Oxera

Agenda

Advancing economics in business

Why do I care about forecasts if they are always wrong?

Economic forecasts play an important role in many industries, informing investment plans and government policy, among other things. However, the way these forecasts are produced often receives less attention than the forecasts themselves. A case study of the GB rail passenger industry, based on a recent Oxera study, illustrates what happens when the numbers change

Accurate forecasts are an important tool, whether you are taking commercial, policy or investment decisions. Forecasts of the demand for a product can inform all of these decisions, either in producing the most likely outcome according to a particular forecast, or in understanding risks arising from different downside scenarios.

There are many ways of producing demand forecasts, ranging from the relatively simple 'this is the best gut feel', to sophisticated and complex statistical and econometric models. In general, the more important the decision being based on the forecasts, the more sophisticated the model ought to be. For example, in industries where the level of supply cannot be changed easily or cheaply, such as rail or energy, using demand forecasts is particularly important for identifying future (capacity, demand management, other) policy requirements.

One common way of producing forecasts is to use elasticities. An elasticity describes consumer behaviour, reflecting how consumers respond to changes in the characteristics of the product, or of other products. An elasticity of demand is the percentage change in demand for a product in response to a percentage change in its price (own-price elasticity), consumer income (income elasticity), or the price of a different product (cross-price elasticity). Models using elasticities vary considerably in complexity, but essentially take forecasts of inputs (income, price, etc) and turn these into forecasts of outputs through mathematical relationships, by calculating the percentage changes in the inputs and applying the elasticities. In many sectors, such as transport, elasticity-based modelling is well developed.[1]

There are alternatives to elasticity-based forecasts, which use different statistical and econometric techniques; however, this article focuses on elasticity-based forecasting as this is one of the most widely used approaches.

Given the decisions that are taken based on economic forecasts, it is important to ensure that the evidence on which the forecasts are based is as robust as possible. This extends to any elasticities that are used. Here, an example is presented from recent analysis of the rail passenger industry in Great Britain, together with some thoughts on the general lessons that can be drawn from the study.

Revisiting the elasticity-based framework

The rail passenger industry in Great Britain has a long history of using elasticity-based models to produce forecasts of the demand for passenger rail travel, with the first version of the *Passenger Demand Forecasting Handbook* (PDFH) being published in 1986. (The PDFH is the key source of elasticities for estimating the demand for passenger rail travel in Great Britain.) In order to ensure that future policy choices are made as robustly as possible, and reflecting concerns that the forecasting framework was unable to predict the strong growth in rail demand towards the end of the last decade,[2] Oxera and Arup were commissioned to review and update the elasticities of passenger rail demand with respect to fares, income, demographics, and other transport modes (eg, cars) in Great Britain.[3] The final output is an alternative framework which can be used to forecast the demand for passenger rail travel in Great Britain. It is important to note that the research presented here is not official UK Department for Transport or industry policy.

The first step in developing this new framework was to undertake a detailed examination of the current state and historical developments of the passenger rail industry in Great Britain in order to inform the hypotheses which were to be tested in the remainder of the study; such as whether the relationship between different measures of income and demand varied between market segments. This stage also included a detailed examination of industry data sources.

The next step involved reassessing the underlying conceptual approach. This underlined the need for the research to explore issues such as:

- whether elasticities change over time, or along the demand curve;
- whether there is any evidence that demand in the passenger rail market is slowing relative to GDP growth due to the increasing impact of other factors, as has been seen in road traffic in Britain;
- whether the correct measures for certain demand drivers were being used; and
- the extent to which responses to certain demand drivers interact with one another (eg, as income rises, do people care more about journey times than fares?)

Within this conceptual approach, a number of issues could then be addressed, such as market segmentation, appropriate analytical techniques and data suitability.

One of the key enhancements made in this work is the treatment of the market segmentation. When estimating and using elasticities, the segmentation of the market between different types of user is important, as the elasticities reflect consumer behaviour. If this behaviour differs systematically within the market where demand needs to be forecast, the elasticities used to generate the forecast will be a weighted average across different types of behaviour, rather than capturing behaviour more precisely. In contrast, segmenting the market into parts within which the elasticities (for example, fare elasticities and journey purpose) are similar is likely to generate more accurate forecasts.

The analysis of how to segment the market consisted of a number of steps. The first was to analyse why elasticities might vary across markets—for example, relative income levels in different geographies might drive consumers to respond differently to changes in the rail offering. The second stage was to analyse the data graphically to understand some of the relationships within it. This was followed by the use of statistical techniques such as cluster analysis to test the hypotheses generated in the graphical analysis.[4] The final part of the process was to examine each of the clusters and determine whether there were particular patterns in the results. The resulting segmentation is a substantial change from that which currently exists in the industry, with potentially important implications for the production of forecasts.

The selection of the most appropriate analytical techniques for the study was carefully considered. This consisted of producing a shortlist of techniques from an initial 'long list'. Once this shortlist had been drawn up, preliminary analysis was conducted at an aggregate level to assess the strengths and weaknesses of different techniques. This process resulted in the selection of a particular econometric technique as being the most appropriate for the task (see the box below for details).

The final step before beginning the statistical analysis was to develop the dataset on which to base the analysis. The rail industry in Great Britain has many separate sources of data on, for example, demand, prices, journey time and performance, which, prior to this study, had not been collated in one place on a consistent basis. In addition, many other factors are expected to affect the demand for passenger rail travel, such as income, the cost of making an equivalent journey by car, and employment. The new dataset, known as 'The Oxera Arup Dataset' (TOAD), contains data at a number of levels of aggregation, and at both the origin and the destination of the rail route, all carefully matched to the other data sources. This dataset covers more than 20,000 rail routes, covering a period of 18 years, with over 60 explanatory variables.[5]

Results of the analysis

The outcome of this analysis is an alternative framework which can be used to forecast the demand for passenger rail travel. The key component of this framework is a set of elasticities, which in some cases are different from those that the industry has been using thus far, with potentially substantial implications for policy and commercial strategy. Table 1 provides some examples of the estimated elasticities. Due to

Analytical technique for panel data selected for the study

The analytical technique selected as the basis for the main analysis is the 'Blundell and Bond' estimator, which was designed for panel data.[1] Panel data exists where there are two dimensions to the dataset, and usually where multiple units (firms, routes, products, etc) are observed over a period of time. This distinguishes it from cross-sectional data, where multiple units (eg, firms) are observed at a point in time (a 'snapshot') and time-series data, where one unit (eg, a firm) is observed over time.

The Blundell and Bond estimator was designed specifically for cases where there are many cross-sectional units (in this case, rail routes) and a relatively small time dimension—ie, 'large N, small T' datasets. After consideration of the alternative approaches, this one was adopted and considered the most appropriate for the task.

Note: [1] Blundell, R. and Bond, S. (1998), 'Initial Conditions and Moment Restrictions in Dynamic Panel Data Models', *Journal of Econometrics*, **87**, pp. 115–143.

commercial confidentiality, it is not possible to present existing industry elasticities for comparison. The elasticity numbers in the table can be interpreted as the expected percentage change in the demand for passenger rail travel after three years, following a 1% change in the factor listed at the top of the column (fares, income, or car cost).

The main results of importance to the rail industry are that:

- the way the rail passenger market in Great Britain has been segmented previously may no longer be appropriate;
- there is evidence to suggest that passengers in most segments are more responsive to changes in factors such as income than previously thought;
- the preferred measure of income (on both conceptual and empirical grounds) has changed from GDP per capita to personal disposable income per capita;
- the cost, but not the absolute journey time, of travelling by car is important in affecting the demand for passenger rail travel;
- performance (ie, reliability) and journey time are important factors in the demand for rail travel;
- it is important to account for any changes over time in income, fares and other factors because passengers take time (approximately three years in most cases) to respond fully to changes in these factors, and hence forecasts which do not account for changes in the recent past are likely to be biased;
- changes in the level of car ownership have a smaller impact on changes in the demand for passenger rail travel than previously thought.

These findings are combined to form a general policy prescription, outlined below. The policy prescriptions presented here should not be taken to represent the views of the project funders. One of the most important observations is that there is limited evidence of market saturation (ie, demand remaining constant despite increases in income). This suggests that the demand for passenger rail travel is likely to continue to increase with rising disposable incomes. This in turn suggests that either the capacity of the network will need to be further expanded, or increased crowding will need to be tolerated on some parts of the network. This would be compounded if, as the analysis suggests, there is a considerable shift from road to rail, should the cost of using a car increase. In addition, passenger demand continues to respond to reductions in journey time and improvements in performance, suggesting that the current industry attention on these factors is justified, although there is clearly a discussion to be had about the relative costs and benefits of pushing for further improvements.

However, the higher fare elasticities suggest that there may be a limit to how far the balance of funding can be moved from the taxpayer to the passenger, as passengers appear to be more responsive to changes in fares than previously thought. This is particularly important given the previous government's intention to rebalance funding for the rail industry from the taxpayer to passengers,[6] and the recent statement by the Secretary of State for Transport that:

> the current fares formula is a reasonable and sensible approach. But it cannot be set in stone when all the other variables are vulnerable to change and to challenges. We will face some very stark choices and it would be irresponsible at this point to rule out even considering an increased contribution from the fare payer as part of the solution to protecting investment in the railways.[7]

Furthermore, the different pattern of fare elasticities (with more responsive season ticket holders than previously thought) may suggest that the current 'basket' system of fares regulation—whereby different tickets can be traded off against each other—may need to be reviewed.

To put these policy implications in context, Network Rail, which manages the rail network in Great Britain, is engaged in a programme of enhancements worth

Table 1 Elasticities from the study

Market segment	Elasticity with respect to fares	Elasticity with respect to income	Elasticity with respect to car cost
Core cities to London, the south-east and east of England, full-fare tickets	–1.41	0.77	1.81
Core cities to core cities, reduced-fare tickets	–1.16	2.01	n/a
Core cities to other, full-fare tickets	–1.71	1.63	1.42
London, the south-east and east of England to core cities, full-fare tickets	–1.27	1.06	1.59
Other to London, the south-east and east of England, reduced-fare tickets	–0.63	1.44	1.57

Source: Oxera and Arup's analysis.

approximately £7.7 billion over the period of 2009–14.[8] Any change in required capacity is therefore clearly putting a substantial amount of money at stake, and changes to demand forecasts have potentially large financial implications for the industry.

General lessons

To answer the question posed in the title of this article, the reason for caring about economic forecasts is that they provide a way of thinking through what is likely to happen in the future, and what the implications of those factors are, whether you are a policy-maker, regulator or commercial decision-maker. The fact that such forecasts are highly unlikely to be 100% accurate does not mean that it is sensible to do without them altogether. Rather, it serves to highlight the importance of planning for an inherently uncertain future.

Given the importance of the decisions taken on the back of forecasts, it is crucial that these forecasts are as robust as possible. This will include updating any elasticities used regularly.

A number of general lessons can be drawn from the case study presented above.

- Market segmentation and differences among types of consumer should be reviewed regularly.
- Elasticities are likely to change over time as product offerings, incomes and other factors change, and so may the 'received wisdom' in a sector.
- Capturing new data sources can lead to more robust parameter estimates for forecasting, and give a much richer picture of how demand is likely to evolve.

It is now possible, with sufficient data, to test multiple hypotheses about consumer behaviour—these can include elasticities changing over time and along the demand curve, dynamic effects, and whether the market for passenger rail travel is saturated.

In summary, changing forecasts can have substantial implications for business strategy and/or government policy, and new estimates may be seen as awkward or against 'the way things are', but updates can help avoid getting expensive decisions wrong.

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[1] See, for example, TRL (2004), 'The Demand for Public Transport: A Practical Guide', and Association of Train Operating Companies (2009), *Passenger Demand Forecasting Handbook v5*.
[2] See, for example, Steer Davies Gleave (2008), *PDFH Update: Phase 1*, June.
[3] The Oxera/Arup report was commissioned by the main funding bodies of GB rail (Department for Transport and Transport Scotland) and the Passenger Demand Forecasting Council, which is responsible for commissioning research into rail passenger demand on behalf of the GB rail industry.
[4] Cluster analysis is a statistical tool that allows groups of 'similar' observations to be grouped. Analysis of the observations in each group may reveal an underlying pattern in the observations.
[5] Access to the dataset is regulated by the Department for Transport.
[6] Department for Transport (2007), 'Delivering a Sustainable Railway', July, p. 127.
[7] Hammond, P. (2010), 'Speech to the National Rail Conference', July 8th.
[8] Office of Rail Regulation (2008), 'Determination of Network Rail's Outputs and Funding for 2009–14', October, p. 202.

If you have any questions regarding the issues raised in this article, please contact the editor, Dr Gunnar Niels: tel +44 (0) 1865 253 000 or email g_niels@oxera.com