High Speed Fail

Assessing the case for High Speed 2

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About the Author

Nigel Hawkins is an investment analyst, who specializes primarily in the electricity, gas, water and telecoms sectors; he also covers several other sectors. He has worked in the City since 1988, notably for Hoare Govett (now RBS), Yamaichi and Williams de Broe (now Evolution).

He is a regular features writer for Utility Week and Cleantech magazines and frequently contributes to the financial media. In addition, he undertakes various research projects on energy, water and economic policies for Westminster-based Think Tanks. For the Adam Smith Institute, where he is a Senior Fellow, he has written five previous publications:

- *Privatisation – Reviving the Momentum;*
- *Re-energizing Britain (UK Electricity);*
- *Ten Economic Priorities;*
- *The Party is Over – A Blueprint for Fiscal Stability;*
- *Privatisation Revisited.*

Prior to joining the City, he worked for six years in politics, including three years as Political Correspondence Secretary to Lady Thatcher at 10 Downing Street.

In 1987, he stood in the general election as Conservative Party candidate in Sedgefield against Tony Blair.

1 Executive Summary

'It is these non-monetised benefits which underpin the strategic case for high-speed rail.'

DfT Consultation Document, February 2011.

- Despite net debt interest payment projections of over £66 billion for 2015/16, the Coalition government seems determined to proceed with the *c*£17 billion 360 km/h (225 mph) High Speed Two (HS2) project that aims to build, as Phase 1, a new London to West Midlands railway line. Phase 2 plans to expand the new high-speed line - via a Y configuration - to terminals near Manchester and Leeds, at an additional cost of over £15 billion. In the long term, high-speed rail connections to Scotland are planned.

- This report analyses HS2 and raises many questions about the project, whose Phase 1 is due to be operational by 2026. The eventual cost – assuming one high-speed rail link to Scotland – would exceed £50 billion. At an estimated £130 million per mile, Phase 1 of this project, according to the Financial Times, would cost over four times more than the average EU high-speed line.

- HS2, the project's promoters, is forecasting a sharp increase in passenger numbers on the West Coast Main LineWCML – from c45,000 passengers per day in 2008 to a projected c136,000 by 2043. Significantly, the promoters of London and Continental Railways (LCR) in the 1990s proved to be very optimistic – actual passenger take-up has been around a third of expectations.

- There will be real concern, too, about costs and likely overruns – with the WCML upgrade fiasco providing an alarming precedent. Of the projected Phase 1 cost of *c*£17 billion, the two largest components are tunnels and stations – accounting for just 10% of the length – and stations, especially the Euston terminal where extensive construction work will be necessary.

- Within the *c*£17 billion Phase 1 project cost figure, there are very material provisions for overruns, including the Treasury's £4.2 billion optimism premium. However, as the Department for Transport (DfT) makes further concessions about HS2's route, the base cost will rise further. Moreover, these figures are based on Q3 2009 cost data; from mid-2012, construction price inflation may well return with a vengeance.

- In terms of the Benefit Cost Ratio (BCR), the DfT's February 2011 projection for Phase 1 of HS2 is just 2.0x, even if Wider Economic Impacts (WEIs) are taken account; without them, the BCR falls to a marginal 1.6x. Prior to the DfT's recent reduction in its aggressive revenue projections, the BCR's were 2.7x and 2.4x respectively.

- Despite the proposed pay-as-you-go funding, it is very difficult to see how HS2 could make a commercial return even if the cost of capital were at a modest premium to the current 2.5% yield on 10-year gilts. Perhaps, the government – given its emphasis on non-monetised benefits - is not seeking one.

- Once operational, Phase 1 of HS2 could be privatised, in line with the pay-as-you-go funding proposal. However, HS1 – which avoided pronounced budgetary overruns – cost *c*£5.7 billion to build but yielded just £2.1 billion when a 30-year franchise, which is underpinned by favourable access charge payments, was sold last November.

- Overseas experience of high-speed rail projects has some relevance. Spain's RENFE and France's *Très Grande Vitesse* (TGV) projects can provide some guidance, but there are major differences, not least that much of central England is already heavily developed, unlike the vast plains of rural Spain. And in France, TGV's operations remain heavily subsidised.

- Any conclusion about HS2 has to recognise that the project, especially if it is eventually linked up to Scotland, is highly expensive; it will also crowd out other much-needed railway investment. Phase 1 itself is very susceptible to two major risks – those relating to revenue, namely demand and average fare-box yields, and to construction risk. Moreover, the economic case, especially following the DfT's recently reduced BCR projections, remains very weak and, if completed, Phase 1 may need substantial – and long-lasting - revenue funding from the DfT to cover its operating losses.

2 Background

In recent years, many of the world's leading economies - France, Germany, Spain, Japan and China - have invested in high-speed rail as they have sought to meet the need for new transport capacity. With the development of High Speed 1 (HS1), which was commissioned in 2007, the UK has followed this trend.

In terms of defining the criteria for high-speed rail, the EU has adopted a definition of a speed exceeding 200 km/h for upgraded track and 250 km/h for new dedicated track. Furthermore, high-speed rail technology is based on first using overhead electrification equipment and secondly in eliminating – or reducing – the various factors that slow down a train. In the latter category are level crossings, regular stops, a succession of curves and other trains, including slow-moving passenger coaches and freight vehicles.

In fact, high-speed rail technology has been operational for many decades, with a Siemens and Halske electrical railcar reported to have exceeded 200km/h at a military track between Marienfeld and Zossen in Germany in 1903.

However, it was the arrival of the *Shinkansen* train in Japan in the 1960s, which stimulated global interest in high-speed rail systems. Originally, the *Shinkansen* was developed to ply the densely populated route between Tokyo and Osaka.

Thereafter, several EU countries started to build high-speed rail lines connecting major cities, including Italy's *Direttissima* route – between Rome and Florence – and Germany's network connecting Hannover with Würzburg and Stuttgart with Mannheim. In France, the roll-out has continued following the commissioning of the Paris to Lyon LGV Sud-Est route.

More recently, Spain has been particularly prominent in embracing high-speed rail. With a generally flat countryside and very dispersed - and small - rural populations, long high-speed rail links between major cities offer many attractions. Its first high-speed rail line, connecting Madrid with Seville, was opened in 1992; several others have followed. Spain has the second-longest high-speed rail network worldwide, after China.

3 The UK Experience

In the UK, where the legendary Isambard Kingdom Brunel built the first extended wide-gauge railway, the Great Western line, the high-speed rail experience has been far less smooth.

In particular, British Rail's failed Advanced Passenger Train (APR) project, which was based on tilting trains, was ignominiously abandoned in the 1980s. However, with the opening of HS1 services in 2007, the UK had built its first extended high-speed line.

Importantly, the widely praised Eddington Transport Study, which was chaired by the former Chief Executive of British Airways and reported in 2006, was somewhat equivocal about the construction of new high-speed rail lines. This policy stance was driven by a combination of the UK's compact geography, the operation of an extensive national air network as well as by the cost risks associated with new high-speed rail technology, such as the MAGLEV system.

This study rightly argued that individual transport problems, such as under-capacity on the West Coast Main Line (WCML), need tailor-made solutions: a high-speed rail line might, in some circumstances, provide this solution.

Nevertheless, in effectively endorsing the subsequent 2007 White Paper, 'Delivering a Sustainable Railway', the government continues to re-affirm its determination to press ahead with the construction of HS2 as set out in the 2010 Coalition Agreement:

> *'We will establish a high-speed rail network as part of our programme of measures for creating a low carbon economy. Our vision is of a truly national high-speed rail network for the whole of Britain. Given the financial constraints, we will have to achieve this in phases'.*

Between 1994/95 and 2009/10, total UK rail passenger miles travelled rose from 18 billion to almost 32 billion, equivalent to an annual increase of almost 4%.

Moreover, Network Rail concluded that '*the WCML, particularly at the southern end of the route, is effectively full and subsequent additional capacity could only be provided by exceptionally expensive infrastructure solutions'*.

Hence, against the background of sharply rising rail travel, especially on the WCML, and for other more general policy reasons, such as narrowing the North/South divide and lowering carbon emissions, the government has indicated its unequivocal backing for the HS2 project.

Last December, the former Secretary of State for Transport, Philip Hammond MP, confirmed that:

> *'The government believes that the best long-term solution to these challenges is the development of a national high-speed rail network. Our proposed strategy is for a Y-shaped network, to be delivered in two phases: the first a line from London to the West Midlands, and the second the onward legs to Manchester and Leeds with connections to points further north via the East and West Coast Main Lines'.*

In terms of improving transport links with Scotland, Mr Hammond added that:

> *'By running trains seamlessly onto existing inter-city routes, our proposed network would also bring Glasgow and Edinburgh to within three and a half hours of London – fast enough to induce a major shift of passengers from domestic aviation.'*

Persuasive though the latter claim may appear to be, the reality is that – even under this government's transport scenario - there will be no high-speed train service to Scotland until the late 2030s at the earliest.

Advocates of the *c*£17 billion Phase 1 of the HS2 project have highlighted various benefits. However, some of these benefits are nebulous. In its High Speed Rail for Britain report, even the HS2 consortium admits '*it is difficult to analyse exactly where the benefits of HS2 would accrue*' – hardly a convincing endorsement by the project's promoters.[1] Furthermore, if there were a pronounced revenue shortfall from 2026 onwards, the implied value of these benefits would be markedly reduced.

Nevertheless, the more obvious benefits of constructing Phase 1 and Phase 2 of HS2 include:

- With far more additional trains running hourly between London and the West Midlands, faster, more reliable, more frequent, and, in many cases, less crowded services would be operating;

- Material advantages for business passengers who would derive around 60% of the benefits, despite accounting for around a third of total estimated trips;

- A reduction in train travel times – with a minimum time between London and the West Midlands of just 49 minutes compared with around 80 minutes currently;

- Following the planned completion of Phase 2 in 2032/33, both Manchester and Leeds being within 80 minutes of train travel from London;

- Net benefits arising from the completion of both Phase 1 and Phase 2 - as confirmed by the Department for Transport (DfT) and including the Wider Economic Impact (WEIs) - of *c*£44 billion:

- An expected narrowing of the North/South divide;

- As a result of Phase 1 alone, the creation of c40,000 jobs, many of which would benefit depressed inner city areas.

1 p174, Section 4.2.8

4 Route

As with every major proposed railway line, there has been detailed analysis in deciding the appropriate route for HS2. Indeed, the precise route is - as yet – unfinalised and will be subject to amendment following the end of the consultation period. It will need, however, to accommodate trains travelling at a speed of up to 360 km/h.

In reality, some changes are expected, especially in the environmentally sensitive Chiltern Hills segment. Following confirmation of the extension of cover for railway cuttings in the sub-segment between Amersham and Wendover, further tunnelling and noise abatement concessions are expected. In the former case, extensive extra tunnelling would have a material upward impact on the project's base construction cost.

As constituted at present, the proposed Phase 1 route between London Euston and the West Midlands has 17 separate segments as well as two station terminals – London Euston and Birmingham Fazely – along with the two planned intermediate stations at Old Oak Common, which will serve Heathrow Airport pending the construction of a dedicated spur line, and the National Exhibition Centre (NEC) on the outskirts of Birmingham. The route would then proceed to Tamworth and link up to the WCML near Lichfield.

The table opposite, published in 2009, shows the main segments of the planned Phase 1 route, along with their share of the £6.9 billion total construction cost. The table has been slightly adjusted to reflect recent cost changes.

Whilst the basics of the HS2 route are established, there are various other key routing decisions that remain outstanding. Amongst the most important are:

- **London Transport Inter-links**: High priority is being given to ensuring that air passengers – to and from Heathrow – will

Table 1: Main segments of the Phase 1 route

Segment	Length (kms)	Projected Cost (£m)
Euston Station	n/a	1,007
Euston – Old Oak Common	8	529
Old Oak Common Station	n/a	569
Northolt – Ruislip (Surface)	15	416
Colne Valley Crossing – Chalfont St Peter	10	321
Amersham – Aylesbury (via Missenden & Wendover)	30	1,156
Aylesbury – Brackley	27	237
Brackley – Boddington	23	250
Boddington – Burton Green	33	576
Burton Green – Berkswell	2	24
Berkswell – NEC (Birmingham)	9	135
NEC (Birmingham) – Coleshill	4	69
Birmingham Station (Inter-change)	n/a	465
Birmingham Lines (Delta Junction)	4	52
Castle Bromwich – Water Ourton (to Delta Junction)	2	42
Water Ourton Corridor	5	73
Fazely Station (Approach)	3	122
Fazely Station	n/a	237
Coleshill – Belfry Golf Course (to Delta Junction)	4	147
Spur Lines (Delta Junction)	4	58
Belfry Golf Course – Lichfield	24	331
Post 2009 Financial Adjustments	n/a	84
Totals	**207**	**6,900**

Source: HS2 Cost and Risk Model (with amendments) benefit from better surface travel connections. As part of Phase 1, it is planned that passengers will join the HS2 train at a refurbished - and extended - Old Oak Common station. This link will enable connections to both Crossrail, whose construction is underway, and to the London Underground. In addition, a link has been proposed to the HS1 track to the north of St Pancras - probably via the North London line near Chalk Farm.

- **A Long-Term Solution for the Heathrow Airport Inter-link**: The DfT has concluded that the construction of a spur to Heathrow Airport, running on the surface close to the M25 for part of its length, represents the best option, especially in terms of cost. Moreover, it allows for the eventual construction of a rail loop if this is warranted. In terms of timing, it is planned that this spur would be part of Phase 2 and would open contemporaneously with the extended HS2 lines to Manchester and Leeds.

- **The Manchester and Leeds Links**: Phase 2 of the HS2 project envisages a Y-shaped extension from the Delta Junction terminal near Birmingham: the proposed route would go northwards before splitting. Eventually, Manchester and Leeds may be linked directly via a high-speed line to complete a triangle, thereby producing an Inverted A-configuration. Two other schemes – the reverse S-configuration, with a route via Manchester and Newcastle, and the Reverse E-configuration, travelling predominantly on the east coast of England - have also been closely analysed. Neither of these schemes seems to offer the level of benefits as that implied by the Inverted A-configuration.

- **The Route to Scotland**: Central to the government's long-term high-speed rail policy is a determination to improve connections between London and Scotland, specifically Edinburgh and Glasgow. Assuming the Inverted A-configuration is eventually confirmed, the Manchester section of the route would be extended and would split at a point in Lanarkshire to the south-west of Edinburgh and to the south-east of Glasgow. Alternatively, the junction in Lanarkshire could be reached via a North-East routing.

If all these links were undertaken, except for the second link from Leeds to Scotland via the North-East, the combined cost of all three Phases of HS2 is expected to exceed £50 billion (at Q3 2009 prices) – a vast investment with some highly questionable returns.

5 Demand Projections

Recent history shows that projecting future demand levels for new railway lines is challenging – and very likely to engender serious over-optimism, especially in the absence of solid information about future ticket prices. Indeed, since much of the potential demand analysis is undertaken by the scheme's promoters, this perhaps is hardly surprising.

In respect of London and Continental Railways (LCR), which was awarded contracts first to build the Channel Tunnel Rail Link (CTRL) between St Pancras and the Tunnel portal near Folkestone and secondly to manage the UK arm of Eurostar, gross optimism prevailed.

In bidding for the contract in 1996, LCR forecast that passenger numbers using Eurostar would reach 21.4 million by 2004. Although the first section of the CTRL was completed broadly on time and on budget in 2003, actual passenger numbers for 2004 were just 7.3 million.

Inevitably, such a pronounced revenue shortfall has a major impact on the finances of any rail project which has a preponderance of fixed costs. It helps to explain, too, why the proceeds from the HS1 30-year franchise sale in 2010 were below 40% of its Regulatory Asset Value (RAV) – effectively, the cost of building the HS2 line.

In the case of HS2, the aggressive revenue projections of the past have recently been pulled back. Nevertheless, if the promoters' projections still prove to be seriously optimistic, the financial impact would be very material. The government would be obliged either to run a heavy loss-making business or to sell it off to the private sector at a very heavy discount to the cost of building the HS2 high-speed line.

In projecting future revenues, to which the HS2 financial model is so sensitive, there are two obvious elements – passenger numbers and the average size of the fare box.

In 2008, c45,000 long-distance passengers travelled daily on inter-city trains over the southern section of the WCML. The average train loading throughout the day was just 51% - far below the 80%+ seat occupancy ratio that low-cost airlines, such as Ryanair and EasyJet, consistently achieve. More recently, Virgin Rail, which currently holds the WCML franchise, reported annual revenues of £780 million from its WCML operations in 2010/11.

According to HS2, whose figures are partly derived from the Passenger Demand Forecasting Handbook, there will be a sharp increase in passenger use by 2033, when both Phase 1 and Phase 2 of the project are due to be operational.

Based on a range of assumptions about shifting travel patterns, HS2 promoters have calculated that a total of c136,000 high-speed rail passengers would be using the line daily by 2043; this compares with the estimated 46,000 passengers currently using the southern section of the WCML.

This passenger growth projection equates to an underlying annual figure of close to 2.5%. Previously, a growth figure of a formidable 3.3% per year until 2043 had been used; due principally to the minimal level of economic growth of late, it has been cut back.

Importantly, after this sharp downward revision, the new figure is more in line with those of other railway organisations, which are projecting a future passenger growth rate of between 2% and 2.5% per year. Network Rail itself is assuming annual growth nationwide of just over 2% and is using a similar figure for the WCML.

Importantly, the widespread use of the internet, including e-mails, over the last decade is impacting travel and working patterns. Increasingly, more people will choose to work on their computers at home rather than travelling each day to their office.

Furthermore, over the next 15 years, many current commuters will have greater scope to avoid peak travelling hours – the main driver for new railway capacity - and the high costs of daily commuting. These workplace trends are very relevant in projecting future rail demand levels.

Of course, if HS2's long-term passenger projections turn out to be seriously over-optimistic – and way below its long-term annual growth projection - there would be a very negative impact on HS2's profit and loss account.

More specifically, it is very difficult currently to assess how holders of classic train line franchises would respond – they may seek to slash their prices to generate increased demand. However, it may be that neighbouring train franchise awards include specific provisions which seriously curtail competition to HS2 from 2026 onwards.

The impact on airlines would be modest initially given that the real competition from that transport sector would become most apparent – and very long-term – once both Edinburgh and Glasgow had been linked up to a high-speed rail line.

Equally uncertain is the average fare-box yield. The DfT has inked in a discounted figure of £13.7 billion – over 60 years - of revenues being generated from Phase 1 of HS2. In 2009, the DfT had been projecting revenues of £15 billion, a figure that has been cut back by over 8% due mainly to the UK's lacklustre economic growth.

However, HS2 may be able to charge a premium – say of 10% - to the prices quoted by competitors such as the WCML franchise holder. Furthermore, the frequency of the train service on offer is a key variable, with the indication that, initially at least, there would be 14 trains per hour during peak periods and 10 trains being available otherwise. Nonetheless, the revenue outlook remains very uncertain.

By comparison, HS1's annual revenues, based mainly on access charges from Eurostar and from South Eastern's Javelin service between St Pancras and Ashford, amount to *c*£265 million per year. Nevertheless, revenues on the latter route remain disappointing.

6 Costs

Assessing the costs – capital and operating - for HS2 is, along with the revenue projections, crucial in assessing its business case. The estimated capital costs of the Phase 1 London-West Midlands link are between £16.0 billion and £17.7 billion.

In calculating this infrastructure cost, HS2 assumed that there would be no direct link to Heathrow – this project is now expected to post-date the commissioning of Phase 1. The cost of the new rolling stock was also excluded.

However, in recognition of previous over-optimistic assessments, a £2.2 billion construction risk allowance has been made. Furthermore, a formidable over-riding provision for £4.3 billion – equivalent to over a third of the projected scheme cost - was added to the base-line figure in accordance with the Treasury's Supplementary Green Book Guidance on optimism basis.

Table 2 shows how the £12.5 billion project scheme costs, prior to the Treasury-driven £4.3 billion optimism provision, are broken down. The data, which was published in February 2011, is derived from HS2 projections. It is based on 2009 Q3 prices.

Within this £12.5 billion project scheme cost, two items stand out. Stations – notably the major works required at Euston – and tunnels are the two most expensive components currently accounting for 13% and 11% of the direct costs respectively.

There are many risks attached to Phase 1 of the HS2 construction programme, which may cause cost overruns.

At a general level, construction price inflation is a perennial risk for long-term infrastructure projects. Whilst 2010 construction prices were sharply down on those for Q3 2009, the period used as the pricing base by HS2, there are widespread expectations of future construction price inflation – of c1% for 2011 over 2010, of over

Table 2: HS2 Phase 1 Project Costing, 2009 Q3 Prices

Construction Segment	£m
Rail Systems	365
Control Systems	215
Traction Power Systems	260
Stations	1,630
Earthworks	725
Structures	565
Tunnels	1,380
Roads	145
Utilities	175
Additional Items	490
Contractor Administration Costs	950
Total Construction Cost	**6,900**
Mitigation	215
Land Costs/Compensation	930
Rolling Stock Depot	250
Heathrow Stubs	50
Project Overheads	735
Design	765
Existing Rail Inter-face Costs	195
Statutory Charges	200
Construction Risk	2,245
Projected Scheme Cost	**12,485**

Source: HS2

2% for 2012 over 2011 and of over 3% for the two subsequent years. Given the current inflation figure, these projections may prove to be a material under-estimate.

HS2's promoters have also identified three more specific risks as set out below:

- **Tunnels**: the current route includes several miles of tunnelling, whose cost per mile is up to thirty times more than that of an open two-track permanent way. Obstructions, ground conditions and alignment issues are all possible impediments;

- **Belfry Golf Course to Lichfield**: additional requirements for the inter-facing of the classic rail network;

- **Northolt to Ruislip**: the proximity of the route to the Hangar Lane inter-change may require additional bridge, highway and/ or rail works.

It is also the case that extensive construction work will be needed on the approach to Euston Station - and at the Station itself - that will take many years to complete and will cause severe disruption to passenger services.

In terms of ongoing operating costs, there are four major cost components:

- Infrastructure operations and maintenance;
- Specialised rolling stock;
- Train crew;
- Station costs.

Of this quartet, a key cost will be the specialised rolling stock, which is expected to consist of 16 high-speed sets that will operate exclusively over the wider-gauge high-speed track and 45 sets that are compatible with the existing track. All these sets will have a 360 km/h maximum speed and will be 200 metres long.

The estimated cost of these train sets is just over £2.8 billion, based on 2009 prices. Almost £2.4 billion of this cost is attributable to the classic-compatible fleet where extensive technical adjustments will be necessary.

In terms of other operating costs, Arup has undertaken various comparisons; in fact, there will be many similarities to the HS1 cost base, especially in respect of Phase 1 of HS2. Total operating costs, of which maintenance and traction of the rolling stock are the largest components, are estimated at £6.2 billion on a discounted basis over 60 years; this figure equates to 45% of projected revenues of £13.7 billion.

It was noticeable that these cost figures exclude any financing costs, presumably on the basis that, in line with the pay-as-you-go financing proposal, the HS2 project will be directly – or indirectly – funded by the DfT through its standard annual Departmental Expenditure Limits (DEL).

Significantly, HS2's capital costs are far higher than standard EU high-speed rail figures. In particular, the UK's greater population density, the need for major redevelopment of UK train terminals and the construction of dedicated tunnels in urban areas has driven up UK high-speed rail costs per km when compared with those elsewhere in the EU.

Furthermore, in most cases, the UK has less unused capacity for new railway lines: much of the spare track has already been re-developed since the large railway closure programme that was undertaken during the 1960s.

7 Financing

The financing of HS2 and what returns might be expected are far from clear. Consequently, a private sector funded project – similar to the financing model for the construction of the Channel Tunnel in the 1980s – now appears to be a non-starter.

Neither is it likely that the construction of HS2 will be financed by Network Rail, whose net debt at March 2011 was £25.0 billion.

The reality is that HS2's financial case is weaker than that of HS1. Despite the latter being on budget in terms of cost and time, a 30-year franchise was sold to the private sector at a 64% discount to the incurred capital expenditure which broadly equates to its RAV.

In fact, much of the justification for HS2 is based on more intangible benefits such as narrowing the North/South divide. A similar *raison d'être* was deployed in terms of the *Très Grande Vitesse* (TGV) investment in France, whose losses continue to be underwritten by the French taxpayer. As such, HS2 is set to become a *grand projet*, which is effectively state-financed, at least until Phase 1 is satisfactorily completed – and probably beyond.

In February 2011, in order to substantiate the HS2 business case, the DfT published a cost/benefit analysis that seeks to demonstrate that Phase 1 of the project's benefits outweigh its costs. The DfT's model showed discounted transport benefits, including WEIs, of £20.6 billion: if the WEIs are stripped out, the figure falls to £16.5 billion.

Based on these projected benefits and forecast revenues, the Benefit Cost Ratios (BCRs) come out at 2.0x and 1.6x respectively. Just a year ago - on the assumption of discounted revenues of £15 billion then as opposed to £13.7 billion now - the figures were 2.7x and 2.4x respectively.

There is no doubt that these revised BCRs are low. Tellingly, in implicitly recognising the serious weakness of its financial case, the DfT went on to argue that '*it is these non-monetised benefits (namely job creation, regeneration and the promotion of sustainable and balanced economic growth) which underpin the strategic case for high-speed rail*'.

Most of the defined transport benefits, which drive the investment case, relate to business travellers, with the remainder being attributable to other passengers. Yet, particularly for business passengers, their time spent in a railway carriage is often not wasted, given the extensive use of laptops and the scope for business-related reading during lengthy rail journeys.

In its own analysis, the DfT's financial estimate of the WEIs is quite modest, despite the narrowing of the North/South divide being a key justification for the HS2 project.

Whilst a BCR, including WEIs, of 2.0x is low, it is also highly sensitive to:

- The assumptions underlying the £20.6 billion of net benefits which are highly subjective;
- The assumptions underlying the *c*£13.7 billion revenue projection, for which only sketchy financial data, such as assumed ticket fares, is apparently in the public domain;
- Revenues falling at least 25% short of HS2's expectations – a more than possible scenario; in such a case, the BCR falls to c1.4x and even lower if the WEIs were disregarded.

Oxera, on behalf of the Transport Select Committee, has recently reviewed the key financial sensitivities. Nonetheless, as the Financial Times has highlighted, the current BCR hurdle for new road projects is close to 6x, rather than the very modest 2.0x figure, including WEIs, that has recently been calculated for HS2.

Even if the DfT's cost of capital is at a slight premium to the current 10-year gilt yield of 2.5%, it is very difficult to ascertain how HS2 can generate a commercial return.

Importantly, Mr Hammond has recently indicated that a pay-as-you-go financing model is being assessed for HS2, whereby its Phase 2 costs would be financed by the proceeds from selling off a long-term operating franchise on Phase 1 shortly after its completion.

Against this background, it seems likely that the HS2 project, assuming that it proceeds, will be financed by DfT, predominantly through debt markets.

As such, initial private sector involvement in the financing of HS2 is likely to be modest given the weakness of the investment case, especially with respect to over-optimistic revenue projections, which so often - literally - de-rail such schemes: the LCR fiasco in the late 1990s is an obvious example.

Given this scenario and the extended time of the construction work – the Manchester and Leeds sections are not due to open until the early 2030s – there will be real concern that the DfT's budget will be under pressure for many years, especially throughout the 2020s.

In any event, there is a need for considerable investment elsewhere on the UK railway network as set out in Network Rail's recently published Initial Industry Plan. With the very high expenditure planned for HS2, far fewer funds will be available to raise capacity levels on both the East Coast Main Line (ECML) and on the Midland Line.

More generally, the UK's Public Sector Net Debt (PSND) is expected to be *c*£1.5 trillion by 2020 when annual net interest payments may exceed £80 billion. Under this scenario, UK public expenditure will remain under very heavy financial constraints for many years, especially if economic growth remains sluggish,

8 Environmental Issues

Politically, environmental benefits have been cited as one of the key merits of the HS2 project. The reality is actually quite different.

After all, Phase 1, due for completion in 2026, will give rise to minimal environmental benefits since there are virtually no scheduled flights between London and the West Midlands. It is only when Phase 2 is complete – expected in 2032/33 - that marginal environmental benefits could accrue as some passengers switch from air to rail. However, it is likely that leading airlines, particularly Ryanair and Easyjet, would respond to this new competition by cutting their fares.

Of course, assuming that high-speed rail eventually reaches Scotland, there may be material environmental benefits. However, such a scenario is unlikely to apply for almost 30 years.

The undeniable weakness of the environmental benefit case was underlined by HS2 itself which admitted that, on a conservative basis about carbon intensity, '*HS2 emissions would represent less than 0.25% of transport emissions*'.

HS2's analysis also suggests that '*the impact of HS2 on carbon emissions will be between an increase in emissions of 26.6MtCo2 and a reduction of 25.0MtCo2 over sixty years*'.

In any event, over that time-frame, UK rail operations are expected to have generated either a stable or lower carbon footprint than currently. Hence, the general environmental benefit case for HS2 is minimal at best and may well be close to neutral.

More specifically, the construction of Phase 1 of HS2 will have a major environmental impact along the route and especially in the Chiltern Hills area of Buckinghamshire, where many inhabitants vigorously oppose the project, which is already imposing severe blight on house prices locally.

The DfT has already made some adjustments to the route to take account of local concerns. More tunnelling has been proposed, despite its far higher cost per km.

Furthermore, the DfT has confirmed that there are plans to introduce a compensation scheme for those with properties blighted by the HS2 proposal; this scheme will sit alongside the existing statutory blight regime.

Noise levels will also be a key issue, although barriers are to be erected on those parts of the line which are closest to housing areas.

It should be added that, during the construction period itself, serious dislocation will inevitably result. However, the two areas most affected will be the already crowded Euston terminus and the suburban parts of the West Midlands through which HS2 trains will pass. In the former's case, its planned re-development may take up to eight years to complete. In the rural sections of the line, the impact of the construction work will be far less pronounced.

It seems clear that many of these issues will be raised during the planned passage of the Hybrid Bill authorising the construction of HS2, which is due to be presented to Parliament in late 2013.

9 Other Options

Central to justifying the case for building HS2 is the oft-quoted conclusion from Network Rail that '*by 2024, the West Coast Main Line, particularly at the southern end of the route, is effectively full.*' Network Rail went on to argue that subsequent additional capacity (to WCML) could only be provided by '*exceptionally expensive infrastructure solutions'*.

Importantly, this key Network Rail conclusion is derived from its assumption that demand on the London-Manchester route will grow by c60% by 2024. Aggressive though these figures may be, they are still significantly below those implicitly assumed by HS2.

With regard to '*exceptionally expensive infrastructure solutions*', Network Rail still remains scarred by the shambles of the WCML upgrade project that, at one time, was due to cost *c*£13 billion but was eventually delivered for *c*£9 billion – still vastly above the original budget projection.

Clearly, Network Rail's analysis by itself does not justify the massive investment in Phase 1 and Phase 2 of HS2 but it does raise the issue of alternative solutions, both in terms of increasing supply through creating greater seat capacity and of responding more efficiently to demand.

Outside the south-east of England, no major new lines have been constructed for generations. While some new branch lines have opened, their number is eclipsed by the extensive railway line closure programme, in the wake of the controversial Beeching Reports during the 1960s, when almost 10,000 kms of line were lost – equivalent to around a third of the total network.

In recent decades, improvements to – and maintenance of – lines have absorbed the vast majority of investment funds – and not the opening of new lines which dominated the expansion of the network during the Victorian era. As such, the notorious WCML upgrade project was the successor to a similar scheme on the ECML which proceeded rather less controversially.

Assuming that Network Rail's projections are broadly sound and that new capacity is needed, there is a clear case to upgrade the existing railway lines between London and the West Midlands.

The obvious supply-related alternative is to use classic trains rather than high-speed trains on a newly constructed route. According to HS2, the capital cost of using classic trains would be c91% of the cost of a high-speed rail network, indicating a saving of less than 10% much of which would arise from smaller tunnel diameters and cost savings on the track itself.

The use of classic trains on a new line would mean an extra c15 minutes of travelling time on the London-Birmingham route. HS2 claims that significantly fewer people would travel on it, thereby cutting fare-box revenues by up to £3 billion.

HS2 also calculates that a new classic line between London and Birmingham would yield over 20% less benefits compared with the proposed high-speed alternative, although costing approximately £3 billion more, would give rise to an additional £6.7 billion of benefits.

However, the highly expensive construction of a new high-speed line assumes that the demand case projections are inherently robust. Previous experience suggests that this is not necessarily the case. Wide-ranging assumptions about how airlines would respond when – and if – Phase 2 opens in 2032/33 also have to be made.

In respect of Phase 2, there are three configurations which have been proposed: all are partly dependent on how passengers in Glasgow and in Edinburgh can access the network as extended by Phase 3. The three configurations, each of which is connected to the proposed Phase 1 link with the WCML near Lichfield, are:

- **Inverse A** – Routing to Scotland via Manchester but also extending to Newcastle via Leeds with the line splitting in the West Midlands;

- **Reverse S** – Routing to Scotland via Birmingham, Manchester Leeds and Newcastle;

- **Reverse E** – Routing to Scotland via Birmingham, Leeds and Newcastle with the line splitting in South Yorkshire to allow an inter-connection to Manchester and Liverpool.

Of course, these three route proposals are very much long-term plans to bring about a major uplift in capacity.

In the shorter term, however, there is clear scope to improve the existing network without building expensive new high-speed lines. Indeed, the DfT commissioned a strategic analysis of three possible enhancement initiatives on the key North-South inter-city routes out of London, with the aim of using longer trains, delivering higher frequency services and reducing journey times.

However, the DfT argues that such initiatives would bring about only comparatively modest benefits, especially with regard to service frequency whilst also requiring major engineering works with all the consequent disruption to passengers. Nevertheless, the implementation of a series of incremental enhancements would markedly raise capacity levels – and at a far lower capital expenditure cost.

Importantly, there are various measures which could reconcile demand more closely to available capacity – and obviate the need for heavy investment in new railway line construction. In effect, such a policy would mean using the existing network to its maximum, which is certainly not the case currently.

Amongst the most obvious supply/demand measures are:

- **The raising of the load factor**. The business models of low-cost airlines, such as Ryanair and EasyJet, are based on achieving high load factors: their latest figures are 83% and 86% respectively. On the London-Birmingham rail route, the load factor is well below these figures; it was just 51% in 2008. Hence, a more aggressive marketing approach, through very differing fare prices, should boost load factors, thereby weakening the case for highly expensive investment in new capacity.

- **The running of more trains to and from London Euston during normal travelling hours**. At present, around 10 trains per hour depart from Euston on the WCML. Recent analysis has suggested that this figure could be raised to 15, without unacceptable levels of over-crowding on the line.

- **The lengthening of trains**. Currently, Italian-designed Pendolino carriages are being built which will enable longer trains to run on the WCML track; they will boost passenger numbers and reduce over-crowding during peak hours.

- **The availability of very low-priced tickets to travel at very unsocial hours**. Such tickets, similar to those bought by passengers booking well in advance with Ryanair, should permit travel - especially for students - between 10pm and 5am when rail tracks are generally little used. Of course, in some cases, freight movements or track maintenance may prevent such a scenario but efficient management should enable many extra trains to run during unsocial hours – and thereby free up additional capacity at peak hours.

If all four of these initiatives were undertaken, potential capacity would rise sharply – and above most long-term travel projections on the WCML. Hence, the case for investment of over £50 billion in Phases 1-3 of HS2 looks weaker still.

It is also relevant that the frequency of services to other major conurbations in the West Midlands, such as Coventry, Wolverhampton and Stoke, is likely to be cut in order to free up the necessary train paths: to date, these proposals have received little publicity.

10 Overseas Experience

Since the opening of Japan's *Shinkansen* line between Tokyo and Osaka in 1964, high-speed rail has continued to develop. At that time, the average speed on the dedicated lines with many miles of tunnels – and a standard gauge rather than the 3ft 6 inch gauge used elsewhere on Japanese railways – was just c160 km/h. Nowadays, the *Shinkansen* speed exceeds 260 km/h.

As the table 3 below indicates, the Chinese government, which is keen to participate actively in the HS2 project, has invested heavily in high-speed railways lines – defined as accommodating trains travelling at 200 km/h or more. However, some of these services are run on upgraded, rather than dedicated, high-speed lines.

Importantly, following last July's Wenzhou disaster in which over 40 people were killed when two high-speed trains collided, the Chinese government is reassessing its commitment to high-speed rail.

Undoubtedly, it is the roll-out in recent years of new high-speed rail lines in the EU that has most relevance for the planned HS2 investment in the UK. Table 4 overleaf shows the most important EU high-speed rail projects over the last decade.

Spain has been particularly aggressive in investing in high-speed rail – at least until the credit crisis arrived with a vengeance in 2008. Its first high-speed line – AVE (*Alte Velocidad Español*) – linked Madrid to Seville in 1992.

Table 3: Dedicated High-Speed Lines (over 250 km/h)

Country	Operational (kms)	Being Built (kms)	Total (kms)
China	4,840	c6,277	c11,117
Spain	1,983	1,761	3,744
Japan	1,986	510	2,496
France	1,897	209	2,106
Germany	1,032	378	1,410
Italy	923	0	923
Turkey	457	308	765
South Korea	330	82	412
Taiwan	345	0	345
Belgium	209	0	209
Netherlands	120	0	120
United Kingdom	113	0	113
Switzerland	35	72	107

N.B. Chinese and Turkey data is approximate
Source: Industry Data

Table 4: EU High-Speed Lines

Line	Country	Opening Date	Length (kms)
LGV Mediterranée	France	2001	250
Cologne–Rhine/Main	Germany	2002	219
Rome-Naples	Italy	2005	205
HS1	UK	2007	109
LGV Est	France	2007	301
Madrid-Barcelona	Spain	2008	621
Erfurt-Leipzig/Halle	Germany	Est. 2015	123

Source: EU data

However, with its recently commissioned 621 km Madrid to Barcelona link, it is very relevant that previous rail journeys between these two cities took some seven hours; hence, most people preferred to fly. Using a 5ft 6 inch gauge, the rail journey now takes under three hours so the time savings – unlike Phase 1 of HS2 – really are material.

France, too, has invested heavily in high-speed rail ever since construction started in 1976 of its first high-speed line to the south-east of Paris. Subsequently, all four cardinal points from Paris have been covered by high-speed rail links, with the 783 km Paris-Marseille line being the longest non-stop rail journey in the world.

Germany has sought to incorporate part of its high-speed rail infrastructure within its existing network on a 'mix and match' basis, whilst the Italian high-speed lines generally run close to existing motorways down the spine of the country linking Turin and Milan with Rome and Naples.

Hence, there is no common high-speed rail model being adopted throughout much of the EU. Instead, each country has to address the issue in respect of its existing rail infrastructure and what it has inherited from past investment. The UK, in seeking to build a high-speed line between London and the West Midlands - and subsequently incorporating Manchester and Leeds - has particular problems given the many towns and suburbs lying close to the proposed route.

This fact partly - though far from entirely - explains why UK high-speed rail costs per km are substantially above the EU average. Other factors include the need for major development of station terminals and for the extensive use of tunnelling, which is disproportionately very expensive. Indeed, the Financial Times recently concluded that Phase 1 of the HS2 project per km would cost more than 4x that of the average EU high-speed rail route.

Other evidence regarding the financial burden of high-speed rail links was recently provided in an incisive – and very persuasive – letter published in the Financial Times, which quoted four respected international public bodies:

- The Director of High-Speed Rail at the International Union of Railways (UICF) claiming in 2009 that, with two exceptions (Paris-Lyon and Tokyo-Osaka), all high-speed rail systems are subsidised;

- The US Congressional Research Service reporting in 2009 that '*Experts say that virtually no high-speed rail lines anywhere in the world have earned enough revenue to cover both their construction and operating costs*';

- Amtrak's Inspector-General stating that six EU nations' (high-speed rail) operations required an annual subsidy of US$42 billion (£26 billion);

- The World Bank in 2010 cautioning about the debt created by high-speed rail systems – '*governments ……should also contemplate the near-certainty of copious and continuing budget support for the (high-speed rail) debt.*'

In China, there are mounting concerns about the cost of its high-speed rail programme . And, in the case of SNCF, which operates the much-praised though highly subsidised French railway network including TGV, its latest net debt figure has swollen to *c*£25 billion.

The UK government, and especially the DfT, would be well-advised to ponder these views from overseas.

11 Conclusion

This report raises a raft of worrying issues about the HS2 project.

At a macro-economic level, HS2 is being planned as the UK's net interest payments are soaring; they are expected to exceed £66 billion in 2015/16, shortly before construction of Phase 1 of the HS2 project is about to start in earnest. Even if the debt associated with funding this project is – in technical accounting terms – treating as being outside the PSND, debt markets will generally consider HS2's debt as an ongoing government liability.

Furthermore, this report argues that the chances of HS2 – either Phase 1 or Phase 2 - making a decent commercial return are very slim; it seems unlikely that overall revenues can grow sufficiently to do so. It concludes, too, that the environmental benefits are minimal for the next 30 years at least.

Yes, HS2 may create a substantial number of construction jobs and yes, it may narrow, to a limited extent, the very wide North/South divide – but it is a very expensive way of doing so. Even the DfT's assessment of the Phase 1 and Phase 2 benefits, amounting to *c*£44 billion, are shrouded in uncertainty – most are tenuous, such as marginal time savings, at best.

There is also a familiar EU transport-related clarion call as set out in the DfT's Consultation Document – '*The government believes that Britain cannot afford to be left behind; cannot afford to ignore the benefits offered by high-speed rail*.'

Fine sentiments, but hardly a compelling case to invest what is expected to amount to over £50 billion for the complete HS2 project. As this report has shown a persuasive case has not been made for HS2. Indeed, it may not be possible to make such a case with any real conviction.

It was a former Labour Chancellor of the Exchequer, Lord Healey, who famously said '*the first law on holes – when you're in one, stop digging*'. This sage piece of political advice could be well applied to the HS2 project - literally and metaphorically.

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