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Roads to nowhere: The accuracy of travel demand forecasts for do-nothing alternatives

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ABSTRACT

Impact appraisals of major transport infrastructure projects rely extensively on the accuracy of forecasts for the expected construction costs and aggregate travel time savings. The latter of these further depend on the accuracy of forecasts for the expected travel demand in both the do-something and do-nothing alternatives, in order to assess the impact of implementing new projects compared to doing nothing or postponing the decision. Previous research on the accuracy of travel demand forecasts has focused exclusively on the do-something alternatives, where inaccuracies have been revealed in the form of large imprecision as well as systematic biases. However, little or no attention has been given to the accuracy of demand forecasts for the do-nothing alternatives, which are equally important for impact appraisals. This paper presents the first ex-post evaluation of demand forecast accuracy for do-nothing alternatives, based on an empirical study of 35 road projects in Denmark and England. The results show a tendency for systematic overestimation of travel demand in the do-nothing alternatives, which is in contrast to the systematic underestimation of travel demand observed in previous studies of do-something alternatives. The main implication for planning practice is that the severity of future congestion problems is systematically overestimated. As a consequence, impact appraisals of road construction as a means of congestion relief appear overly beneficial.

1. A blind spot in ex-post project evaluation

Ascher (1978) was among the first to address the accuracy of model-based forecasts used for policy-making in a comprehensive manner, concluding that both general imprecision and systematic biases were problematic for certain types of demand forecasts. He therefore highlighted the need for continued ex-post appraisal of forecast accuracy to improve future forecasts and their usefulness as decision support. Subsequent research on the accuracy of demand forecasts for transport infrastructure projects has shown widespread occurrence of inaccuracies in the form of large imprecisions as well as systematic biases for implemented projects. Generally, the biases have been found to be larger for rail than road projects, although considerable inaccuracy has been documented for both types of projects (see Nicolaisen and Driscoll (2014) for a comprehensive overview of studies). From the current body of literature it seems fair to conclude that travel demand for new (untolled) road infrastructure projects is generally underestimated (Flyvbjerg et al., 2005; Nicolaisen, 2012; Parthasarathi and Levinson, 2010; Welde and Odeck, 2011). Conversely, travel demand for rail infrastructure and tolled road projects appear to be systematically overestimated (Bain, 2009; Button et al., 2010, 2010; Flyvbjerg et al., 2005; Fouracre et al., 1990; Nicolaisen, 2012; Pickrell, 1990; Welde and Odeck, 2011).

All the above-mentioned findings are based on comparisons of forecasted and actual travel demand for completed transport infrastructure projects, i.e. the preferred *do-something* alternatives from the appraisal. However, this does not account for the potential inaccuracy of the demand forecasts for the alternatives that were not implemented (henceforth referred to as the *do-nothing* alternatives, a.k.a. zero alternatives, no-build alternatives or similar). As will be argued in this paper, erroneous forecasts for the do-nothing alternatives may be an important source of bias in road infrastructure planning. The moderate deviations between predicted and actual traffic volumes for road projects found in most of the above-mentioned studies do not portray the full extent of systematic bias in demand forecasts. Bias may also take the form of unrealistic predictions of how the future situation will be in the absence of the proposed new infrastructure. For example, if the forecasted traffic in the do-something alternative is based on trend extrapolation, then neglect of the deterrent effect of congestion might lead to systematic bias (overestimation) of traffic for the

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do-nothing alternative (Næss, 2011). This type of error has so far not been addressed much in the literature and is mentioned neither in the widely cited articles by Flyvbjerg and colleagues, the vast majority of the above-mentioned studies of forecasting accuracy, nor among the 21 types of error and bias in transport appraisal listed by Mackie and Preston (1998). The studies carried out so far tend to focus on the specific project link while ignoring network effects or counter-factual scenarios. The latter issue is the core focal point of the present study, which is aimed at investigating the accuracy of traffic forecasts for do-nothing alternatives for road projects.

The above-mentioned observations of overestimated traffic for rail projects and underestimated traffic for road projects have sometimes led to the conclusion that benefits of road projects are underestimated, while benefits of rail and toll projects are generally overestimated. As an example, Flyvbjerg et al. (2005, p. 140) noted how road forecasts "*are substantially more balanced than rail forecasts, which indicates a higher degree of fair play in road traffic forecasting*". The logic seems to be that if the project carries more traffic than expected, the societal benefit must also be higher than expected (vice versa for rail). However, this is too simple an interpretation of these results. First, in addition to the observed biases there are also large variations in accuracy among projects of the same type (road/rail/toll), making it difficult to compare projects even in the absence of systematic bias (Nicolaisen and Driscoll, 2014). Second, when evaluating project benefits in the form of travel time savings, the relation between overall travel demand and associated benefits is not linear. In cases where capacity is already insufficient for peak demand (e.g. most larger urban settings), additional traffic will likely reduce overall benefits by worsening congestion for all users (Næss et al., 2012). Third, in addition to the expected travel time savings there are also other effects of transport infrastructure projects that are of relevance to consider. More traffic also leads to more adverse environmental and social effects (especially in urban areas). Conversely, rail projects can have considerable economic benefits that are not included in the conventional evaluation framework (Banister and Thurstain-Goodwin, 2011), making overestimated ridership a revenue issue more than societal benefit issue. It is the second of these dynamics that will be the focus on the present paper.

In order to perform an impact assessment for a proposed road project, an ex-post scenario for the do-nothing alternative must be constructed for the sake of comparison. An implicit assumption in reappraisals for completed projects is often that the forecast for the do-nothing alternatives are accurate, since these are counter-factual scenarios where no data exists for ex-post evaluation. The same baseline scenario is thus used for comparison with both the ex-ante and ex-post travel demand levels for the do-something alternative, but just like forecasts for the do-something alternatives, the forecasts for the do-nothing alternatives can be inaccurate and biased. The consequences of inaccurate forecasts for the base alternatives are of course equally relevant when assessing the validity of forecast-based decision support. In a case study of a proposed motorway link, Næss (2011) showed that the assessment methodology for the do-nothing alternatives introduced a bias, and suggested that this was a general problem in appraisal of road projects. The present study expands on this work and evaluates the accuracy of demand forecasts for the do-nothing alternative for 35 road projects in Denmark and England. It has not been possible to obtain similar data for rail or toll projects, and for the remainder of the present paper we therefore refer to demand forecasts in the context of untolled road projects, unless otherwise stated. To the best of our knowledge, this study is the first of its kind to assess the accuracy of demand forecasts for do-nothing alternatives for a larger sample of projects. While the sample is limited, this is a general issue for ex-post evaluations in general and should not detract from the value of the study in comparison with previous studies. To put this into context, the seminal works by Pickrell (1990) and Flyvbjerg et al. (2005) on rail forecasts were based on sample sizes of 10 and 27 projects, respectively.

2. Methodology

In order to assess the accuracy of demand forecasts for do-nothing alternatives it is necessary to identify suitable units of observation as well as suitable reference points for the ex-ante and ex-post figures we seeks to compare. Since the purpose of the present study is to gauge the validity of forecasts used for decision-making, the decision support documentation available at the time of political approval has been chosen as the ex-ante reference point, as recommended by Flyvbjerg (2005). This will typically be in the form of environmental impact assessments (EIA) or cost benefit analyses (CBA), but since the same demand forecasts are typically used in both documents, these sources can largely be considered interchangeable for the purposes of the present analysis. The forecast target year for these forecasts has been selected as the ex-post reference point to allow the most straightforward comparison of expected and actual demand. For reasons of practicality, annual average daily traffic (AADT) or annual average weekday traffic (AAWT) levels on the planned project links have been selected as the unit of observation for the present study. Typically this will be the primary unit reported in decision support documents and also the most readily available unit for comparison in databases of observed traffic volumes.

Inspired by Flyvbjerg et al. (2005) we define, in accordance with common practice, the inaccuracy of a traffic forecast as observed minus forecasted traffic in percentage of forecasted traffic.

$$I = \frac{O - F}{F}$$

where I is the inaccuracy, O the obsevation (actual traffic) and F the forecast (predicted traffic).

This provides a simple measure of inaccuracy as the relative deviation between observed and predicted values, where the central tendency will be used as an indicator of bias and the spread as an indicator of imprecision. Perfect accuracy is thus indicated by a measure of zero. Negative values indicate less demand than expected (demand is overestimated) while positive values indicate more demand than expected (demand is underestimated). A more sophisticated measure of inaccuracy would be desirable, since the chosen measure is a point estimate that is sensitive to fluctuations in the opening year. However, as is typical for ex-post evaluations of demand forecasts (Flyvbjerg et al., 2005; Parthasarathi and Levinson, 2010), data availability did not allow for more than this simple measure to be established. It also allows comparison with previous ex-post studies of completed projects, which often use an identical or very similar definition of inaccuracy (Nicolaisen and Driscoll, 2014).

In addition, the focus on do-nothing rather than do-something alternatives limits the amount of relevant projects to include in the sample, thereby severely reducing the available population for sampling. In order to make a useful comparison of predicted and observed values for the purpose of the present study, projects must fulfil one of following three criteria:

1. A political decision to abandon or postpone the project has been reached. This is essentially a true do-nothing scenario that the baseline forecast was prepared for, and thus allows for an evaluation of the accuracy of the forecast.
2. The project has been significantly delayed so construction has not yet begun at the ex-post reference point. At first, it might