement Actions on the Value of New and Existing Toll Road Projects

Background

Revenue-generating roadway projects (toll roads) rely on revenue from collected tolls to repay the debt incurred during construction. As such, the projects can be successful if they generate enough revenue to retire the debt, or unsuccessful if they fail to generate enough revenue to repay bonds and/or loans. The objective of this research project was to capture the effects of investment in surrounding roadway networks on the success of toll road projects.

Determining the monetary value of toll road projects is inherently tied to analysis of the supporting transportation network as the travel time, capacity, and condition of surrounding network links are important factors in users' choices for utilizing the toll road. In this context, two types of network links can be distinguished. Feeder links are the links that feed traffic to the toll link, while competing links are the links that compete for the same traffic (e.g., parallel roads). If the conditions (travel time, capacity, etc.) on feeder links are improved, more people will likely take the toll link. On the other hand, if competing links are improved there will likely be less people on the toll link because users will choose improved competing links to complete their trips. In complex urban transportation networks, long-term transportation plans must be analyzed to assess the viability of toll road projects.

What the Researchers Did

The researchers investigated the correlation of traffic flows in complex urban networks and developed a model that links the toll road revenue risk (i.e., ability of the project to generate enough revenue to repay the debt) with the three financial instruments most commonly used in public-private partnership (PPP) agreements: bank loans, bonds, and buyback and salvage options. The project developed a new methodology that links transportation network planning parameters with financial risk measures. This network-based valuation method provides a quantitative assessment of the impact of changes in the network structure on the financial feasibility of toll road projects.

Research Performed by:

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What They Found

The researchers found the network-wide impact on the toll road revenue risk can be assessed using four sequential steps:

- Step 1: **Getting Link Flows.** Using existing information about origin-destination demand pairs and network characteristics, one can determine traffic flows on all links in the network using available commercial software tools for traffic assignment (based on the principles of user equilibrium).
- Step 2: **Adding Uncertainty.** Based on information about traffic flow on the link of interest, the next step is to model the uncertainty of the traffic flow. To do so, one specifies traffic flow as a random process. The required parameters for this modeling approach are drift rate (average growth) and volatility (variance) of traffic flow. These parameters need to be estimated from historical data, or assumed if such data are not available.
- Step 3: **Analyzing Sensitivity.** This step uses sensitivity analysis of the toll road traffic flow with the changes in the capacity on the links in the surrounding network. The identification of feeders and competing links is introduced in this step: positive elasticity between increases in the capacity and traffic flow identify the feeders, while negative elasticity identifies competing links.
- Step 4: **Evaluating Output.** The traffic flow model and elasticity values are used as the inputs for analysis of bonds, bank loans, and buyback and salvage options. The final output is the marginal change of adopted financial risk measures resulting from changes in link capacities.

What This Means

The valuation method developed in this research is a valuable tool that has potential to add to the current practices of toll road modeling by:

- creating a basis for objective assessment of the impact of transportation network policies on the ability to secure toll road project financing,
- providing a decision-support tool to quantify the impact of changes in the network structure on a project's financial feasibility, and
- building common ground to ensure that decisions made by the public sector are interpreted in a meaningful manner by project managers and decision makers.

For More Information:

0-5881-1 Quantifying the Effects of Network Improvement Actions on the Value of New and Existing Toll Road Projects

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