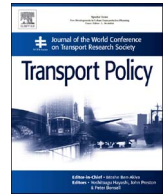




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## Can high-speed rail have a transformative effect on the economy?☆

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## ABSTRACT

High-speed rail is frequently claimed to have a transformative effect on the economy. By bringing cities and regions closer together it is argued that economies can benefit from lower generalised costs of transport leading to enhanced growth and productivity. A counter argument is that such effects are largely redistributive with some regions benefiting and others suffering depending on their ability to take advantage of new opportunities. However, some argue further than this and claim that such step changes in transport provision can lead to major changes in economic structure that can transform regions' absolute as well as relative position and thus redress the existence of regional disparities.

In this paper, we address the question as to whether there is a clear and robust economic theory of the transformational impact of high-speed rail and if there is any consistent evidence to support it? The paper uses evidence from the North-west European High-Speed Rail network and a more detailed study of the UK's first high-speed line, HS1. This is followed by a discussion of the various claims and counter-claims for the impact of the proposed HS2 that will link London with Birmingham, Leeds and Manchester. On the basis of this some of the implications for the appraisal of such projects are considered. The main conclusion from the paper is that transport infrastructure by itself is not likely to be transformative, but coupled with other policy interventions it can contribute to such an effect.

## 1. Introduction

Transport has for a long time been seen as a major determinant of land use and economic development. The economic evaluation of this link – the wider economic impacts (WEI) – has, however, been the subject of continuing controversy. As a result, formal appraisal techniques have tended either to exclude the possibility of wider economic impacts, largely because of the fear of double counting, or have simply included an arbitrary add on. The double counting issue arises because of the concern that the economic impacts are adequately taken care of in the user benefits; consumers' willingness to pay for time savings translate directly into increased rents or land values at locations with improved accessibility. This argument depended on the assumption that there would be perfect competition in the transport using sectors such that any change in transport generalised costs would be translated directly and fully into prices in the using sectors (SACTRA, 1999). An arbitrary add on of around 10 per cent of benefits has often been used reflecting the typical mark ups in imperfectly competitive sectors.

Recent work, both theoretical and empirical, has improved our understanding of the way in which accessibility affects the performance of firms and particularly the operation of labour markets. Starting with

the 'new economic geography' (Krugman, 1991) it could be shown that changes in transport costs and accessibility could, in some cases, in an imperfectly competitive world, have profound effects on the location of activities and agglomeration. Increased agglomeration would, in turn, impact on productivity and create potential benefits in addition to the direct user benefits. This idea was captured in the context of the appraisal of transport investments by Venables (2007). Empirical support was provided by Graham (2007).

However, the empirical evidence remains problematic for a number of reasons: endogeneity and causality questions; conflicts between macro- and micro-based estimates; and the interrelationship and spillovers between different areas. Recognition of the potential of wider impacts is important in appraisal and the UK, amongst other countries, does have a formal estimation procedure for including WEI in investment appraisal (Department for Transport, 2014). This provides a means of assessing the impacts on local economies of an investment with a direct effect on that locality. It separates out the labour supply effects, the impact of increased density, the relocation of employment and an allowance for changing the degree of competition as a result of improved accessibility. However, as further work by Graham et al. (2010) has shown, the distance decay of these impacts is likely to be quite strong such that changing accessibility only has a very localised effect.

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The Eddington Report (HM Treasury, 2006) into the likely impacts of major new transport investment in the UK raised the question as to whether such investment could have a transformative impact on the economy as a whole, rather than just on directly affected local areas. In particular, this posed the question as to whether such investment could change the regional balance of the economy. This view has come to dominate discussion of the creation of a new high-speed rail line in the UK, HS2, which would link London with Birmingham, Manchester and Leeds (HS2 Ltd, 2014). Similar issues have been raised in the context of improving communications between the cities of Northern England (SERC, 2009). Laird et al. (2014) have shown the limitations of conventional cost-benefit analysis in dealing with investments of this type. But attempts to go beyond conventional cost-benefit analysis approaches to try and capture this effect in terms of a direct impact on output (KPMG, 2013) have led to serious criticism, in terms of both the assumptions and the net result (Overman, 2013).

Meanwhile there are those who continue to argue that the concept of wider impacts is misguided and that should not be used to justify investment (e.g. Crozet, 2015).

In this paper, we look at the specific case of high-speed rail (HSR) that has the potential to create step-changes in accessibility. We first examine the theoretical arguments in favour of the existence of wider economic impacts. We then assemble some evidence from existing HSR projects to determine whether there is a case for their existence. Finally, we suggest some ways forward in moving to a more robust and transparent way of assessing such impacts.

## 2. The theoretical basis of wider economic impacts

Transport and the economy are inextricably linked. Transport is usually described as being a derived demand from the demand for activities; transport is only useful as a way of bridging the spatial gap between locations, it has no value in its own right. This suggests that transport only responds to the needs of the wider economy. However, transport is also a substitutable input so that cheaper transport can be substituted for other more expensive inputs such as land leading to relocation and the potential for an increase in productivity. In this way, transport can be argued to be an engine of growth.

Here we see the potential problem of causality arising. In the aggregate, better transport and better economic performance are clearly associated, but which is the driving force is ambiguous. It is clear that without good transport economic performance may be constrained, but simply improving transport, without ensuring that other conditions for growth are met, is likely to be counter-productive. This is the problem with attempts to assess the role of transport in the type of aggregate growth models that follow the tradition of Aschauer (1989). But it can also lead to attempts to underestimate the role that transport may have as an enabler of growth; Ansar al (2016) have argued that HSR investment has slowed rather than enhanced Chinese growth by essentially resurrecting the crowding-out argument in a purely aggregate study that ignores the economic geography context (see Chen and Vickerman, 2017).

The key to understanding the economic impact of transport is in understanding the role of accessibility. Changes in accessibility affect the generalised cost of transport. If transport costs are reduced industries become more competitive and hence improved transport contributes to productivity growth. But it may also lead to changes in the optimal location of activities thus leading to faster growth in employment in some areas and slower growth in others. This is the potential for an agglomeration effect. But conventional measures of continuous accessibility may be inadequate in identifying the way that HSR changes the potential for firms and individuals to connect with each other. HSR has an essentially discontinuous effect where some lose accessibility through the penalty of connecting to the new network and any associated reduction in service on classic rail lines.

The 'new economic geography' (Krugman, 1991) provides the

necessary linkages to sustain this argument. Transport costs are the determinant of the real price of an urban location and hence of the real wage. Note that it is the real rent or wage that is critical here; as transport costs fall the implicit real wage will rise. This takes us beyond the simple valuation of time savings as the indicator of a transport benefit.

Agglomeration lies at the heart of the argument since it is agglomeration that is associated with higher levels of productivity. This is an old argument about the extent to which larger cities are more productive than smaller ones (Glaeser and Gottlieb, 2009). Although the evidence is mixed there is general acceptance that the association is normally positive. The theoretical basis of agglomeration lies in the extent to which in an imperfectly competitive world larger markets can accommodate increasing returns. Lower transport costs enable markets to expand in size thus resources are drawn into the larger market, which can continue to grow as the increasing returns cancel out the self-balancing mechanism that would apply in a perfectly competitive world. Backward and forward linkages in the local economy reinforce this process of cumulative causation. The circular process continues with increased market size promoting further increasing returns, which in turn reduce costs and encourage the further inward movement of resources as real wages and profits increase. Firms in the core region can better overcome the transport costs and supply markets in the periphery more cheaply.

This core-periphery effect suggests that lowering transport costs will always increase movement towards the core and hence centralisation and increasing inequality between regions – an argument that is frequently used to counter any arguments in favour of HSR rebalancing regional development. However, the new economic geography model (see Fujita et al., 1999) shows that this is not inevitable. Whilst the general result seems to hold for small changes in inter-regional transport costs, it does not necessarily hold for large changes or in cases where the existing structures of industries in the core and periphery are less appropriate for changing patterns of demand. Large changes in transport costs, making them less relevant in the choice of location can restore the advantage to firms in the periphery whilst negative externalities in the core such as congestion, pollution or crime constitute a constraint on ever increasing size at the core.

This is where the argument ceases being a purely theoretical one and becomes an empirical one.

## 3. From a theoretical model to appraisal

The problem with the theoretical model is that it does not have an easy analytical solution. Numerical simulations can show the range of possible outcomes, but this is less satisfactory as a decision-making model to build into an appraisal framework. Venables (2007) provided a valuable link between the theoretical model and its potential use in an extended cost-benefit analysis framework. The essence of this model is that as transport costs fall labour markets thicken in the sense that at each location labour has a wider choice of potential jobs and employers have a wider choice of potential employees. Thus, better sorting and skill matching becomes possible. From an evaluation perspective, the important issue is not just that labour markets get larger, but that the agglomeration effects increase the productivity of all workers and this is the additional benefit the traditional model does not capture.

This enables an empirical model to be developed in terms of the effective density of the labour market at each location (now often referred to as economic mass, see Venables et al., 2014). Graham (2007) estimates the effective density as a function of the generalised costs for each mode and the rate of distance decay, for each sector, given total employment in each area.

Given the change in density as a result of the improvement compared to the base case, and given GDP per worker and employment for each area and each sector for the forecast year, and given the elasticity of productivity with respect to density in each sector, we can

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