frontier economics

Bulletin

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First class performance?

ANALYSING PERFORMANCE ON THE UK RAIL NETWORK

During 2003-04 there were over a billion passenger journeys on the UK rail network – more than at any time in the last 40 years. Faced with rapidly increasing demand, combined with an ageing and congested rail infrastructure, train operators have struggled to maintain historic levels of rail performance, let alone improve them. Frontier's modelling work for the DfT has however highlighted a number of key performance drivers that could be used to improve punctuality.

In 2003 there were over 10 million train delays[1] on the UK rail network. In the London area the number of delayed trains in 2003 was around twice as many as it was eight years ago. Improving the punctuality performance of the rail network is therefore one of the Government's key public transport policy objectives.

The Government published a White Paper in July 2004 which brought in changes to the way in which the rail system is run and giving new impetus to the DfT's efforts to understand the real drivers of performance. In March 2005, Frontier was commissioned →

by the DfT to conduct an analysis of punctuality performance on the network. The particular question we were asked was whether, and how, statistical techniques could be used to identify the drivers of punctuality performance.

The question of whether such techniques could be used to analyse rail performance is an important one, as no systematic attempts had been made to do so, at least not with UK data. It soon became apparent that such analysis could yield useful results and this analysis provided the kind of data that in other network industries has enabled regulators to benchmark different companies' performance and build improvement incentives into the regulatory regime.

KEEPING TRACK

The Strategic Rail Authority (SRA) provided Frontier with three years (2001, 2002 and 2003) of performance data that included detailed information on each individual incident on the network causing a delay of more than three minutes. The dataset covered 31 million train delays, leading to a total 181 million minutes of delay. In Figure 1, we group the information for 2003 by the organisations ultimately responsible for the delay. As this shows, incidents for which Network Rail and IMCs were the primary cause accounted for almost two-thirds (62%) of train delays. However, the DfT Rail Group's first point of interest is the extent to which TOCs' actions affected overall performance on the network.

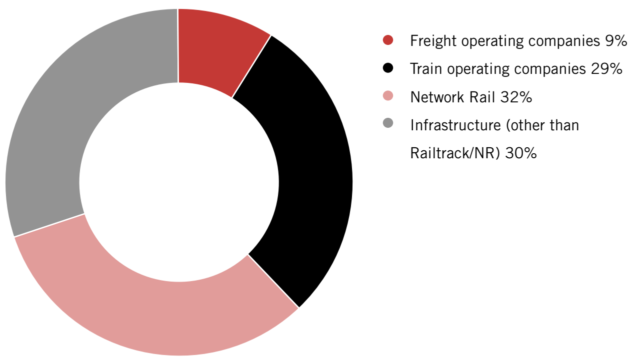

Figure 1: Proportion of total train delays in 2003 caused by IMCs, FOCs, TOCs or Network Rail

Source: Frontier Economics

TOCs are the organisations with primary responsibility for 29% of total train delays. A breakdown of the causes of these produced some useful results. If all the factors related in some way to rolling stock failures were aggregated, they accounted for 39% of all TOC-related delays. A number of other unrelated factors (including the famous "leaves on the line") each accounted for under 10% of TOC-related delays. The biggest of these categories was "driver-related delays", which accounted for nearly 9% of TOC-related delays[2]. Rolling stock failures and driver-related delays therefore account for nearly half of the "TOC delays". The question for Frontier was whether we could quantify the statistical relationship between these delays and observable TOC characteristics, such as the age and type of rolling stock or TOC policy relating to driver rostering.

MILES ON THE CLOCK

Following consultations with key industry stakeholders, we articulated two questions[3].

- Does the propensity for a TOC to experience rolling stock failures increase with the average work-rate of each unit of rolling stock?
- Does the propensity for a TOC to experience rolling stock failures increase with the average age of each unit of rolling stock?

We used econometrics to test these propositions. The results showed a strong positive correlation between the propensity for a TOC to have a rolling stock failure and the average work-rate of its rolling stock. In fact, we found that, for a 1% increase in the average number of kilometres travelled by each unit of rolling stock in a TOC's fleet, the average number of rolling stock failures per unit of stock also increased by 1%[4]. The results therefore support the view that there is a trade-off between how hard TOCs work their rolling stock and performance on the network.

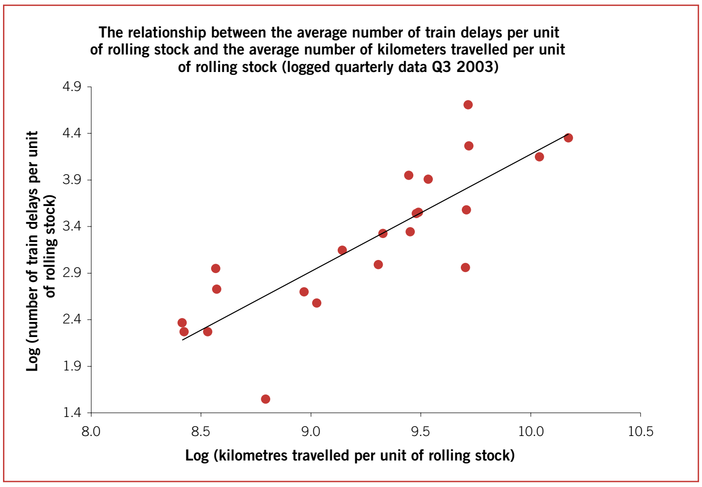

Figure 2: The relationship between rolling stock work-rate and the propensity for rolling stock related delays

Source: Frontier Economics

The second hypothesis we tested was whether the average number of rolling stock failures per TOC increased with the average age of the rolling stock. Figure 3, which plots the average delay for each TOC according to the age of its rolling stock, certainly indicates a relationship. In order to determine its strength (i.e., statistical significance), we introduced into our regression model controls for a number of other factors that might affect performance. For example, the results illustrated in Figure 2 made it clear that the average number of kilometres travelled per unit of rolling stock in each TOC's fleet had an important effect on performance: to isolate the distinct effect of rolling stock age, we therefore needed to control for mileage.

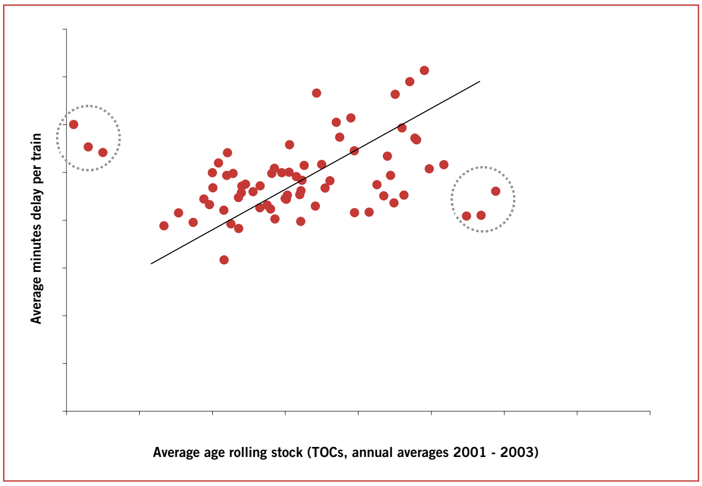

Figure 3: The relationship between rolling stock age and the average delay minutes per rolling stock failure

Source: Frontier Economics

The estimated elasticity from the regression was 0.25. This indicated that for a 1% increase in the average age of vehicles in a TOC's fleet, the number of rolling stock failures leading to delays increases by 0.25%. These results therefore indicated the potential for improvement in performance to be gained by removing old and creaking rolling stock from some of the TOCs' fleets.

MILES AT THE WHEEL

Driver incidents were the second largest single cause of TOC-related delays and so we investigated the nature of these incidents in more detail. The hypothesis we tested was whether the propensity for a TOC to experience a driver-related incident leading to a delay increases with the average number of hours of driving done by each driver. Figure 4 suggests that there is indeed a relationship.

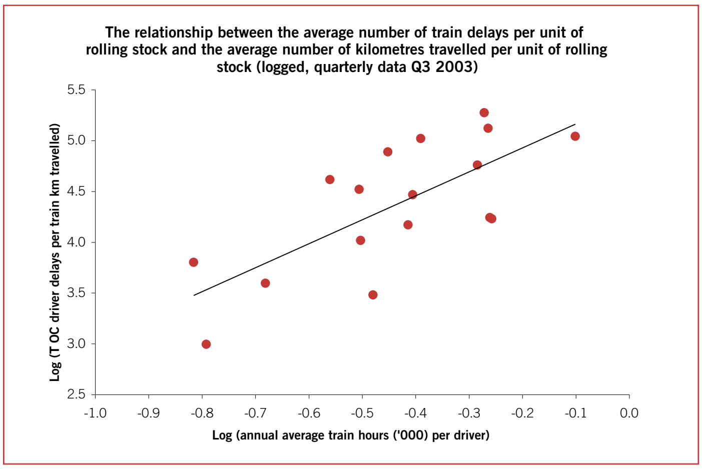

Figure 4: The relationship between the average number of TOC driver delays and average train hours per driver (logged Q3 2003)

Source: Frontier Economics

The regression estimates imply an elasticity of 0.5, indicating that the number of trains delayed due to TOC driver incidents increases by 0.5% for a 1% increase in the total number of driving hours per driver. Whether this is caused by knock-on from one delay to another, if there is too little time margin between the trains drivers are expected to drive, or attributable some deeper cause, is a matter requiring further investigation; but the results do suggest there is a potential for performance improvement from better staffing and rostering.

PERFORMANCE AND POLICY

These results can be used by policy makers both to improve performance forecasting and to analyse the possible effects of policy changes. We can use such techniques to predict the average number of delays we should expect during a given time period. Comparing forecasted performance against actual performance will allow the policy makers to identify TOCs whose performance is better, the same as, or worse than we would expect. This would enable regulators to carry out the same kind of benchmarking analysis they conduct in other regulated industries. Policy-makers could use this benchmarking approach either to provide better incentives for TOCs to reduce the number of driver incidents leading to delays, or to identify unexpected variations in TOC performance, the causes of which can then be investigated in greater detail.

This type of analysis can also be used to assess the impact of policy changes. For example, policy-makers can use such techniques to compare the benefits of renewing older rolling stock, in terms of better performance, with the costs of renewal. A similar cost-benefit analysis of the effect of increasing driver numbers could also flow from this work on driver-related numbers.

SOURCE

1. *SRA delay database, January – December 2003. Consisting mostly of passenger train delays, but also including a number of freight train delays (approximately 20% of all trains delayed). Delays of less than three minutes are not recorded.*
2. *Driver-related delays include a number of possible driver-related problems or incidents, including: injuries to a driver, drivers passing a signal at danger due to signaller error, driver passing a signal at danger due to leaf fall contamination, station overrun which is the responsibility of a driver, driver exceeds agreed limits for 'time-loss' in a station or a section, waiting traincrew/driver – allocated to incidents in stations and then to the TOC who manages the station.*
3. *Of course, the scale of service run by each TOC will affect the propensity for there to be delays on a given service. We get around this problem by analysing the average number of delays (as opposed to the total) number per unit of rolling stock for each TOC.*
4. *The actual regression coefficient is 1.07 (t-statistic 18.92), with an R-squared of 0.60.*

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