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Demand and operating cost forecasting accuracy for toll road projects

Morten Welde [a,b,*]

[a] Norwegian Public Roads Administration, P.O. Box 8142 Dep, 0033 Oslo, Norway
[b] Norwegian University of Science and Technology, 7491 Trondheim, Norway

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ABSTRACT

Inaccurate forecasts represent a major source of risk in road and toll projects because they could result in financial difficulties or even bankruptcy. This paper focuses on demand and operating cost forecasting accuracy for Norwegian toll projects by comparing the forecasted and actual levels of traffic and operating costs. The differences among the types of projects and the effects of project size, time and demand ramp-up are also examined. Our study finds that traffic forecasts for Norwegian toll projects are fairly accurate, on average. However, a majority of the investigated projects experienced overestimation, and a huge general error in the forecasts suggests that this is also a source of risk that merits greater scrutiny. Inaccuracies are common among all project types and sizes. Operating costs are frequently underestimated; on average, these costs are about 30% higher than estimated.

1. Introduction

Several countries have traditionally used direct tolls to accelerate road construction and to decrease the need for government funds. Today, the increasing use of road tolls raises several interesting issues that require further examination. As the number of new toll projects around the world increases, the need to establish better estimates of revenues and operating costs becomes crucial. Toll projects are subject to traditional cost-benefit analysis and to financial analysis, both of which rely heavily on the accuracy of the forecasts being used.

Norway is a striking example of a country that has extensive experience with toll financing; since the 1930s over 100 road projects have been financed with tolls. Today, there are 50 projects in operation throughout the country, and tolls comprise approximately 45–50% of Norway's total annual road investment funds. According to the National Transport Plan for 2010–2019, this percentage is expected to increase in future years. The success rate of toll projects in terms of fulfilling their financial objectives is high; only one project has ever declared bankruptcy, which could indicate that demand and cost estimates in Norwegian toll projects have been relatively accurate. From 2000 to 2009, 19 projects repaid their initial investments, which permitted the cessation of tolls for these projects. Moreover, among these projects, tolling ended earlier than planned in seven of the projects, and only three projects experienced financial difficulties that necessitated the extended use of tolls beyond the time period that was originally planned. In the remaining nine projects, tolling was ended according to the original estimates.

This summary, however, is somewhat inaccurate. According to government regulations, toll companies can increase tolls by up to 20% or increase the pay-off period by up to 5 years if the financial health of a toll project shows poor development. Because alternative routes to tolled roads are often non-existent or also subject to tolling to avoid revenue leakage, toll companies rarely encounter severe financial difficulties. To evaluate whether the planning and implementation phases of a toll project are successful, we must instead consider the original parameters according to which the project was developed.

This paper proceeds as follows. Section 2 discusses the primary risks in toll projects. Section 3 presents some previous research concerning the forecasting inaccuracies in road projects with particular emphasis on toll projects. Section 4 presents the data and the methodology used in this study, and consequential results are presented in Section 5. Section 6 provides some conclusions.

2. The risks of toll financing

Norwegian toll financing is provided by independent, non-profit toll companies that are fully or partly owned by local authorities. The motivation for involvement in a toll project does not lie in the potential for profits but in the opportunity for better access to national and international markets through the country's trunk road network. In some cases, the willingness to raise

* Correspondence address: Norwegian Public Roads Administration, P.O. Box 8142 Dep, 0033 Oslo, Norway.
E-mail address: morten.welde@vegvesen.no

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private funds through tolls may generate additional government funds for the region (Odeck and Bråthen, 2002).

Whether a road project can be completely or partly financed with tolls largely depends on the traffic level (i.e., the number of paying vehicles), toll collection costs and financing costs. In the standard contractual regime that governs Norwegian road construction, the responsibility (and risks) for construction and maintenance costs remains with the government, regardless of whether the project is financed using tolls. In addition, while interest rates are primarily determined by macroeconomic factors that are outside the control of project planners, traffic levels and toll collection costs are variables that planners should be able to predict with a reasonable degree of accuracy.

Accurate estimates are important from both a financial and a social perspective. Traffic and cost forecasts are essential for the credit risk assessment of a toll project. Traffic levels below those of the original forecasts or operating costs higher than those originally estimated could result in financial difficulties or even bankruptcy. For privately funded projects in which investors expect some return on their invested capital, the treatment of risk is essential. For high-risk projects, investors require a greater expected return so as to compensate for the additional risk. In cases in which several input variables suffer from inaccuracy, such as demand shortfalls and cost overruns, the risk of financial difficulties or default is further increased.

Major infrastructure projects are usually subject to some type of social appraisal, such as cost-benefit analysis. Cost-benefit analysis is based on a measurement of costs and benefits in monetary terms and the discounting of variables over a period of 25–40 years. Thus, if estimates of cost and benefit variables are inaccurate, the resulting analysis will be of little value. The overestimation of benefits and underestimation of costs could result in the implementation of the wrong projects. This phenomenon was illustrated by Anguera (2006), who demonstrated that the Channel Tunnel rail link should never have been constructed as systematically overestimated benefits in the original cost-benefit analysis concealed the fact that the tunnel has never been a viable project in cost-benefit terms.

Inaccurate forecasts are, however, not necessarily a problem. If errors are randomly distributed around the expected values, they could potentially cancel one another out in a project portfolio. The problem arises when forecasts are systematically biased with averages that significantly differ from zero due to over-optimism or dishonesty among planners. If dishonesty is the cause of the bias, mitigating this problem is much more difficult than if the error is due to inaccuracies in the transport model.

3. Literature review

An increasing number of studies have demonstrated that the forecast intervals from cost-benefit analysis are quite broad, which should be a serious cause for concern for project planners and decision makers. Transport projects are risky because of their complex nature and the long-term scope of their planning; the failure to inform decision makers of the risks inherent in forecasts thus represents a major source of error in project appraisals.

Early work by Pickrell (1989) used forecasts that were prepared for 10 transit projects in nine urban areas from 1971 to 1987 to demonstrate that US urban rail transit suffered from serious demand shortfalls and overly optimistic forecasts. This field of research was later expanded by Flyvbjerg et al. (2006), who investigated 84 road projects throughout the world. These authors concluded that planners in the transport industry do a poor job of estimating demand in transport infrastructure projects. Their study found actual road traffic to be an average of 9.7% higher than that forecasted, and over half of the projects in the sample exhibited a difference between actual and forecasted traffic of more than $\pm 20\%$. The findings by Flyvbjerg et al. are similar to the earlier findings by Goodwin (1996), who showed that a year after opening, traffic in 151 UK Department of Transport road schemes was an average of 10.4% higher than that the corresponding year-one forecast. On 85 of the alternative routes to these schemes, traffic was 16.4% higher than forecasted. This dichotomy illustrates the complexity of transport planning and transport modelling in general. It thus appears that underestimation is prevalent in toll free-projects.

As the relative importance of toll financing for road construction increases, the risk assessment of toll projects for potential investors and/or other stakeholders becomes essential to providing reliable business models for such projects. The credit rating agency Standard & Poor's (S&P) has carried out several risk assessment studies of traffic forecasts in toll projects, concluding that optimism bias and error is widespread in toll projects throughout the world (Bain and Wilkins, 2002; Bain and Plantagie, 2003, 2004; Bain and Polakovic, 2005).

In the latest S&P study, traffic from a sample of 104 toll projects was an average of 20–30% lower than that forecasted (Bain and Polakovic, 2005). Thus, while traffic on toll-free road projects is generally underestimated, the opposite result seems to occur for the toll projects in the S&P sample. Actual traffic volumes varied from only 15% of the forecasted level to more than 150% of the forecasted level. For potential investors, these results are alarming and emphasise the importance of subjecting all toll projects to a thorough risk assessment. Furthermore, the S&P sample was likely biased by an over-representation of toll facilities with higher credit ratings; the worst cases of traffic overestimation were probably not included in the sample. Forecasts for complex road schemes with intricate traffic patterns are also likely to be vague or non-existent, making follow-up studies more difficult.

Findings parallel to the results from the S&P sample study were reported in an early work by Odeck and Skjeseth (1995), who found that traffic in 11 of 14 Norwegian toll road projects was overestimated. The authors concluded that an overestimation of traffic along with an underestimation of costs represents a significant risk that was never brought to the attention of the relevant decision makers.

These conclusions were supported by Næss et al. (2006), who reported that traffic on European and American toll roads was generally overestimated; Li and Hensher (2010) provided similar findings for Australia, where traffic on five major toll schemes was an average of over 40% lower than forecasted. A more recent study by Welde and Odeck (2011) used data on both tolled and toll-free roads to show that traffic on toll roads was slightly overestimated; meanwhile, traffic on toll-free roads was severely underestimated, possibly due to a failure to account for induced traffic.

The concept of demand ramp-up (i.e., an improvement in forecast accuracy over time) is often considered to be an argument against using the first entire year of operation as the basis for measuring forecast inaccuracy because travel demand often depends on variables that may take years to propagate through the system. The S&P studies showed no such effect; however, Li and Hensher (2010) observed small improvements over time, and Welde and Odeck (2011) suggested that reaching the full traffic potential on toll roads may take a few years. Similar conclusions were reached by Fitch Ratings (George et al., 2003), which reported that the actual performance of U.S. toll projects was heavily skewed downward, but these authors found clear evidence of ramp-up and claimed that traffic tends to gravitate toward and even exceed original forecasts over time.