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## **When is HSR worthwhile? Lessons from Western Europe and implications for Central and Eastern Europe**

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### **Abstract**

This paper examines Western European experience of the circumstances in which HSR is economically justified, and explores the degree to which such circumstances are found in Central and Eastern Europe. Specifically it examines the ex post evaluations of HSR projects in France and Spain and of HS1 in Britain and the ex ante appraisals of HS2 in Britain. It then applies the lessons from these studies to consider the prospects for economic justification of high speed rail proposals in Central and Eastern Europe.

The case for HSR depends heavily on demand, with typically 9m trips per annum end to end being needed. A second key factor is construction cost. Lower construction costs may be achieved by routing which avoids tunnelling, only building wholly new track on bottleneck sections and upgrading existing tracks elsewhere, using spare capacity on existing right of way and stations. But of course to the extent that these solutions reduce quality of service they will also reduce benefits.

The case is better the greater the value of time savings. This is likely to be greater when existing rail infrastructure is of poor quality. The value of those time savings depends on the mix of trips by journey purpose and on incomes. The extent of wider economic benefits remains controversial. A further consideration is the

extent to which the proposal relieves congestion on existing transport infrastructure.

There are various characteristics of Central and Eastern Europe that may affect the case for HSR. With the exception of Poland, CEE countries are smaller and lower in population than main countries of the West. Thus a bigger proportion of potential traffic is international. The poor quality of much rail infrastructure in CEE countries means that there are potentially very large time savings to rail users. On the other hand, much traffic on the main international routes uses air travel, compared to which the benefits may be much lower. Also, values of time savings are generally correlated to incomes, and the lower incomes in CEE countries will tend to reduce the value placed on benefits. Other important factors are the level of construction costs and the benefits of increased capacity. If the forecasts of low construction costs, moderate demand and high time savings are accurate then it appears that there may be a case for HSR in CEE countries. But further studies are needed to verify this.

**Keywords:** HSR, Western Europe, Central and Eastern Europe.

## **1 Introduction**

Achieving speeds of more than 250kmph on rail has required construction of new high speed lines. Following opening of the High Speed Rail (HSR) line from Paris to Lyon in 1981, there has been substantial construction of new HSR lines in Western Europe. By 2020, France had 2734km of HSR lines, whilst Spain had overtaken it with 3330, the aim in Spain being to link all major cities to Madrid by HSR. Britain has lagged behind, with only the line from London to the Channel Tunnel being open, but construction of a second purely domestic HSR line linking London to Birmingham and Manchester is now going ahead.

By contrast, there are no HSR lines in Central and Eastern Europe (CEE) although the issue has moved from political discussion to concrete plans. In the Czech Republic, an HSR line connecting (Dresden) - Prague - Brno - (Vienna) and another one from (Vienna) - Brno - Ostrava - (Poland) are planned. The feasibility study works in variants of maximum speeds of 250, 300 and 350 km/h (1). In Poland, the 2010 study assumed the construction of the HSL (Y line) on the route Warszawa - Lodz - Wroclaw/Poznań - (Berlin) (2). Other planned HSRs are to connect Warsaw and the tri-cities in the north, Ostrołęka - Łomża - Giżycko, Sieradz - Poznań, etc. In total, the preparatory work covers a total of 1,300 km. The current plan is that although the line will have parameters for operation at 350 km/h, the start of operation will be at a maximum speed of 250 Km/h - i.e. no new trains will be purchased (3). In Slovakia, no feasibility study has been carried out yet, the route connecting (Brno) - Bratislava - (Budapest) is envisaged.

This paper examines Western European experience of the circumstances in which HSR is economically justified, and explores the degree to which such circumstances are found in Central and Eastern Europe. Specifically it examines the ex post evaluations of HSR projects in France and Spain and of HS1 in Britain and the ex ante appraisals of HS2 in Britain. It then applies the lessons from these studies to consider the prospects for economic justification of high speed rail proposals in Central and Eastern Europe.

## **2 Methods**

The methodology is essentially to examine ex post studies of lines that are already open, and ex ante appraisals for lines yet to open. The French government routinely undertakes ex post evaluations of major projects, and such evaluations are available for 6 highspeed lines (4). These show all the lines showing an adequate internal rate of return; all carried more than 15m passengers in their first year after opening. By contrast, Betancor and Llobet (5) present evaluations of the two busiest Spanish high speed lines. Neither offers an acceptable internal rate of return, and both carry fewer than 9m passengers per annum. The British National Audit Office undertook a partial ex post evaluation of the HS1 line from London to the Channel Tunnel (6) and showed its justification to be doubtful despite relatively high demand from a combination of international and domestic services. The reason it is marginal is very high costs. The most recent update of the case for the British HS2 line from London to Birmingham, Manchester and Leeds was undertaken in 2021 (7) and shows a benefit-cost ratio (BCR) of 1.5, well above 1 but below what is usually expected of projects in Britain which is a BCR of around 2. Again this is despite high demand figures and the problem is high costs. In Central and Eastern Europe, several studies have been carried out, but the demand forecasts for HSR vary considerably. If there is an independent forecast of HSR demand, it tends to be less optimistic than government estimates. In the Czech Republic, an independent estimate, based on big data analysis and questionnaire surveys at Masaryk University, arrives at an estimated annual demand of slightly below 5 million passengers. This number is calculated for the busiest domestic section, i.e. on the Prague - Brno route. Demand is expected to be significantly lower for the other sections of the line. In contrast, the official feasibility study on the Prague - Brno route forecasts 18 million passengers per year (1). In Poland, the government's estimate of demand on the Warszawa - Poznan route is slightly over 12 million passengers per year (2).

### **3 Results**

The case for HSR depends heavily on demand, with typically 9m trips per annum end to end being needed (8). This could be a mixture of long distance and regional trips provided that there are substantial benefits to regional passengers from using the high speed line. Another way of raising the average density of traffic on a high speed line is to share a section of new track before branching to a variety of destinations. This is true of the French network and of the HS2 proposal in Britain. By contrast the geography of Spain limits the extent to which one line can serve more than one major city.

A second key factor is construction cost. A survey undertaken for HS2 (9) showed a wide range of construction costs ranging from £11m for rural lines to £79m for lines in urban areas and/or involving a lot of tunnelling. Obviously lower construction costs improve the case for HSR; these may be achieved by routing which avoids tunnelling, only building wholly new track on bottleneck sections and upgrading existing tracks elsewhere, using spare capacity on existing right of way and stations. But of course to the extent that these solutions reduce quality of service they will also reduce benefits.

The case is better the greater the value of time savings. How much time does HSR save compared with the best alternatives (existing rail, road or air services)? This is likely to be greater when existing rail infrastructure is of poor quality but still has a relatively high market share. The value of those time savings depends on the proportion of trips made for business purposes and on incomes.

The extent of wider economic benefits remains controversial. It is generally accepted that transport improvements produce agglomeration economies but these depend on improved services for commuters. The extent to which

improvements to longer distance services create wider economic benefits remains uncertain (10).

A further consideration is the extent to which the proposal relieves congestion on existing rail routes as well as roads and airports. HS2 in Britain is forecast to bring significant benefits by relieving congestion on existing rail infrastructure.

#### **4 Conclusions and Contributions**

There are various characteristics of Central and Eastern Europe that may affect the case for HSR (11). A key determinant of the case for HSR is the potential number of passengers. With the exception of Poland, CEE countries are smaller and lower in population than main countries of the West. Thus a bigger proportion of potential traffic is international. This adds complexity to projects; moreover, there is evidence that traffic between cities in different countries tends to be lower than between similar sized cities in the same country. Official forecasts put demand for HSR in Poland and Czechia at well above 9m, which is the sort of level at which HSR is often justifiable. But independent forecasts for the Prague - Brno line are only half that figure.

A second important factor is the level of benefits users receive. The poor quality of much rail infrastructure in CEE countries means that there are potentially very large time savings to rail users. For instance between Prague and Brno it is forecast that HSR would reduce journey time from 2 hours 30 minutes to 55 minutes (12), and from Warsaw to Wroclaw from nearly 5 hours to 1 hour 40 minutes (13). On longer international routes the saving could be even greater. On the other hand, much traffic on the main international routes uses air travel, compared to which the benefits may be much lower, although of course there are environmental benefits of reducing air travel to consider. Also, values of time savings are generally correlated to incomes, and the lower incomes in CEE countries will tend to reduce the value placed on benefits.

Other important factors are the level of construction costs and the benefits of increased capacity. Construction costs are generally lower in areas of low population density and of flat terrain. The official studies forecast lower costs than the cheapest of the lines examined in the study for HS2, although it is not clear that these estimates are realistic. Upgrading existing lines is also less attractive as an option when lines (and alternative infrastructure such as roads and airports) are already heavily congested. Some of the existing lines, such as significant part of Prague - Brno line, are heavily congested. If the forecasts of low construction costs, moderate demand and high time savings are accurate then it appears that there

may be a case for HSR in CEE countries. But further studies are needed to verify this.

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