



**HIGH SPEED RAIL IN BRITAIN**

# *Consequences for employment and economic growth*

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**GREENGAUGE 21**

**High Speed Rail**  
**Consequences for employment**  
**and economic growth**

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*This report contains 29 Pages*



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# 1 **Executive summary**

In September 2009, Greengauge 21 published *Fast Forward*, a report making the strategic and economic case for the development of a national HSR network serving Great Britain's core cities. Our *Fast Forward* report focussed on the welfare cost benefit analysis of this national network and demonstrated the value for money case on these terms. In order to strengthen further the strategic economic case for HSR, Greengauge 21 commissioned KPMG to analyse the impact of HSR on national employment, wages and long term economic growth.

This report builds on *Fast Forward's* analysis and describes KPMG's analysis of the strategic economic impacts that HSR could have on the national economy. Instead of a cost benefit analysis, this paper sets out a quantified assessment of the ways that HSR could boost employment and prosperity and change the shape of the national economy. Supported by thorough research, this work goes some way beyond the bounds of more traditional transport appraisal to investigate whether HSR really will help Britain to close the productivity gap with its international rivals, support new jobs and balanced growth that contributes to closing the North-South divide.

The key findings from KPMG's analysis are that:

- Changes in rail business to business connectivity can drive long term changes in both productivity and employment and contribute to economic growth;
- A comprehensive national network of high speed services could provide a step change in business to business connectivity and effectively link the core cities, creating a single national market for service sector and knowledge based businesses;
- Overall, HSR could boost annual GVA (a measure of economic output) in 2040 by between £17bn and £29bn, depending on how effectively this network could enable other service changes on the rail network to be implemented and capacity constraints to be addressed;
- Additional annual economic impacts on this scale could increase annual tax receipts by between £6 and £10 billion in 2040 (2010 prices). The present value of the future tax income stream generated is between around £90 and £150 billion<sup>1</sup>. HSR therefore appears to be an investment that delivers a

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<sup>1</sup> The present value of this tax income stream depends on a number of assumptions about the timing of implementation and the discount factor chosen. This calculation is based on discount rates taken from the Treasury appraisal guidance Green Book and assumes the

good return to the Treasury and taxpayer and is a cost effective approach to securing future national prosperity;

- The HSR network could contribute between 25,000 and 42,000 additional jobs in Britain, as more productive businesses offer higher wages and attract people into the labour market. KPMG has only been able to model those jobs that are expected to come from domestic residents encouraged to enter the labour market but expect that attracting foreign firms and workers to the country could give rise to a further positive impact on employment;
- HSR supports larger economic impacts in the North of the country with the largest productivity and employment gains in Yorkshire and the Humber, Scotland, the North East and North West and East and West Midlands. In this sense HSR really could help to spread prosperity outside of the most productive areas of the South East and London and contribute to closing the North-South divide;
- HSR could have substantial impacts on Great Britain's economic geography, tending to concentrate activity in the centre of the core cities served as well as changing the future pattern of regional economic growth. Areas most peripheral from the network are likely to see slower growth in employment as businesses are instead created in areas that benefit most from the advantages brought by HSR.

Like the original coming of the railways, HSR has the potential to transform the shape of the national economy and make a substantial contribution to economic growth. By 2040, HSR could leave national economic output up to 2.1 per cent<sup>2</sup> higher than it would otherwise have been, essentially allowing the country to leap ahead one year in its economic growth.

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network is progressively implemented between 2020 and 2040. Although it may well be developed later than this, this would also push back when the costs are incurred.

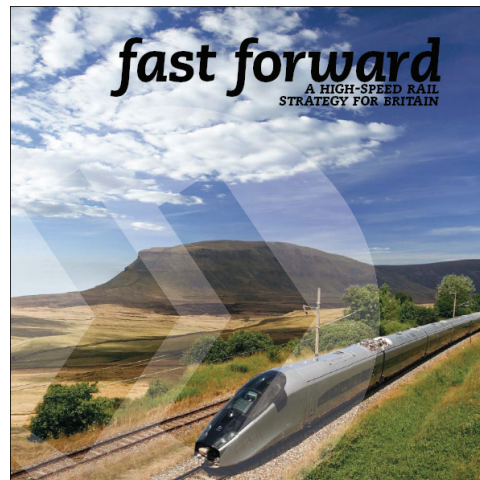
<sup>2</sup> KPMG's economic modelling anticipates economic output to be 1.2% higher by 2040 in their central HSR scenario by 2040 and 2.1% higher in a sensitivity test which includes strengthening of local services that could be made possible by the implementation of a national HSR network.

## 2 The economic debate about High Speed Rail

### 2.1 Background

The debate about developing a national High Speed Rail (HSR) network is hotting up. Our *Fast Forward* report, published in September 2009, presents a roadmap for the long term development of a network of high speed lines and services across the country showing the value for money case for each of the future elements of this potential network.

Supported by both the main political parties, the government has set up the HS2 company to develop proposals for a second high speed line linking London and Birmingham and forming the next stage of a future HSR network. HS2 has now reported its findings to the Secretary of State who is expected to respond in March.



### 2.2 The strategic economic debate about HSR

Developing Britain's HSR network could be the most significant and expensive transport investment in recent history – with wider reaching impacts than the Channel Tunnel or Crossrail and perhaps comparable to the development of the national motorway network. It is widely felt that an investment of this scale could transform Great Britain's economic geography and shape development for many decades to come.

The strategic economic case is made on the basis of:

- Linking the regions of Great Britain to create a true national market for businesses;
- Spreading the prosperity and productivity of London and the South East to the rest of the country;
- By expanding their market reach, supporting the growth of the core cities – the country's most productive locations; and
- Improving Great Britain's competitive position – often versus our European economic rivals where the development of HSR is further advanced.

All of these issues are ultimately related to national economic prosperity – jobs and the money in people's pockets.



## **2.3 Jobs and GVA versus time savings**

This report is a contribution from Greengauge 21 to the wider economic debate about HSR, based on work commissioned from KPMG. The recommendations in our *Fast Forward* report are based on a appraisal of the economic case for HSR consistent with Department for Transport appraisal guidance. This demonstrated that the roll out of HSR across the country would deliver good value for money.

We commissioned KPMG to assess how HSR could change Great Britain's economic landscape and impact on employment and economic output. To do this KPMG has found it necessary to take a different approach from the one usually taken by the Department for Transport when it appraises transport investments.

The Department for Transport's appraisal approach does not capture all of the wider impacts that HSR could have on Great Britain's economy. It focuses on the welfare<sup>3</sup> impacts of a transport investment which and is mainly based on an estimate of users' willingness to pay for the improved journey. The approach that KPMG has taken examines transport investment from a different angle, asking "How will HSR change the way that the national economy works?". In technical transport planning circles the debate about transport and the economy often relates to whether there are elements of wider economic impacts that are additional to the usual categories of welfare benefit within the more traditional DfT appraisal framework. The findings presented in this report instead examine how transport change can support growth in economic activity as measured by Gross Value Added (GVA) which is a separate measure from welfare. This analysis is therefore asking a different question from a conventional appraisal and the results are therefore not additive to a welfare cost benefit analysis.

Another significant difference between the approach KPMG has taken and the DfT's usual approach is that the DfT usually requires appraisals to assume that the number and location of jobs, residents and businesses is independent of transport provision. The original development of Britain's railways led to the growth of our industrial cities. This marked the beginning of the clustering of economic activity and kicked off the golden age of national industrial growth by enabling businesses to cluster in the most efficient locations and serve markets across the country and across the world. The impact of early railways on the physical location of economic activity in Britain was immense. The changes brought about in the location of activity led to further growth in productivity as the cities provided the clusters of activity necessary for further specialisation. To understand these impacts, it has been necessary to assume that land use can vary in response to transport supply.

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<sup>3</sup> Welfare is a measure of consumer satisfaction. This is different from Gross Value Added (GVA) which is a measure of economic output equal to the value of goods and services produced minus the cost of the raw material inputs that went into making them.

A traditional approach to transport modelling is therefore fundamentally unsuitable for understanding the strategic economic issues surrounding HSR in Great Britain such as:

- Will it accelerate economic growth and support more jobs?; or
- Will it help close the North South divide?

KPMG has instead developed an assessment framework based on the DfT's first objective in Delivering a Sustainable Transport Strategy (DaSTS) which is:

*"To support national economic competitiveness and growth, by delivering reliable and efficient transport networks"*<sup>4</sup>

This approach therefore focuses on how changes in transport supply can affect the scale and pattern of economic activity (including jobs and productivity) rather than an approach based on the DfT's appraisal criteria which concentrate on measuring time savings and transport revenues.

## **2.4 A more efficient business environment**

Improving transport supply can change the way businesses work, influence their location decisions and how they grow and provide jobs. This makes businesses more productive and competitive, an effect which persists over time.

Major investment also supports jobs by creating the demand for construction workers, engineers and operational staff. This is similar to the fiscal stimulus packages now being implemented by many countries around the world to counter the effects of the global recession. In the long term, this kind of demand side impact tends to displace other economic activity. This is why economic appraisals do not usually consider these injections of spending to be 'creating' jobs. Indeed, any type of government expenditure can create jobs in this sense by providing demand for them which displaces private consumption. When there is a high level of unemployment and spare capacity in the economy, fiscal stimuli can have a positive effect in the short run as governments borrow to spend. In the long term, this kind of fiscal stimulus must be paid back – perhaps by the next generation.

Although investment in a national HSR network will undoubtedly have far reaching consequences for the demand for certain types of employment, KPMG's analysis focuses on how transport changes can improve business conditions and make all businesses more efficient. In the long term it is growth in productivity that supports faster economic growth and long term job creation and marks out expenditure as a sound investment.

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<sup>4</sup> Delivering a Sustainable Transport Strategy, page 7 DfT, November 2008

## 3 Why HSR supports jobs and GVA

### 3.1 Transport and productivity

The links between transport and economic outcomes are a subject of great debate. Some of the transmission mechanisms are well known and understood and others much less so.

Substantial investment in HSR would bring about a step change in how major British cities are connected with far reaching implications for business to business connectivity and potentially also for labour market catchments. It could affect the productivity of firms in three different ways:

**Impact 1: Changes within particular business sectors:** Individual businesses may benefit from cost savings or increased efficiencies. This may happen, for example, as their staff save time when making business trips, or if the firm is able to address a wider market and become more specialised in a particular role. These impacts have been the subject of much research, particularly by the UK Department for Transport. Faster rail travel can bring about time savings that free up staff time and enable them to be more productive. Indeed, those switching to use rail may be able to use their travel time more effectively than if they were, say, driving. In addition to this, recent research has shown that areas which are better connected to potential employees and to other businesses tend to have higher productivity – a process known as agglomeration. This captures the ability of businesses within a business sector to specialise in what it is good at, as its potential market increases in size. This is one of the cornerstones of economic development.

**Impact 2: Changes in the location of businesses and jobs:** Some areas of the country are host to more productive businesses. In particular, dense city centre environments tend to exhibit higher levels of productivity and offer higher wages. This is partly due to the type of business environment that these places offer. HSR will transform the connectivity of the city centres that it serves, tending to make these locations even more attractive to businesses and concentrating business activity in dense (and productive) urban locations. This geographic redistribution of jobs could have a substantial impact on national productivity.

**Impact 3: Changes in the mix of businesses:** By changing the connectivity offered between key British cities, HSR could benefit certain business sectors more than others. For example, improving long distance passenger transport will help to create a national market for many companies in the service sector. By supporting the long term structural change towards the knowledge economy, this could accelerate economic growth and enhance productivity as the structure of Britain's industry accelerates towards the more productive businesses in knowledge based sectors. Quantifying this impact is very difficult. KPMG finds some evidence that transport can affect the sectoral mix in different areas, but is not aware of any evidence to help

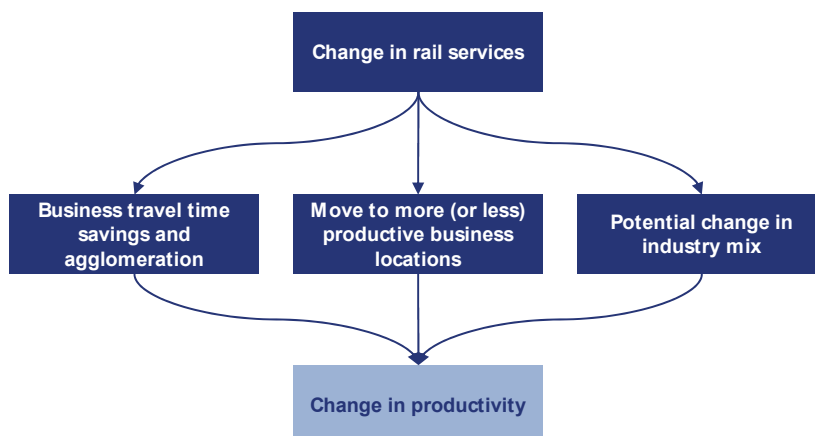
quantify any potential net national changes in sectoral mix so has excluded this from the analysis.

***“To sustain future productivity, transport policy must reflect the economic and structural changes that are shaping the UK’s transport needs.”***  
 Eddington Review

Only the first of the three impacts on productivity described above would normally find its way into a more traditional cost benefit analysis because the second and third imply that improving transport services changes the pattern and location of businesses.

Figure 1 below shows these impacts diagrammatically. The left hand side shows how rail connectivity affects GVA when assumptions about land use are fixed. It does this by making the existing businesses more productive, for example, through reducing business travel costs and through supporting agglomeration. This is captured in KPMG’s analysis of GDP impacts and within the Department for Transport’s appraisal guidance and is often calculated as an additional impact in the welfare cost benefit analysis of transport investments. However, changes in transport can also lead to changes in productivity through two other mechanisms when less rigid assumptions about land use and business behaviour are taken into account. The remainder of Figure 1 represents the impact on business location and sectoral mix that can come about in this case.

**Figure 1: How rail connectivity can affect productivity within sectors and affect the sectoral mix**



Source: KPMG

Enhancing national productivity is the key to ensuring long run economic growth and prosperity. It is what keeps the country competitive. This can come about if

businesses move to more productive locations<sup>5</sup> or if transport conditions themselves change the comparative advantage of different locations and lead to a change in the sectoral mix of industry at a national level.

### 3.2 **Transport and jobs**

Higher labour productivity means that people become a more valuable resource. This incentivises companies to create more jobs. At the same time, higher wages and easier commuting incentivise people to enter the labour market. A more efficient and more productive economy creates jobs faster.

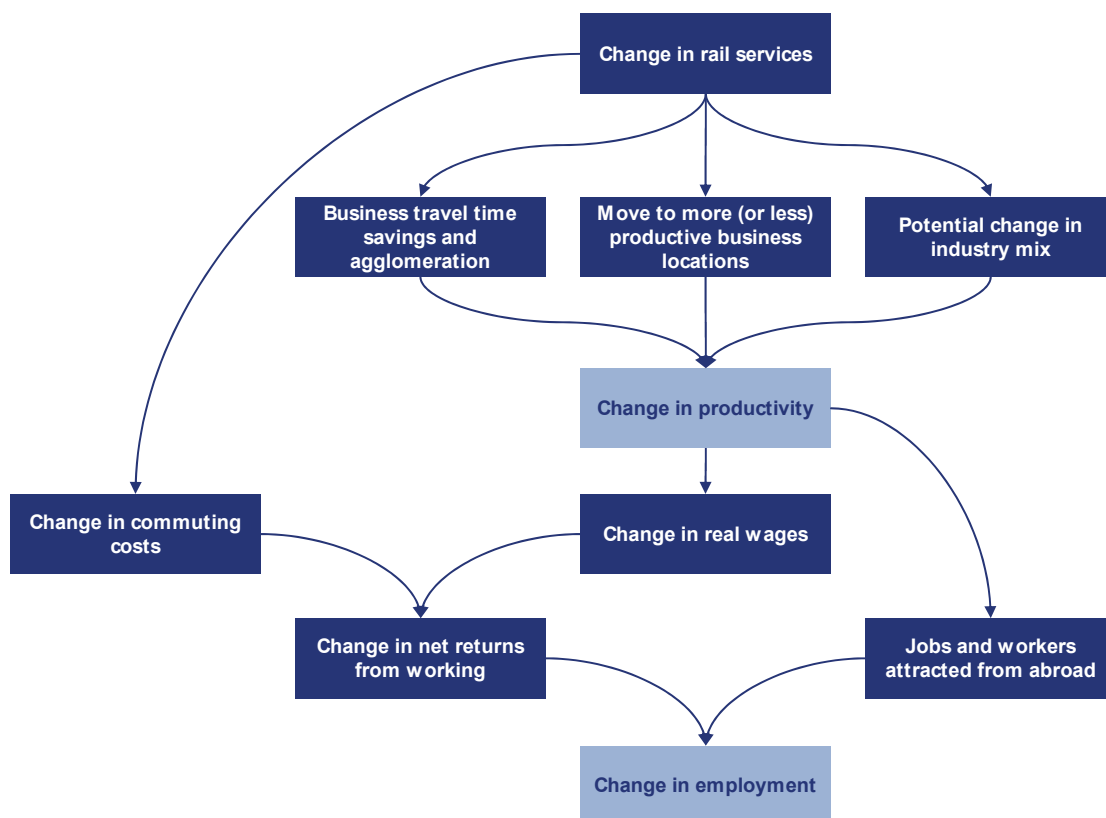
Changes in transport supply can affect long term sustainable employment in three main ways. First, wider and deeper business to business and labour markets drive up labour productivity as both companies and employees can specialise more and increase their output. This means that people are a more valuable resource to companies and incentivises companies to create more jobs. As this drives up wages, it attracts people into the workforce. The additional employment will result in further net new business activity and will boost GVA. Second, if investment can provide the capacity to improve commuting services then this will reduce the hassle of commuting. For some, this will make working more attractive and further attract people into the workforce<sup>6</sup>. Finally, a more competitive national economy will tend to encourage foreign direct investment and skilled international migration. These relationships are outlined in Figure 2 below.

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<sup>5</sup> This can also reinforce agglomeration benefits if businesses move to areas that are denser and where their presence supports denser clusters of activity. This further impact has not been included in KPMG's analysis and would be additional to it. However, this could also be negative if changes in land use led to businesses being less closely clustered, although this is more often due to road schemes on the outskirts of cities than public transport schemes serving urban centres.

<sup>6</sup> While HSR predominantly affects business to business markets, the changes that it makes possible on the classic rail network could have a significant impact on services used by commuters. This is discussed in more detail in section 5.5.

**Figure 2: How changes in connectivity affect net national employment**



Source: KPMG

Calculating the net national employment impacts of transport schemes has not been a focus for DfT economic appraisal. Within WebTAG<sup>7</sup> there is some guidance on assessing how changes in commuting costs feed through to employment impacts through changing the net returns from work. However, changes in productivity levels and wages can also attract international migration and foreign direct investment. Again, these impacts require the analysis to go a stage further than DfT's guidance to adequately capture the way that transport can change the economy. There is limited quantitative evidence to enable analysis of these impacts and KPMG has not been able to robustly quantify them within this study.

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<sup>7</sup> WebTAG (Web Transport Appraisal Guidance) is the DfT's online repository for all transport appraisal guidance.

## **4 An approach to estimating HSR's wider economic impact**

### **4.1 Introduction**

The analysis described in this report is comprised of two key stages which in summary can be described as:

- Understanding how enhanced connectivity provided by rail services can affect business behaviour and economic outcomes; and
- Using these insights to understand how HSR will provide a step change in business connectivity and affect economic outcomes.

The analysis takes as its starting point the hypothesis that transport can affect different aspects of business behaviour including productivity but also where businesses choose to locate, how many jobs they create and how many people enter the workforce. That is not to say that rail connectivity is the only determinant of these economic outcomes, but that it contributes to them and this contribution can be measured.

### **4.2 Summary of KPMG's technical approach**

Using data on rail journey characteristics and observed socioeconomic outcomes, KPMG has:

- Developed measures of rail connectivity to other businesses and to potential employees (labour markets) for each location;
- Tested hypotheses about the links between rail access and business behaviour;
- Evaluated the strength of these impacts; and
- Developed a forecasting approach which incorporates them.

This analysis has been undertaken using data on rail services between all 408 districts within Great Britain using data from the national version of the MOIRA rail network planning model. Full details are provided in the accompanying technical report.

#### **Measuring Rail Connectivity**

Using data on rail services, observed travel behaviour and socio-economic data, KPMG has calculated measures of 'effective market sizes' for:

- Rail based business to business markets: to represent the scale of business to business connections available to a firm in a particular location; and
- Rail based labour markets: to represent the number of potential employees that would be willing to commute to the business by rail.

Areas with faster rail services, higher frequencies, more destination options or connected to denser areas of economic activity will have larger effective market sizes.

### 4.3 **Setting out and testing hypotheses**

The rail network is one way that a firm can access other businesses and access employees. Other things being equal, KPMG hypothesises that improving rail access to either of these groups is likely to make a location more attractive as a place to do business.

To do this KPMG has developed measures of rail connectivity that, for each district in Great Britain capture:

- The opportunities to travel to all other districts in the country by rail, including the journey time, number of interchanges, service frequency and the rail fare;
- The businesses<sup>8</sup> in those other places that could serve as potential trading partners and the working age population that could furnish potential rail commuters; and
- Observed behaviour on how far<sup>9</sup> people travel to make business to business and commuting journeys.

An illustration of how this measure was derived by KPMG for rail business to business markets is shown in Figure 3 below.

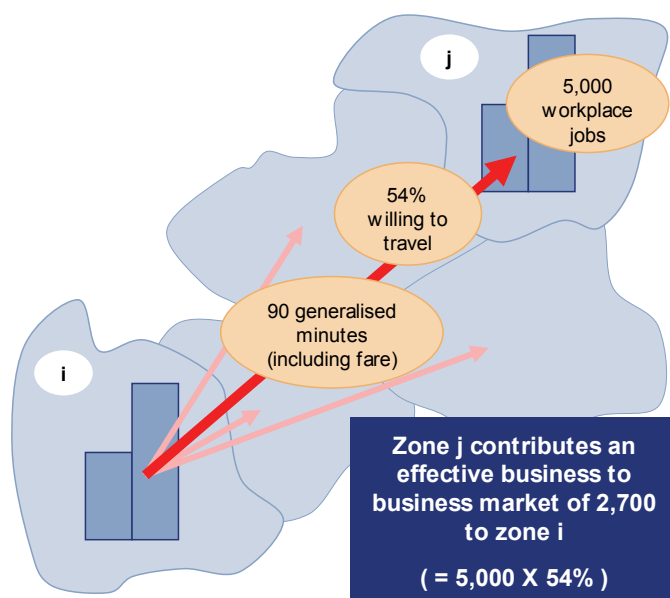
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<sup>8</sup> In fact, KPMG assess access to workplace jobs rather than businesses as this is a better measure of the amount of business activity in that area. Larger businesses are therefore weighted as more important than smaller businesses in KPMG's analysis.

<sup>9</sup> KPMG measure how 'far' apart two places are using the generalised cost between them. This captures different aspects of the overall cost and difficulty of the journey, not just the distance. The measures of connectivity are therefore similar to those used when calculating effective economic density in agglomeration calculations, except that the calculations use a trip length distribution rather than an exponential decay function to represent how the importance of an opportunity reduces as generalised cost increases.



**Figure 3: Illustrative example of contribution of destination zone j to business to business market catchment of origin zone i**



*Source: KPMG*

Summing across all destination zones for outbound business to business trips, KPMG used this approach to estimate the total business to business market catchment of each district. Using a similar approach KPMG calculated the labour market catchment of each district by assessing access to working age residents.

They have then assessed whether these measures of rail connectivity are linked to the economic performance of different areas. This has been done using statistical techniques which are described in the accompanying technical report. The analysis draws on socio-economic data from public sources, and comprehensive rail service data from the national version of the MOIRA rail network model covering rail service levels from key stations across England, Scotland and Wales. This enabled KPMG to make comparisons across regions and to analyse a wide range of different types of location – from central London to rural areas.

Using this data, KPMG asked the following four questions:

- First, does rail connectivity affect the overall average wage levels offered within an area? (This corresponds to all the channels through which rail connectivity affects productivity in Figure 1).
- Second, does rail connectivity affect the wage levels offered within individual business sectors due to factors such as business time savings and agglomeration? (This corresponds to the first channel through which rail can impact on productivity in Figure 1).

- Third, does rail connectivity affect the sectoral mix of an area and hence the average wages offered in that area? (This corresponds to the third channel through which rail can impact on productivity in Figure 1).
- Fourth, does rail connectivity affect the attractiveness of an area as a place to do business and hence the density of employment found there? (This corresponds to the second channel through which rail can impact on productivity in Figure 1, the move to more productive jobs).

The second and third questions relate to why average wages may be different in areas with different levels of rail connectivity. Is it because rail skews the sectoral mix of businesses to ones with different wage levels, or is it because it affects wages within individual business sectors? The answers to these two questions should be in line with the answer to the first question which is about overall wage differences. The final question informs how businesses relocate to make the most of the productivity benefits offered by different locations.

Full details of the methodology KPMG has employed and the results are contained in the accompanying technical report. Due to the poor quality of data on the economic output of local areas, they have used wages as a proxy for productivity and hence instead of GVA, they calculate total wage income.

KPMG's statistical analysis shows that there is strong evidence that **areas with higher levels of rail connectivity have higher wage levels**. The evidence suggests that **an area with 10% higher business to business rail connectivity will tend to have an overall wage level which is 1.1% higher**. In technical terms, this is an elasticity of wages to rail connectivity of 0.11.

The analysis shows that the overall impact on wages varies by industry. The results are shown in Table 1 below.

**Table 1: Estimated elasticity of wages with respect to rail business to business connectivity**

Sector	Elasticity	T Statistic	Significant at 95% confidence level?
Agriculture and fishing	-0.00	-1.10	No
Energy and Water	0.06	4.96	Yes
Manufacturing	0.06	7.76	Yes
Construction	0.06	8.80	Yes
Distribution, hotels and restaurants	0.10	10.12	Yes
Transport and Communications	0.06	6.49	Yes
Business services and finance	0.12	10.81	Yes
Public Admin, education and health	0.05	8.06	Yes
Other	0.11	11.10	Yes
<b>Total</b>	<b>0.11</b>	<b>12.92</b>	<b>Yes</b>

*Source: KPMG analysis of 408 districts in England and Wales*

The influence of rail connectivity on labour productivity is most pronounced in the business services and finance sector and not present in the agriculture sector. This is perhaps not surprising given the different transport usage characteristics of these industries and is consistent with work by the DfT on agglomeration. The total is not the same as the average of the results for different business sectors for two reasons. First, the analysis for all sectors is able to use more data points and so provides a better guide to the strength of the overall relationship across business sectors (as evidenced by the larger T statistic); and second some business sectors are much larger than others, skewing a weighted average.

KPMG has attempted to break this productivity impact down into constituent parts to better understand how rail connectivity affects business behaviour and productivity. The two different elements are:

- Influencing the wages offered within individual business sectors through supporting business time savings and agglomeration; and
- Influencing the mix of business sectors within a location leading to a change in the overall average wage offered there.

They find that both of these factors exert an influence on the productivity of an area. The combined effect of these factors is consistent with that found for wages as a whole in Table 1 above.

At a national level, the influence within individual business sectors appears to be around three times as large as the impact on the mix of business sectors. The elasticity of wages due to changes within sectors is 0.09 across England and Wales. This compares to an elasticity of wages to changes in sectoral mix of 0.03 across the same area. The first effect is intuitive. Higher levels of rail connectivity are likely to positively influence the productivity of businesses within business sectors because areas with better connectivity are likely to benefit directly from rail journey time savings compared to their peers in other locations as well as benefiting from agglomeration economies as other businesses are effectively brought closer. However, it is not necessarily intuitive that rail connectivity is associated with a sectoral mix offering higher wages. It suggests that the business sectors that benefit from rail connectivity and locate in response to it tend to offer higher wages than average. This provides support for the contention that rail access engenders clustering of more productive industries, or at least higher wage industries.

KPMG's statistical analysis also shows that there are **strong links between the employment density of an area (measured in jobs per square kilometre) and rail connectivity** to labour and to other businesses. This evidence suggests that, other things being equal, a location with 10% higher rail connectivity tends to have an employment density that is around 14% higher. Another way of describing this is that the elasticity of employment density to rail connectivity is +1.4.

**Table 2: Estimated elasticity of employment density with respect to rail business to business connectivity**

Sector	Elasticity	T Statistic	Significant at 95% confidence level?
Agriculture and fishing	0.2	4.0	Yes
Energy and Water	n/a*	n/a*	No
Manufacturing	1.2	17.4	Yes
Construction	1.2	18.8	Yes
Distribution, hotels and restaurants	1.3	18.3	Yes
Transport and Communications	1.4	18.0	Yes
Business services and finance	1.7	21.6	Yes
Public Admin, education and health	1.3	16.5	Yes
Other	1.4	18.9	Yes
<b>Total</b>	<b>1.4</b>	<b>18.8</b>	<b>Yes</b>

Source: KPMG analysis of 408 districts in England and Wales

\* Insufficient data

The relationship between rail access and employment density is **strongest for the business services and banking sector** with an elasticity of 1.7. The relationship is much weaker for the agriculture forestry and fishing sector with an elasticity of +0.2. Again, the relationship found for all sectors taken together is not the same as a

weighted average for each of the individual business sectors. This is mainly because it is based on more accurate data as the wage data for different industries in different locations has wider margins of error. These relationships are explained in detail in the accompanying technical report.

While this relationship shows how areas with better rail connectivity are more attractive to businesses and hence support higher levels of employment density, it does not show that rail connectivity creates jobs. The link between rail connectivity and employment does exist, but is slightly more complex. Rail supports employment growth by driving growth in productivity and wages and attracting people into the labour market. Instead of showing how rail service changes could lead to net employment impacts, this relationship shows how they could lead to a redistribution of business and jobs. The relationship is therefore used to support the analysis of business relocation and the productivity impacts of this. In the long term, net new jobs are only supported through the mechanisms described in section 3.2. This analysis of business location decisions presupposes that transport can affect land use and so, as previously discussed, it falls outside of the guidance on transport scheme appraisal issued by the DfT.

#### **4.4 Forecasting changes in economic outcomes**

The second stage of the project formalised these relationships into a forecasting model that takes account of potential future changes in the rail service (and hence in rail connectivity) and assesses the economic consequences of these. This model takes into account both the impacts of rail connectivity on wages, employment and the geographical distribution of economic activity.

KPMG's analysis necessarily goes some way beyond usual DfT transport appraisal guidance, but we have drawn comparisons where necessary and highlighted where impacts on wages and employment will lead to net national outcomes and which are redistributive.

#### **4.5 Areas for further analysis**

Data constraints and inadequate statistical results mean that KPMG has not been able to construct a forecasting model that separately assesses changes in the size and location of businesses, and wages offered by different business sectors. Instead, they have modelled the aggregate changes in wages offered in different areas and the pattern of overall employment as a result of introducing HSR services.

A second important data constraint is the difficulty of collecting local data for each model zone relating to all the variables that can affect economic outcomes. Planning designations for example may affect business location decisions. KPMG has not collected local data for these variables and the quantitative analysis is therefore partial. It does not attempt to capture all of the factors that affect the wages offered and the employment density observed in different areas, but rather the marginal changes that changes in rail connectivity can make. When used for forecasting, KPMG's analysis therefore makes some implicit assumptions:

- First, that there is a causal relationship between rail connectivity and business behaviour. There are good reasons to believe that causation runs in this direction, although this is a difficult issue that is described further in the accompanying technical report; and
- Second, that rail connectivity is not correlated to other factors that may drive business productivity. This particularly applies to connectivity provided by other modes of transport such as bus or the road network. Again, this is described further in the accompanying technical report.

Little is known about how the quality and coverage of transport services impact on foreign direct investment or international migration. Some evidence is available about how businesses make international location decisions and what share of changes in the business stock is due to the behaviour of international businesses. Other studies have estimated positive employment impacts from job redistribution from overseas. For example Oxford Economic Forecasting estimated that that 17% of the employment benefits of Crossrail would come from international sources. In 2006 around 30% of the migrant inflow to the UK regions was international with the remaining 70% being domestic. From this it has not been possible to draw robust quantitative conclusions about the impact on attracting internationally mobile business activity. However, we would expect this impact to be unambiguously positive as productivity increases.

Another factor biasing KPMG's results downwards is the feedback effect from relocation of businesses to denser urban areas which will tend to reinforce agglomeration benefits. The productivity impacts of this relocation are therefore understated in this regard. Unfortunately, within the budget and timescales available for the study it has not been possible to correct this omission.

The model is essentially an unconstrained model that assumes that other factors such as the planning system and the location and use of other public infrastructure continue to influence economic outcomes as they have in the past. It may be that planning policy either supports or frustrates some of the modelled changes. For example, planning policy may change to encourage denser development in the core city centres when HSR is implemented. Conversely, modelled growth in economic activity could lead to congestion on other transport and public services (e.g. public open spaces) in the core cities. Investigating these feedback effects through congestion is beyond the scope of this study but could benefit from further work.

## **5 What does a national HSR network deliver?**

### **5.1 The HSR network tested**

This section describes how KPMG's economic forecasting model has been applied to understand the economic impacts that the development of a national HSR network could have on national economic outcomes.

We asked KPMG to take a long term view of the development of a national HSR network with the following characteristics:

- A northwest route London to Birmingham, Manchester, Glasgow and Edinburgh linked to services through the Channel Tunnel and to Heathrow Airport, including a link between Edinburgh and Glasgow;
- A northeast route following the M11 corridor serving Stansted, Nottingham, Sheffield, Leeds, Newcastle and Scotland;
- A Transpennine route connecting Manchester with Leeds/Sheffield; and
- A western route to South Wales and the South West.

This is the preferred final network recommended by SYSTRA-MVA in their final report for Greengauge 21 and as described in *Fast Forward*.

This network would require phased construction over a number of years. In this analysis, KPMG has used 2040 as the forecast year for appraising the full network, although this should be treated as indicative. The progressive phases of development to the full HSR network may not be possible within these timescales, but this assumption balances this with the difficulty of forecasting economic conditions far into the future. As the timing and phasing of this network are uncertain, we have not presented a net present value of the GVA and employment benefits that KPMG has calculated. Instead, we present point estimates in 2040 which reflect the additional jobs and output that could occur in the economy in that year if this HSR network was operational by then.

### **5.2 Representing HSR in the economic forecasting model**

KPMG has drawn on data from SYSTRA-MVA's transport analysis to represent the journey time savings from HSR within the economic activity model. The key assumptions are as follows:

- Generalised journey time<sup>10</sup> changes including changes in rail journey time, frequency, interchanges required and fares have been translated directly into the model;
- Changes on air competitive flows have been included if rail travel comes to dominate the market (i.e. have a market share of over 90%) following the introduction of HSR; and
- Reductions in crowding on existing long distance rail services have been extracted from SYSTRA-MVA's work and implemented in the model as further reductions in rail generalised cost.

### 5.3 Changes in the connectivity between businesses

The HSR scenario described could support a step change in the levels of connectivity between firms in London, Birmingham, Manchester, Sheffield, Leeds, Edinburgh, Glasgow, Bristol and Cardiff as well as other cities closely connected to them. This could substantially transform the way that they do business, leading to greater specialisation between firms around the country. The HSR network modelled offers the following changes in key journey times.

**Table 3: Changes in key journey times**

Origin	Destination	Journey time saving
Central London	Birmingham	0h 40
Central London	Manchester	0h 55
Central London	Leeds	1h 00
Central London	Sheffield	0h 50
Central London	Newcastle	1h 10
Central London	Glasgow	1h 50
Central London	Edinburgh	1h 50
Central London	Cardiff	0h 20
Central London	Bristol	0h 20
Birmingham	Paris	1h 30
Manchester	Newcastle	1h 00

*Source: Fast Forward, Greengauge 21, 2009*

<sup>10</sup> Generalised journey time is a measure of the 'hassle' of making a journey. It includes both actual minutes of travel time, plus allowances for other journey characteristics such as waiting time, the need to interchange and even the financial penalty that is represented by the fare. This can be expressed in minutes or in financial terms using a value of time to convert time elements into pounds or financial elements of the journey into minutes. Throughout this report we use the generalised time to mean an overall measure of the difficulty of a journey which includes both time and financial costs and is measured in minutes.



Changes in journey times of this magnitude offer step changes in the levels of business to business connectivity across the country. Figure 4 below shows the changes in business to business connectivity that could be brought about by HSR.

**Figure 4: Business to business connectivity measures for key cities, 2040**



*Source: KPMG analysis*

The changes are particularly stark in Birmingham and in Leeds, Sheffield and Manchester where HSR provides a step change over existing rail and air services to many centres of economic activity. Both the existing market sizes and the impacts of HSR are somewhat smaller in Scotland because HSR offers relatively modest journey time improvements over air travel and more local markets tend to be smaller. Impacts on the Greater Western corridor are smaller because the scenario tested included smaller journey time improvements on this corridor.

## 5.4 Induced changes in wages, employment and economic output

Enhanced connectivity enables businesses to boost productivity and competitiveness and pay higher wages, attracting people into the workforce and accelerating growth

in economic output. The headline economic findings from KPMG's analysis for Great Britain are shown in Table 4 below.

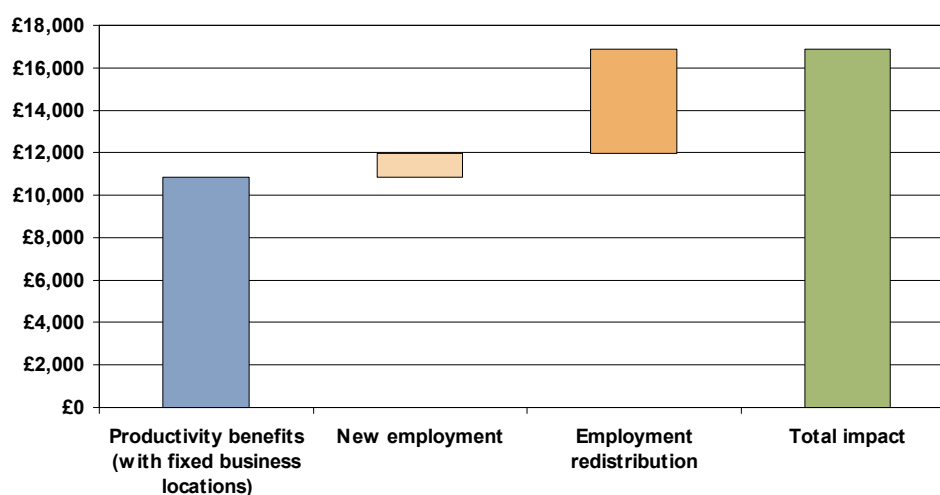
**Table 4: Changes in economic variables as a result of HSR network, 2040**

Economic variable	Change	% change
Employment	25,200	0.09%
Average wages, £	409	0.95%
GVA, £bn	£16.9	1.48%

*Source: KPMG analysis*

KPMG's analysis suggests that HSR could boost wages in the average job by around 1% in 2040 as businesses compete in a more national market, increasing competitiveness and specialisation and concentrating economic activity in some of the most productive locations in the country. The result of this is an increase in pay of some £400 per annum on an estimated 2040 average wage of around £43,000 per annum<sup>11</sup> and an overall national GVA increase of some £16.9bn per annum by 2040. Figure 5 below shows how these results are constituted.

**Figure 5: Composition of overall impact on national GVA in 2040**



*Source: KPMG analysis*

The first of these columns represents changes in productivity within business sectors and accounts for 64% of the total modelled impact. This has been calculated by KPMG based on analysis of the link between rail connectivity and average wages.

<sup>11</sup> Expressed in 2009 prices

Although calculated differently, much of this is capturing the benefits of business time savings, agglomeration and specialisation that are enabled by larger markets as well as some other effects on business productivity that may not be taken into account by current DfT guidance such as rail business trips enabling some productive use of travel time. The modelling does not reveal details of how change occurs within different business sectors. As an illustration, improved rail connectivity may enable a more generalist regional architect's practice in Leeds to develop its specialism in public open spaces as it can now effectively serve markets across the country. In addition it would gain as business trips would be shorter and more likely to be by rail where time could be used more productively.

The second impact comes from increases in employment driven by these increases in wages. The increase in employment across the country of 25,200 (shown in Table 4) gives rise to a GVA increase of £1.1bn. Again, by way of illustration, it may be that HSR enables the specialist architectural practice described above, by reducing its costs and enabling it to specialise to improve its product, earn higher profits and offer higher wages. By driving up wages and output, improved productivity attracts people into the labour market, from architects to its supporting print shop workers, suppliers of computer equipment and office cleaners. These net national benefits through supply chains are implicitly included in the analysis, although explicit multiplier effects have not been calculated because these can often represent economic activity displaced from other areas or sectors rather than net new national economic activity.

The third constituent impact comes from the relocation of jobs to those areas that benefit most from HSR. This and the first impact on productivity within business sectors from time savings and agglomeration both contribute to the overall impact on average wages of £409 per year reported in Table 4. With city centre stations in many major cities, the HSR network would effectively function as a series of 'mini airports' directly connecting the city centres of the core British cities and making them much more attractive business locations. These locations tend to be the most productive locations in the country. They offer higher wages because companies located in these places can effectively bring together skills and connect to companies across a very wide area. The most obvious example of this is the City of London which offers labour market and business to business catchments of more than four times that of the average workplace in Great Britain<sup>12</sup>. By supporting and encouraging growth in these areas, HSR could play a significant part in influencing the future pattern of employment across the country, much as the early railways did from the 19<sup>th</sup> Century.

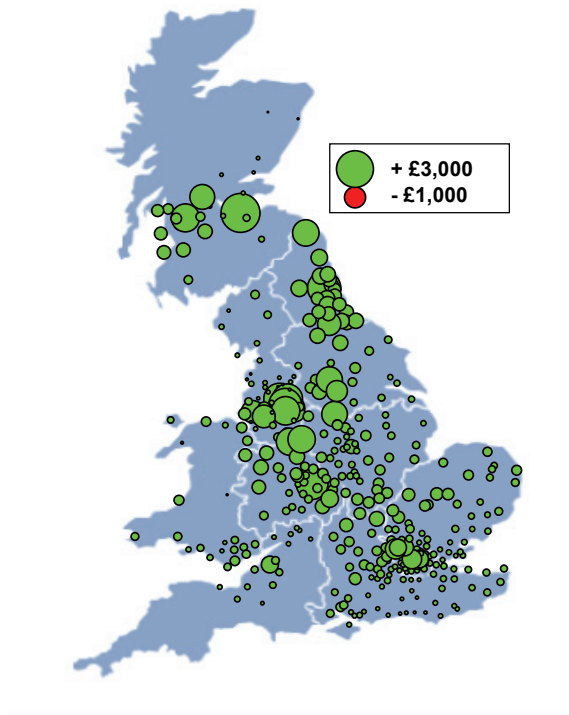
The net national increase in productivity is a function of changes in productivity feeding through into higher wages and attracting people into the labour market.

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<sup>12</sup> Based on KPMG analysis of the effective market sizes of all districts in the UK described in Chapter 4.

However, there is also a substantial redistribution of employment. Modelled changes in average wages by model zone are shown in Figure 6 below.

**Figure 6: Modelled change in average wages by district in 2040 due to HSR**



*Source: KPMG analysis*

Figure 6 shows the pattern of changes in average wages. Each circle represents one of the 408 model zones across Great Britain for which economic impacts have been calculated. These include areas directly served by HS as well as other districts. The impacts are universally positive as the implementation of HSR expands markets, reduces business travel times and brings businesses closer together. The largest impacts are concentrated in:

- Sheffield, Leeds and particularly Newcastle and surrounding areas along the Eastern HSR route;
- Birmingham, Stoke-on-Trent, Manchester and Liverpool along the West coast route
- Edinburgh, Glasgow and the central belt in Scotland; and
- In and around London.

The changes in relative prosperity are enough to drive some large changes in business locations, concentrating businesses around the hubs of the new high speed

network. The modelled regional changes in employment make small changes to the modelled employment growth rates in these areas. Table 5 below shows the estimated employment growth rates in these areas in the without HSR scenario and in the with HSR scenario.

**Table 5: Regional employment growth rates, 2021 to 2040**

Region	Base employment, 2007	Base case with no HSR, 2040		HSR scenario, 2040	
		Employment, 2040	Annual growth rate 2007 to 2040	Employment, 2040	Annual growth rate 2007 to 2040
East	2,380,000	3,052,000	0.76%	3,012,000	0.72%
East Midlands	1,910,000	2,414,000	0.71%	2,389,000	0.67%
London	4,080,000	5,579,000	0.95%	5,520,000	0.92%
North East	1,030,000	1,071,000	0.12%	1,117,000	0.25%
North West	3,040,000	3,532,000	0.46%	3,594,000	0.51%
Scotland	2,410,000	2,726,000	0.38%	2,790,000	0.45%
South East	3,730,000	5,006,000	0.89%	4,935,000	0.85%
South West	2,240,000	2,937,000	0.83%	2,889,000	0.78%
Wales	1,170,000	1,260,000	0.22%	1,239,000	0.17%
West Midlands	2,360,000	2,645,000	0.35%	2,713,000	0.42%
Yorkshire and the Humber	2,240,000	2,550,000	0.39%	2,599,000	0.45%
<b>Total</b>	<b>26,580,000</b>	<b>32,771,000</b>	<b>0.636%</b>	<b>32,797,000</b>	<b>0.638%</b>

*Source: KPMG analysis of data from SYSTRA-MVA*

Productivity and wage changes of this magnitude could be responsible for an increase in employment of some 25,000 jobs by 2040 as people are attracted into the labour market.

Together, these reductions in business costs and changes in the way businesses operate, induced employment growth, international business activity attracted to the country and business relocation effects contribute to an overall impact on annual GVA in 2040 of around £17bn. This is expected to be distributed as shown in Table 6 below.

**Table 6: Regional changes in Wage income used as a proxy for Gross Value Added (GVA), £m, 2040**

Region	Base wage income, 2007	Base case with no HSR, 2040		HSR scenario, 2040	
		Wage income, 2040	Annual growth rate 2007 to 2040	Wage income, 2040	Annual growth rate 2007 to 2040
North East	21,800	39,000	1.73%	41,800	1.93%
Scotland	56,800	111,800	2.01%	118,300	2.18%
West Midlands	53,800	104,000	1.96%	109,300	2.11%
North West	70,000	140,700	2.08%	146,100	2.19%
Yorkshire and The Humber	50,200	98,500	2.00%	102,200	2.11%
London	136,700	326,000	2.59%	325,700	2.59%
East Midlands	42,900	93,300	2.31%	92,700	2.29%
East	57,700	127,700	2.36%	126,500	2.33%
South East	96,800	224,200	2.50%	221,500	2.46%
South West	51,100	115,800	2.44%	114,400	2.40%
Wales	24,800	46,000	1.83%	45,400	1.79%
<b>Total</b>	<b>662,700</b>	<b>1,427,000</b>	<b>2.28%</b>	<b>1,443,800</b>	<b>2.32%</b>

Source: KPMG analysis of rail generalised journey time data and economic data from SYSTRA-MVA

The impacts across the different regions are as follows:

- The **North East** gains from substantial improvements in journey times to a wide variety of areas, boosting wages by over 2% and attracting people in the local labour market. The largest impacts are seen as the region competes more effectively for employment growth as footloose businesses increasingly choose to locate there.
- **Scotland** sees the business connectivity of Edinburgh and Glasgow and surrounding areas leaps as HSR connects these cities to a wide range of destinations across the UK. The benefits mostly comes from access to areas across the north of England as air services already provide good links to areas in the south. Employment growth is forecast to become more concentrated in these cities as businesses expand their markets, specialise and create jobs.
- The **West Midlands** gains from improved access to London and across the country. This allows it to compete more effectively and raise average wage levels by around £700 as businesses create jobs. Redistribution of employment to the region from areas of the UK that are less well served than HSR could see employment grow by around 60,000 to 70,000 and GVA leap by close to 6%.
- The **North West** sees large connectivity benefits for Manchester and Liverpool as well as other areas on the existing WCML that gain easy access to high speed services. This boosts labour productivity, encouraging job

creation within the region. HSR also improves the competitive position of the region, attracting employment growth from other regions and boosting annual GVA by around 4.5% by 2040.

- **Yorkshire and the Humber** sees HSR services to Sheffield and Leeds boost business connectivity and concentrate activity in these places, attracting up to 50,000 jobs to the region.
- **London's** markets expand, although already dense local markets mean that this is less significant than in some other locations. Already high productivity rises by a further 0.5%, but larger benefits elsewhere in the country lead some economic growth to shift to other locations. Employment growth in the capital is still expected to be the fastest of all the UK regions at 0.92% per annum.
- The **East Midlands** benefits from HSR services connecting Nottingham to London, although the service specification tested includes only a single high speed train per hour to Nottingham. The East Midlands sees a productivity gain similar to London's but again tends to see some employment growth drawn to those areas where HSR provides the biggest boost to business connectivity. The regional employment growth rate falls slightly from a high 0.71% per annum between 2007 and 2040 to 0.67% per annum reflecting the relatively limited service HSR represented.
- The **East of England** is more peripherally affected by the HSR network, although it still gains from increased productivity and wages with employees in 2040 being some £160 per annum better off. However, changes in the national pattern of development moderate annual employment growth in the region from 0.76% per annum to 0.72% per annum with consequent slower growth in GVA than would otherwise have been the case.
- **Wales** sees HSR connections to Cardiff along the Great Western route, although modelled journey time savings of around 20 minutes to London are smaller than for other HSR routes as HS-WW has not been modelled as a full HSR scheme. The growth in business connectivity improves wages by some £130 per annum by 2040 and attracts around 400 new residents into the labour market. However, business and employment growth is abstracted somewhat to the most significantly affected areas in the north and Midlands of England slowing overall employment growth rates.
- The explosive growth in the **South East** is moderated by HSR as the national pattern of growth shifts north. More productive businesses gain better access to the rest of the country via Ashford and London. The long term annual employment growth rate is expected to ease down from 0.89% to 0.85% reducing future pressures on the environment and local services.
- The **South West** benefits from an HSR connection to Bristol and areas can benefit through interchange with the HSR network at Bristol, Birmingham

and London. However, limited journey time improvements have been modelled for Greater Western services which explains the relatively small impacts in these areas. The impact is again to ease employment growth rates by around 1/20<sup>th</sup> of a percentage point per annum although wages are forecast to rise slightly by around 0.2% by 2040. As with the impacts in Wales, if a full HSR line to Bristol and Cardiff were modelled, the impacts would be commensurately greater.

## **5.5 Enabling better local services**

The development of a new HSR network would not only take the pressure off existing services, but could free capacity on the existing, or 'classic', network for use by other services. In particular, there may be opportunities to introduce new commuting or semi-fast services from London and other stations around the country where classic services are reshaped. There may also be opportunities to accommodate additional freight services, although this has not been modelled.

KPMG's analysis has followed the assumptions about additional capacity freed up made by SYSTRA-MVA in the analysis that underpinned the *Fast Forward* report. In summary these are:

- An additional 13 London suburban services per hour;
- An additional 8 Non-London suburban services from Birmingham, Manchester and Leeds per hour; and
- An additional 16 semi-fast services of which 13 serve routes from London on the West Coast, East Coast and Midland Mainline routes per hour.

If these could be implemented within the design of the HSR network, they would provide much needed additional capacity to ease overcrowding and would increase train frequencies and so improve journey options.

KPMG has used these assumptions to assess changes in the generalised costs of rail travel by applying them to the appropriate origin to destination flows in the economic activity model. Any additional capacity freed up through the implementation of HSR could be used in a range of different ways. It should also be noted that this analysis required taking route level cost changes and applying them to specific origins and destinations. It therefore is a relatively crude representation of these effects and so should be treated as illustrative.

The results of this scenario are shown in Table 7 below.



**Table 7: Regional changes in economic outcomes, 2040**

Region	Increase over base case in central case HSR scenario	Increase over base case in scenario with additional local and semi-fast services
Employment	25,200	42,300
Average wages, £	409	715
GVA, £m	16,900	29,400

*Source: KPMG analysis*

The additional GVA benefits from relieving capacity constraints on the existing classic network are calculated to be around 43% of the total benefits of implementing HSR. Of this, KPMG estimates that some 69% is due to the benefits of reducing crowding while the remaining 31% is due to the impacts of increases in frequency on the commuter and semi-fast routes that gain extra services.

In the scenario modelled, an additional implication is that the national geographic pattern of benefits shifts slightly to the south, with London's relative position improving as most of the services modelled were estimated to provide crowding benefits on commuter services to London. However, the regional distribution of benefits is heavily dependent on assumptions on where the additional classic rail services would be focused and so in practice the pattern of economic benefits may be different from those modelled for this report.

## 5.6 Fiscal implications

If HSR brought about the modelled changes in wages, employment and economic out, this would give rise to additional tax revenues. KPMG has taken a conservative view that 35% of the increase in Gross Value Added is taken in taxes, this translates to almost £6 billion per annum by 2040 and could translate into a present value of tax receipts of around £87 billion in current prices.<sup>13</sup>

If the potential benefits from local service changes are also included then this number could be larger. If annual GVA impacts were £29 billion per year, then the present value of additional tax receipts could reach over £150 billion.

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<sup>13</sup> The build up of GVA and tax impacts have not been modelled over time, so for this analysis KPMG have assumed that impacts ramp up over the 20 years between 2021 and 2040 and grow thereafter at the rate of real economic growth. This analysis also assumes discount rates consistent with the Treasury Green Book appraisal guidance.

## 6 Conclusion

The aim of this analysis was to assess the likely economic impacts of the development of HSR on the national economy. In particular our aim was to seek answers to some of the strategic economic issues surrounding HSR and provide evidence where these arguments are often currently based on conjecture or anecdote.

Drawing on the evidence from KPMG's analysis, we conclude that the development of a HSR network in Britain could indeed have a significant impact on jobs, wages and output and help close the productivity gap with respect to our global competitors. As companies grow more efficient in a nationally competitive market and the development of our core cities is supported and promoted, the KPMG analysis estimates that HSR could support growth in average wages of £409 per annum, encouraging an additional 25,000 people into work and underpinning growth in national GVA of some £17bn per annum.

Moreover, HSR will also free up capacity for additional local services which KPMG indicatively estimates could boost the GVA impact of HSR to around £29 billion per annum in 2040. To put this in context, this is equivalent to over one year of real economic growth at the average long term growth rate of around 2.25% per annum. In the event that the modelled HSR network was delivered between 2020 and 2040 KPMG estimates that it could accelerate national growth rates by around one twentieth over this period.

All areas of the country see a productivity benefit as HSR expands business market catchments and supports the agglomeration of business activity. The largest impacts are seen in the Northern core cities and in Edinburgh and Glasgow. In this sense, HSR really does spread prosperity across the country.

Looking 30 years ahead can only ever be an indication of what could happen. Nevertheless, this analysis suggests that the development of HSR could significantly reshape the nation's economic geography supporting the further growth and concentration of the productive centres of the core cities.

This geographic analysis of employment gains provides strong support for the claim that HSR would help to 'rebalance the national economy' with faster economic growth impacts predicted in the Northern regions and the West Midlands. The exceptions to this are places on the fringes of the network or areas where HSR provides smaller journey time savings. In the HSR scenario that KPMG has modelled, smaller journey time improvements are modelled in areas such as Wales and the South West, although a full HSR line would see significantly larger benefits in these areas.

Returning additional annual GVA of between £17 and £29 billion per year by 2040, HSR can be expected to deliver substantial returns to the exchequer as additional tax revenue accruing from this could be between £6 and £10 billion per annum. At

conventional discount rates, the present value of tax income returned to Treasury could more than cover the cost of the project. This suggests that HSR is a good investment for the national tax payer as long as financing can be found for its construction.

