



# The accuracy of toll road traffic forecasts: An econometric evaluation



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## ABSTRACT

This study assesses the accuracy of toll road traffic forecasts in Norway. This study contributes to extant literature regarding transportation economics and policy because few studies have analyzed the accuracy of toll road traffic forecasts and current studies on this topic do not use a succinct econometric framework to infer the forecast's bias and efficiency, which are determinants of the accuracy of forecasts. The data for this study include 68 toll road projects where forecasts and actual out-turns were available. All projects that are included in this study were opened for traffic during 1975–2014. Transport models were made mandatory for forecasting toll traffic in 2006. The results of this study reveal the following: (i) Norwegian toll road traffic forecasts are underestimated but are close to accurate because the mean percentage error is a mere 4%. This result sharply contrasts international studies that resulted in large overestimations at more than –20%. (ii) The accuracy of forecasts has not improved since transport models became mandatory. (iii) The Norwegian toll road traffic forecasts are unbiased, which implies that they do not tend to be one-sided. (iv) Norwegian forecasts are efficient, which implies that available information is used adequately when making forecasts. Our conclusion is that the toll traffic forecasts in Norway perform fairly well compared to the forecasts of other countries. In addition, we recommend that the assessment of forecasts in the transportation sector should be based on succinct econometric frameworks; otherwise, the conclusions may lack important information regarding the bias and efficiency of the forecasts.

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## 1. Introduction

Traffic forecasts are a major determinant of transportation policies. Before regulating authorities nominate any transportation development for approval, they require an assessment of the potential impacts, particularly regarding future traffic volumes, which determine the financial and/or socio-economic merits of the project. Governments rely heavily on these assessments when making policy decisions. The importance of accurate and unbiased traffic forecasts is obvious; over- or underestimating traffic may severely bias the estimates on which government decisions are based. Overestimating traffic may overestimate the social surplus derived from the cost-benefit analyses that is used in the appraisal of potential projects. If the government had known the actual traffic volume and the actual net present value, it may have opted for other more viable options or implemented the same project in a different form. Conversely, underestimation may represent a case of

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pessimism-bias where viable projects do not obtain public funding due to an underestimation of benefits. In other cases, traffic growth is undesirable, such as in urban areas. An underestimation of demand could represent a shorter period of relief from congestion and an underestimation of the do-minimum alternative. Furthermore and perhaps more importantly, toll projects rely on the revenue that is provided by the users of the road. When traffic is underestimated, the effects of the project may include a financial deficit, increased toll fees or guarantors may be required to partly or fully redeem their obligations.

Interest in the performance of road tolls with respect to traffic levels has increased in recent years. One of the most recent studies on this topic is [Gomez et al. \(2015\)](#); these scholars studied the variables that determine the light-vehicle demand for toll roads in Spain. However, few studies have specifically focused on the accuracy of toll traffic forecasts.

In this study, we evaluate the accuracy, bias and efficiency of traffic forecasts with respect to toll road projects in Norway. We use a succinct econometric framework that is commonly used in prior studies regarding forecasting; for example, [Holden and Peel \(1990\)](#) and [Clements and Hendry \(2005\)](#). The rationale for this study and its contribution to extant literature regarding transportation research and toll road traffic forecasting are as follows: (i) Norway extensively uses tolls to finance transportation infrastructure projects and the lessons that have been learned could provide a useful benchmark for other countries. (ii) Prior studies regarding the inaccuracy of toll traffic forecasts have not used succinct econometric frameworks to check for forecast bias and efficiency. Therefore, our application adds value to extant literature regarding transportation. We use data from 68 toll projects that are spread throughout the country and information regarding traffic forecasts that were made for the years after opening and actual out-turns for the first five years after opening.

This paper proceeds as follows. Section 2 describes tolling in the context of Norway, including forecasting methods. Section 3 provides a brief literature review. Section 4 describes the econometric method that is used to assess the accuracy, bias and efficiency of traffic forecasts. Section 5 describes the data that are used in this study. Section 6 presents the results. Section 7 discusses the lessons that can be learned from the Norwegian experience. Finally, Section 8 provides the concluding remarks.

## 2. Road tolling in the Norwegian context

In the past three decades, Norway has experienced a tremendous growth in the number of toll companies that have been established to collect tolls to fund road infrastructure projects. The reasons for this growth are similar to those experienced in many European countries and in the US; government funding is constrained. Therefore, road authorities seek alternative measures to fund much-needed infrastructure projects. One of the primary reasons for constrained government funding in Norway despite large oil revenues is the need to control the level of activity in the economy. Expansively using public funds during up-turns in the economy may overheat the economy and lead to an undesired level of inflation.

However, the Norwegian form of road tolling is peculiar in an international setting. Unlike the rest of Europe and the US, Norwegian toll companies are non-profit organizations that are established by local authorities and interest groups solely for the purpose of collecting funds for financing road infrastructure; these funds help finance infrastructure projects sooner than would be possible with only government funds. The Norwegian model for financing road infrastructure by tolling has become popular among Norwegian policy makers and new projects are consistently proposed and implemented.

To date, tolls have financed more than 100 projects and only one project declared bankruptcy due to insufficient toll fund collections that could not repay the loans for the road project. Other cases of financial difficulties have occurred where the consequences have been less severe but where the tolls were increased and the loan repayment period was extended. Despite certain project failures, the Norwegian system of road tolls is regarded as successful because it is effective in implementing projects quicker than would otherwise be possible (see for example, [Odeck and Bråthen \(2002\)](#), [Odeck \(2008\)](#), [Bråthen and Odeck \(2009\)](#), and [Welde and Odeck \(2011\)](#)).

The organizational framework of toll funding proceeds as follows. The Ministry of Transport and Communication (MTC) establishes operating regulations that apply to all toll companies. These regulations include the time period for which tolls can be claimed (generally 15–20 years), after which the project is paid for and the tolls are removed. Toll rates may vary for projects and depend on traffic volume and construction costs. The Government instituted the 15- to 20-year limit to ensure that tolls do not become permanent but rather serve as a temporary solution for road funding. In most cases, toll collection is terminated prior to the end of the concession period due to conservative financial forecasts that are used in the analyses. Not all construction costs are paid for by tolls. A percentage of the costs, generally 20–50%, is paid for with government funds. The MTC evaluates this percentage based on recommendations from the Norwegian Public Roads Administration (NPRA), which is responsible for overseeing the planning and construction of the national road network. Parliament may accept and sanction this percentage. Factors that are included in this percentage include the level of traffic, the number and location of toll stations, total construction costs, and the level of toll fees. Occasionally, local authorities finance a certain percentage of the construction costs based on their own suggestions. A toll company collects the tolls, which in all instances, must be owned by local or regional authorities.

Generally, road tolling is not politically controversial because toll projects that are presented to the Parliament are often approved without discussion. However, there may be one particular objection to this. It is the fact that tolling lead to dead-

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