Oxera

Review of the Government's case for a High Speed Rail programme

Prepared for the Transport Select Committee

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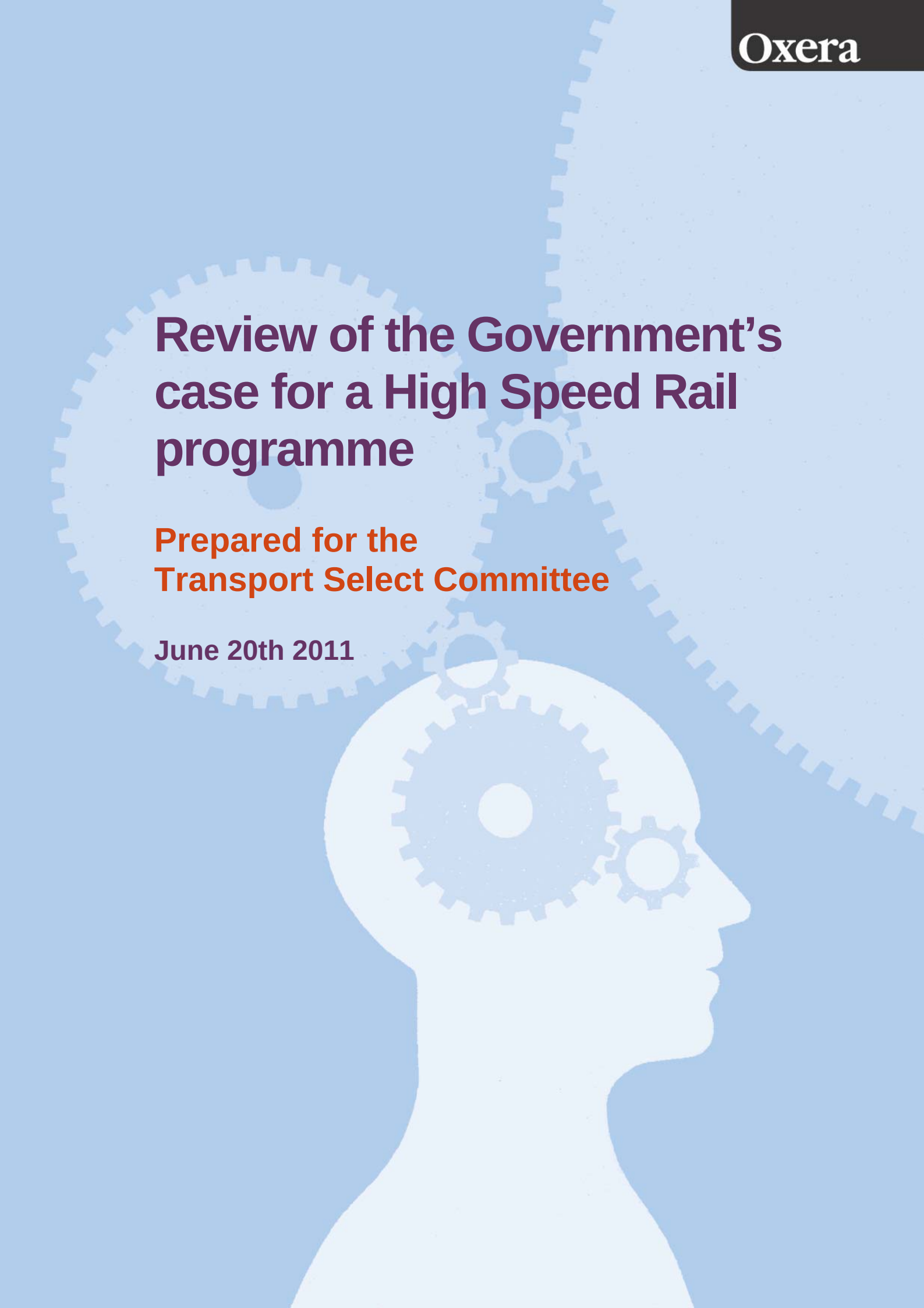

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1 Introduction

1.1 The Transport Select Committee (TSC) is conducting an inquiry into high-speed rail.[1] This report—commissioned by the TSC and prepared by Oxera—provides a review of the Government's case for a High Speed Rail programme.[2] The report does not seek to conclude whether specific schemes under the programme should go ahead; instead, it reviews the approach to appraisal taken and highlights the areas of the case which are most sensitive to the assumptions that have been made.

1.2 The High Speed Rail programme would be a substantial capital investment for the UK; its construction and operation would have a significant impact on transport users, the economy and the environment. As such, there is a responsibility to ensure that the programme and its specific schemes are well justified. Aspects of the business case are highly technical yet very important to the decision-making process. The TSC has therefore commissioned Oxera[3] to provide an independent review of the published economic case[4] for the programme and a set of questions that the Committee could use to probe the evidence base put forward by witnesses during its inquiry.[5]

1.3 The economic case is just one part of the overall business case for the High Speed Rail programme. As the Department for Transport (DfT) has set out, in making transport decisions there are five aspects that need to be considered: the strategic, economic, commercial, financial and management cases. This report focuses primarily on the economic case—which considers economic, social and environmental impacts—and the economic appraisal that underpins it.

1.4 Oxera has reviewed all published aspects of the case for the High Speed Rail programme, including the economic case, demand modelling reports, cost modelling, appraisal of sustainability, and the wider economic impacts (WEIs). Oxera has had direct access to the DfT and HS2 Ltd in order to seek clarifications on certain technical points. The TSC has also provided Oxera with copies of written submissions to its inquiry.

1.5 The blue boxes in each section below highlight suggestions for questions that the TSC Members might choose to use during oral questioning of witnesses throughout the inquiry.

1.6 Broadly speaking, the areas that questioning is likely to cover include the following.

– *What the programme is being assessed against*—HS2, the Y network and the strategic alternatives are all being assessed against a 'do the minimum' scenario. On this basis, both HS2 and the best-performing strategic alternative provide twice as many benefits as costs over a 60-year appraisal horizon. While HS2 is expected to cost nearly three times as much as the strategic alternative, it is expected to deliver nearly three times as many benefits. On the same basis, the Y network is estimated to provide 2.6 times as

[1] http://www.parliament.uk/business/committees/committees-a-z/commons-select/transport-committee/news/hsr---new-inquiry/

[2] The High Speed Rail programme currently includes two main phases: London–West Midlands, followed by an extended Y network. This review uses the terminology 'HS2' to refer to the specific London–West Midlands line proposed by the Government and 'Y network' to refer to the full scheme of HS2 with extensions to Manchester and Leeds.

[3] Oxera was awarded the commission following a competitive tender process.

[4] HS2 Ltd (2011), 'Economic case for HS2. The Y Network and London - West Midlands', February.

[5] Oxera's assessment focuses on the business case for HS2 and the Y network, and has not assessed the relative merits of the specific route choices.

many benefits as costs, while the strategic alternative to the Y network provides 1.4 times as many benefits as costs. Any scheme with a benefit to cost ratio (BCR) of greater than 2 offers 'high' value for money on the DfT's scale.

- *The case for the extra capacity*—the timing of any infrastructure upgrade along the routes proposed by the government is dependent on demand growth projections. Timing is sensitive to assumptions on economic growth, the performance of other modes, and the degree to which demand is managed or allowed to continue rising (both before and after the scheme is introduced).

- *The quantified benefits delivered*—these will depend on assumptions regarding the value of travel time saved (in particular, the degree to which passengers are productive on board trains, including services on the existing network), and the degree to which productivity in the wider economy is enhanced by the programme.

- *The degree of non-monetised impacts*—the published Economic Case does not include items such as landscape and carbon in its BCRs, although it might be possible in principle to do so. Other items—such as land-use impacts, which may have wider economic consequences—are not included due to the lack of meaningful evidence supporting quantification, but are assessed qualitatively. However, previous schemes (such as the Jubilee Line Extension, discussed in Appendix 2) have delivered considerable benefits derived from changes in land use around stations.

- *Scheme costs*—for HS2, the costs have been subject to fairly rigorous scrutiny, and standard 'optimism bias' adjustments have been applied. The detailed design and scheme costs for the Y network have been subject to considerably less scrutiny. In addition, it is less clear how the costs and risks associated with planned engineering works for the strategic alternatives have been captured in the appraisal of those schemes. Based on experience with the West Coast Route Modernisation, the disruption associated with that type of investment can be considerable.

- *Who benefits*—there is relatively little evidence presented on the regional and socio-economic impacts of the programme.

1.7 The report has grouped the reviewed material into related areas, rather than following a structure that corresponds directly to each separate published document. Thus, the report is structured as follows:

- section 2 reviews what the programme is being assessed against;
- section 3 reviews the assumptions and approach to appraisal that have been used;
- section 4 asks whether the standard approach to appraisal is appropriate in this case;
- section 5 summarises; and
- additional (generally more technical) material is provided in the appendices.

2 What is the programme being assessed against?

2.1 Before assessing the Government's appraisal of HS2 itself, it is necessary to be clear against what the business case for the scheme is being assessed (the reference case). For example, is the counterfactual no investment, or some other form of investment, such as further improvements to the West Coast Main Line (WCML)?

2.2 The Economic Case for HS2 and the Y network has been evaluated against a reference case that includes some short-term changes to the existing conventional services. This reference case includes investments up to 2015 and other major committed schemes (eg, Crossrail).[6] While it is unlikely that there would be no further changes to the conventional network beyond 2015 without the High Speed Rail programme, the programme is not directly assessed against more substantial long-term changes to the conventional network. Instead these potential changes are presented separately as a range of alternative strategic options—Box 2.1 presents the schemes proposed as part of the best-performing strategic alternatives.

Box 2.1 Best-performing strategic alternatives

According to the analysis undertaken for the government, 'Rail Package 2', and 'Scenario B' are the best-performing strategic alternatives to HS2 and the Y network, respectively. The text below describes the key schemes anticipated as part of these packages, which are additional to schemes in the Do Minimum scenario (against which both the high-speed and conventional alternatives are being compared). The schemes in the Do Minimum scenario are:

– station upgrade at Birmingham New Street, plus Bletchley area remodelling;
– nine-car Pendolino trains assumed to be lengthened to 11 cars;
– capacity increases on the WCML via new rolling stock delivered as part of the Inter-City Express Programme; and
– capacity increases on the Chiltern Line via train lengthening in the peaks.

The strategic alternatives are as follows.

Rail Package 2 (RP2)

This package takes the form of a series of infrastructure enhancements on the WCML, including:

– a Stafford area bypass; grade separation between Cheddington and Leighton Buzzard; three new platforms at Euston station; three extra platforms at Manchester Piccadilly (with grade separation at Ardwick); four-tracking Attleborough–Brinklow (including freight capacity works at Nuneaton); Northampton area speed improvements; and four-tracking Beechwood Tunnel to Stechford.

Scenario B

These upgrades consist of the WCML upgrade seen in RP2, plus upgrades to the Midland Main Line and East Coast Main Line (ECML).

– WCML—infrastructure enhancements include a Stafford area bypass; grade separation between Cheddington and Leighton Buzzard; three new platforms at Euston station; three extra platforms at Manchester Piccadilly (with grade separation at Ardwick); four-tracking Attleborough–Brinklow (including freight capacity works at Nuneaton); Northampton area speed improvements; and four-tracking Beechwood Tunnel to Stechford.
– Midland Main Line—infrastructure enhancements include electrification from Bedford to Sheffield; a freight loop facility between London and Bedford; reinstatement of four tracks

[6] HS2 Ltd (2011), 'Economic Case for HS2, The Y Network and London–West Midlands', February. In the reference case, additional investment in the road network beyond 2015 is included at a rate based on the DfT's road traffic forecasts.

between Bedford and Kettering; reinstatement of two tracks between Kettering and Corby; station area remodelling at Corby; remodelling and four-tracking in the Leicester area; and electrification and increased stabling capacity at depots.

– ECML—infrastructure enhancements include throat remodelling at Kings Cross, reinstatement of a third tunnel and six-track approach; four-tracking Digswell–Woolmer Green; four-tracking Huntingdon–Peterborough; Peterborough area works (Werrington Flyover); four-tracking Stoke Junction to Doncaster; provision of a flyover for the Nottingham–Lincoln route at Newark; works to address low-speed points and restrictive signalling at Retford; electrification and upgrades for Retford–Sheffield; remodelling and extra platforms at Doncaster; and electrification of Hamble Junction to Leeds.

Source: Atkins (2011), 'High Speed 2 Strategic Alternatives Study: London to West Midlands Rail Alternatives—Update of Economic Appraisal', February, p 11, and Atkins (2011), 'High Speed Rail Alternatives Study—Strategic Alternatives to the Proposed 'Y' Network', February, p. 15.

2.3 Primarily, the strategic alternatives are enhancements to the capacity of the three main north–south lines out of London.[7] This separation of the high-speed and conventional options and their assessment against the same reference case essentially treats the two options as independent, suggesting that only one will be chosen. In other words, the options as constructed rule out a combined solution.

2.4 Some of the key summary statistics from the appraisal of these alternatives are compared against HS2 in Table 2.1.

Table 2.1 Appraisal of high-speed and strategic alternatives (60-year present value)

		Economic Case		Strategic alternatives	
		HS2	Y network	London–WM Package 2	Y network Package B
a	Transport user benefits (£ billion)	17.5	38.3	6.6	12.0
b	Other (£ billion)	0.4	1.7	0.0	0.1
c	WEIs (£ billion)	4.0	6.3	–	–
d	Indirect tax adjustment (£ billion)	–1.3	–2.7	–0.6	–1.1
e = a + b + c – d	Total benefits (£ billion)	20.6	43.7	6.0	10.9
f	Total costs (£ billion)	24.0	44.3	8.9	18.7
g	Revenues (£ billion)	13.7	27.2	5.8	11.0
h = f – g	Net cost to government (£ billion)	10.3	17.1	3.2	7.7
e/h	BCR	2.0	2.6	1.9	1.4

Note: The two strategic alternatives shown here are enhancements to the conventional network rather than new conventional lines, and are those with the highest BCR of those assessed by HS2 Ltd. Various rows have been omitted. The indirect tax adjustment on the strategic alternatives means that the transport user benefits do not equal the total benefits. Values have been taken from the model output spreadsheets, and in some cases the presentation means that the values differ from those presented in the Economic Case.
Source: HS2 Ltd.

2.5 Table 2.1 shows that the reported BCRs for the strategic alternatives are lower than those for high-speed rail. Using the DfT's BCR classification system, the high-speed options would both be assessed as 'high' value for money (VfM) and the two strategic alternatives as

[7] Atkins (2011), 'Strategic Alternatives to the Proposed "Y" Network', February, prepared for the DfT.

'medium' VfM.[8] Based on these stated BCRs, the high-speed options appear to offer better VfM than the strategic alternatives, and both options are preferable to the reference case.

2.6 At this juncture, it is worth noting that the recently published Report of the Rail Value for Money Study argues that 'there is a need to ensure that a full range of whole-system options is considered' and, specifically, that 'in common with other transport sectors, there should be an end to "predict and provide" in the rail sector, and there should be a move towards "predict, manage and provide", with a much greater focus on making better use of existing capacity.'[9] The study recommends in particular that planning in the industry should consider demand management options, where appropriate. In this context, it is unclear to what extent the case (and in particular the opening year) for the High Speed Rail programme, and the alternatives against which it is being assessed, have taken into account whether demand management has the potential to contribute to resolving the capacity issues that the schemes are intended to alleviate.

Q: To what extent would demand management on the conventional network delay the need for extra rail capacity?

2.7 There are some potential inconsistencies between the assessment of the strategic alternatives and high-speed options. The business case for the High Speed Rail programme covers WEIs, which include the benefits of higher employment densities (agglomeration), labour market benefits (such as improved labour supply) and other benefits. Oxera understands that the largest component of the WEIs for the high-speed options is agglomeration, which arises primarily as a result of releasing capacity for short-distance services.

2.8 In contrast to the high-speed options, the analysis of the strategic alternatives appears to omit WEIs. In general, some WEIs would be expected from the strategic alternatives, although the agglomeration benefits would be expected to be smaller than those for high-speed rail. This is because the ability of the strategic alternatives to increase capacity on the conventional network for commuter services and simultaneously improve long-distance capacity may be limited by the continued use of existing stations for both services. Given that agglomeration benefits are driven by increased capacity for commuter services, these benefits from the strategic alternatives would be expected to be small.

2.9 The WEIs for the London–West Midlands strategic alternative Package 2 were previously estimated in the 2010 business case.[10] If these were to be added to the current BCR estimates for Package 2 (ie, 1.9), its BCR would reach 2.0—the same ratio as HS2.

Q: What is the latest estimate of WEIs for the conventional strategic alternatives to HS2?

2.10 The presentation of transport user benefits in the published reviews of the strategic alternatives implies that crowding and other transport user benefits are omitted.[11] However, HS2 Ltd has informed Oxera that these benefits, with one exception, are included in the transport user benefits, but that the disaggregation is not shown.[12]

[8] The DfT recommends that projects with a BCR of between 2.0 and 2.5 constitute 'high' VfM and that those with a BCR between 1.5 and 2.0 are 'medium' VfM. See Department for Transport (2011), 'Value for Money Assessments', May.

[9] Rail Value for Money Study (2011), 'Realising the Potential of GB Rail', Summary Report, June, p. 48.

[10] Agglomeration was £190m–£299m, imperfect competition £238m–£412m, and labour market impacts were negligible. See Atkins (2010), 'High Speed 2 Strategic Alternatives Study, Strategic Outline Case', March.

[11] The Transport Economic Efficiency Tables in the strategic alternatives documentation show 'travel time savings' only.

[12] The strategic alternatives have been assessed by Atkins on behalf of the DfT using HS2 Ltd's model; hence, the appraisal includes the same benefits as those for high-speed services, with the exception of reliability impacts.

2.11 The exception relates to the impact on reliability. A reliability benefit has been included for high-speed services. This is because all of these services would run at the same speed, which tends to improve reliability relative to lines with a mix of speed services, as per the conventional network. However, no impact on the reliability of the conventional lines is included for either the high-speed options or the strategic alternatives. HS2 Ltd has informed Oxera that to conduct these estimates for the conventional line would require more detail than is currently available at this stage in the development of the scheme. The impact of incorporating reliability changes for the strategic alternatives is currently unclear. It is possible that the strategic alternatives could reduce the reliability of conventional services.

Q: Is further work progressing to estimate the impact on the reliability of conventional services for both the high-speed rail options and for the strategic alternatives?

2.12 The BCRs for the high-speed options and strategic alternatives—as shown in Table 2.1—are little different. The economic case for proceeding with HS2 itself is contingent on funding being available for costs that considerably exceed the strategic alternatives, which offer broadly similar value for money on conventional rail. This suggests that the case for the High Speed Rail programme over the strategic alternatives rests on estimates of the net benefits and option values of the extension to a Y network. However, the estimates of the benefits from the Y network are described as a 'high level assessment', with a substantial element 'extrapolated from our experience of work on HS2 (London - West Midlands)'.[13]

Q: Is it appropriate to focus on the benefits of the Y network given that its case has been assessed in less detail?

Q: Has further work been completed to improve the robustness of the case for the Y network?

2.13 In the same way that the construction of HS2 would enable the construction of the Y network and its associated benefits, it is possible that the Y network would create a 'valuable option' for further extensions. For example, future potential extensions from Scotland are likely to have greater benefits if they can link to a high-speed Y network at Manchester and/or Leeds compared with linking to a conventional network.

Q: Has the prospect of benefits from further extensions to the Y network been considered and analysed?

2.14 The Economic Case does not consider whether investments in road networks would be a viable alternative to a high-speed rail network; however, it is based on the Government's previous assessment of the potential benefits and costs of improving road (and rail) networks, which indicated that major upgrades to existing road networks would provide much less capacity, more disruption and fewer connectivity and journey time benefits than a new rail line.[14] Therefore, HS2 Ltd notes that it has not considered upgrades to the road network on the basis of the Government's decision that a new high-speed rail network would better support its strategy to promote economic growth.[15] It is unclear to what extent this decision has been subject to full appraisal.

[13] Department for Transport (2011), 'Economic Case for HS2: The Y Network and London – West Midlands', February.
[14] Department for Transport (2010), 'High Speed Rail', March.
[15] HS2 (2011), 'High Speed Rail: Investing in Britain's Future', Consultation, February.

3 How robust are the assumptions used?

3.1 Economic appraisal of future schemes inevitably involves some uncertainty due to its reliance on forecasts. The robustness of the assumptions and forecasts used can therefore have a significant impact on the estimated costs and benefits, and hence the BCR. This section reviews the implementation of appraisal of the High Speed Rail programme and the assumptions that underpin the assessment of transport user benefits, revenues, costs, wider economic impacts, environmental effects, and distributional impacts.

Transport user benefits

Use of travel time

3.2 The largest component of the monetised estimated benefits of high-speed rail comes from the time savings of business travellers (for HS2 these are £5.7 billion out of the £20.6 billion of total benefits, or 28%, excluding the reliability and wait time components).[16] The value of these time savings depends on the assumption around the use of travel time.

3.3 The assessment of benefits assumes that workers cannot use their journey time productively since this is the standard assumption used in transport appraisal. However, the Economic Case acknowledges that:

> [with] the advent of technologies such as laptops and 'wifi' internet networks which allow people to work on trains we recognise this is an area of debate.[17]

3.4 Research also shows that the level of productivity that can be achieved on a train is very similar to that which can be achieved at a normal workplace. For instance, the Mott MacDonald IWT Consortium study in 2008 found that the average productivity factor—or the amount of working time needed if work were done at the normal workplace relative to that on a train—is between 96% and 98%, depending on the duration of the train journey.[18] However, this is at odds with earlier studies, which have suggested that around 10–20% of rail travel time may be productive.[19] There are three potential effects of including productive use of travel time in the appraisal:

- it would reduce the benefits attributed to the reduction in travel time because the value placed on these time savings is dependent on how much the time spent travelling costs the employer, which would then be negligible/significantly lower;
- it would increase the benefits for passengers remaining on conventional services, who would experience less crowded conditions (currently, the only benefit from reducing crowding is reduced discomfort);
- it would increase the benefits when passengers switch from other modes if they can work more productively on HS2 than on their previous mode of travel.

[16] HS2 Ltd (2011), 'Economic Case for HS2: The Y Network and London–West Midlands', February.

[17] HS2 Ltd (2011), 'Economic Case for HS2: The Y Network and London–West Midlands', February, para 4.3.4.

[18] The Mott MacDonald IWT Consortium (2008), 'The Productive Use of Rail Travel Time and Value of Travel Time Saving for Travellers in the Course of Work', by Fickling, R., Gunn, H., Kirby, H., Bradley, M. and Heywood, C., p. 9. See also Oxera (2007), 'How to value in-work-time crowding', August 28th.

[19] See, for example, Fowkes, A.S. (2001), 'Principles of valuing business travel time savings', ITS Working Paper 562, December.

3.5 The Economic Case notes that if productive use of travel time is taken into account, the reduced productivity from having to stand on trains should be taken into account.[20] The sensitivity test in Chapter 7 explains that if the business value of time is halved and if crowding impacts are adjusted to reflect the loss of value experienced by business passengers travelling in crowded conditions (instead of using commuter values for business passengers), the BCR would increase slightly.

Q: To what extent do you consider that travel time should be considered productive? How realistic is the sensitivity test in Chapter 7 of the Economic Case?

Value of travel time

3.6 The valuation of travel time for business travellers used in the appraisal is £45 per hour in 2009 prices (£37 per hour in 2002 prices). The basis for the estimate is 2002 earnings data applied to 1999–2001 National Travel Survey data.[21] The April 2011 document published by HS2 Ltd notes that there is some survey data evidence to suggest that business travellers value time more than the values used in the business case.[22]

3.7 Oxera has tested a sensitivity whereby the value of time for business users is reduced by one-third. This had the impact of lowering the BCR for HS2 to 1.7 with WEIs (1.3 without WEIs), or, for the Y network, to 2.1 with WEIs (1.8 without WEIs).

3.8 Oxera also notes that the DfT uses a uniform value of time across the country, but is keeping under review the option of reflecting regional variations in earnings.[23] Should it decide to include regional variations, this would alter the business case, depending on the balance of travel between regions with higher and lower incomes.

Q: How confident are you in the estimated values of time?

Revenues

3.9 Calculating the expected revenues that will be generated by HS2 requires two interacting components to be estimated: demand forecasts and fare levels.

Demand forecasts

3.10 The demand forecasting element of the appraisal appears to be one of the most developed elements of the business case. The forecasts are based on a number of bespoke passenger demand forecasting models, with inputs from standard DfT models and standard rail industry guidance.[24]

3.11 The broad approach to demand forecasting consists of several steps. First, demand forecasts for the conventional network from now until 2021 and 2043 have been estimated. This is necessary in order to estimate the base level of demand on the conventional network in the absence of high-speed services. Second, the rate of demand growth following opening of the high-speed line is estimated. Third, an assumed cap to rail demand growth is applied beyond which there is no further growth in demand for long-distance rail—this is intended to reflect saturation of rail demand.

[20] HS2 Ltd (2011), 'Economic Case for HS2: The Y Network and London–West Midlands', February.

[21] Department for Transport (2011), 'Values of Time and Operating Costs TAG Unit 3.5.6', April.

[22] HS2 (2011), 'Valuing the Benefits of HS2 (London-West Midlands)', April.

[23] Department for Transport (2011), 'Review of decision making in the Department for Transport', written statement of the Rt Hon Phillip Hammond MP, April.

[24] The suite of models includes models for long-distance, South, Midlands, Heathrow and station choice.

3.12 However, the demand forecasts inevitably rely on a range of assumptions, and these continue to evolve. There have been regular revisions, the latest of which were published in April 2011.[25]

3.13 The important points arising from the latest demand forecast include:

- the greatest proportion of trips on HS2 is abstracted from the conventional network (65%);
- a cap on demand growth (at roughly double the current WCML levels) is implemented in 2043;
- a reduction in overall demand growth from 1.4% to 1.1% per annum reduces the BCR of HS2 to 1.3 (excluding WEIs).

3.14 The approach to modelling has been based on industry standard guidance, known as the Passenger Demand Forecasting Handbook (PDFH).[26] However, in other contexts, the reliability of PDFH forecasts has been questioned, particularly because of a perception that it has systematically underestimated the generally high levels of demand growth experienced by the industry in the last six to seven years. A number of alternative demand forecasting options exist, including versions of the PDFH[27] and other customised demand models (see Appendix 1 for further details).

Q: How dependent is the business case on the standard forecasting framework? Have alternative (especially non-PDFH) rail demand forecasting frameworks been tested?

3.15 The demand forecasts appear to be one of the areas in which sensitivity tests have been applied most thoroughly. HS2 Ltd has tested sensitivities on both the rate of growth and the level of demand at which growth has been capped. These are tested as direct assumptions on demand, and sensitivities on exogenous growth factors are tested separately. See Table A1.1 for a summary of these sensitivities.

3.16 HS2 Ltd has elected to cap demand growth for rail travel. This decision is partly as a function of the modelling, which, without a cap would predict unconstrained demand growth. The cap is equivalent to approximately double the current level of demand on the WCML. The justification for this cap is somewhat arbitrary; however, HS2 Ltd has tested scenarios (replicated in Table A1.1) which show that the implementation of the cap has an important impact.

Q: How was the level of the demand cap determined? What evidence is there to support it being set at the level selected?

Fare levels

3.17 The base-case scenario for the modelling is long-term rail fare growth of RPI + 1%. This is equivalent to the current cap on annual increases in regulated fares. In the description of changes to the modelling published in April 2011,[28] it is stated that the assumptions in the model were updated to incorporate the short-term impact of RPI+3% for three years from

[25] HS2 Ltd (2011), 'A Summary of Changes to the HS2 Economic Case', April.

[26] Association of Train Operating Companies (2005), 'Passenger Demand Forecasting Handbook v4.1'.

[27] The elasticities on exogenous variables come from PDFH v4.1 and fare elasticities from PDFH v4.0. The most recent version of PDFH is v5.

[28] HS2 Ltd (2011), 'A Summary of Changes to the HS2 Economic Case', April.

2012, as announced in the 2010 Comprehensive Spending Review.[29] The stand-alone impact of this does not appear to be described separately from those of other changes.

3.18 HS2 Ltd has tested a scenario of RPI + 2% in the long term, and found that this caused the BCR (without WEIs) for HS2 to fall to 0.9. This indicates that the assumption on rail fare growth is important.

3.19 Despite the real-terms increases in fares experienced since 2004, the Secretary of State for Transport has indicated that, in the long term, the intention is for there to be an end to above-inflation fare increases.[30] Fare increases at or below inflation would not be exceptional—indeed, before January 2004, regulation of fares was at the level of RPI – 1%. Given the change in BCR resulting from the sensitivity of RPI + 2%, it may be useful to test other scenarios, such as RPI + 0%, or at least anticipate the optimal fares strategy for the new services and reflect this in appraisal.

Q: Have other scenarios of higher or lower fare increases been tested?

3.20 The fare levels assumed on the conventional and high-speed services are the same.[31] It seems unlikely that the optimal fare strategy will be equivalent pricing between the two types of service, given passengers' willingness to pay more for faster journeys. For example, there is currently a fare differential for passengers using domestic HS1 services relative to passengers using conventional services between the same origin and destination. It would therefore seem appropriate to test a scenario based on differential pricing between the high-speed and conventional lines.[32] This is particularly the case if there is a desire to use fares as part of a demand management programme designed to 'lock in' the benefits of the new capacity delivered by the High Speed Rail programme.

3.21 The impact of differential pricing could be to increase revenues and hence reduce the net cost to government. Whether this improves VfM would then depend on the relativity of the revenue increase to the impact on the reduction in benefits from the demand response to premium fares. It may also be the case that fares for using the high-speed network could be used to 'lock in' the benefits of the High Speed Rail programme.

3.22 Premium fares for high-speed services may also have distributional consequences. The consequence of such fares will tend to shift the cost burden towards users and away from general taxation. If the users of high-speed rail services are generally expected to come from more affluent socio-economic backgrounds, this may be a more progressive form of funding for a high-speed rail scheme (as is further discussed later in this section).

Q: Has further work on premium fares for high-speed services been conducted since 2010? How would premium fares affect expected revenues? In particular, is there a role for demand management to 'lock in' the benefits of the High Speed Rail programme?

[29] HM Treasury (2010), 'Spending review 2010', October.

[30] Department for Transport (2011), 'Hammond welcomes value for money report that could bring efficiency savings to benefit passengers and taxpayers', May.

[31] In the 2010 documentation this is explained as a feature of the model structure, see HS2 Ltd (2010), 'HS2 Demand Model Analysis', February, para 3.5.3.

[32] In the 2010 documentation, premium fares were tested in an alternative model, however HS2 Ltd concluded that it was 'an issue that could be investigated in more detail in the future'. See HS2 Ltd (2010), 'HS2 Demand Model Analysis', February, para 3.5.6.

Costs

3.23 High-speed rail infrastructure and rolling stock involve substantial costs that fall into three categories: construction costs, rolling stock costs and operating costs.

3.24 The construction costs include the cost of tunnels, rail systems and land purchase. They are by far the largest component of the total scheme costs—in the Economic Case for HS2, they are estimated at £16.8 billion out of £24 billion of total costs, or 70%.

3.25 HS2 Ltd has approached the estimation of these construction costs by estimating the procedures needed for each specific component of the scheme, as identified in the detailed route planning. For each route section and station, HS2 Ltd has costed the scope of work based on a detailed route plan and section drawings.

HS2 Ltd has undertaken considerable benchmarking of infrastructure costs by type against costs in other countries. Benchmarked costs have been allocated by section of route, and optimism bias adjustments appear to have been derived from standard Green Book guidance.[33]

Q: Has the benchmarking suggested areas where costs could be reduced through efficiency savings?

3.26 The process of construction of a high-speed line will involve disruption to the existing conventional services. HS2 Ltd estimates that the cost of possession management and compensation for operational disruption is £195m.[34] The cost of any unplanned disruption is presumably captured within the optimism bias.

3.27 However, there is a question as to whether the degree of planned disruption is greater for high-speed rail or for the enhancement to the conventional network under the strategic alternatives. Works associated with the WCML upgrade caused considerable disruption to existing services, with revenue growth on the WCML falling considerably behind that seen on the parallel East Coast Main Line during the upgrade works.

Q: Has there been an assessment of the relative degree of planned disruption between the high-speed and strategic alternative options?

3.28 The second cost category is that associated with the purchase of rolling stock. These costs are estimated as £2.8 billion (or 12%) for HS2. Two types of rolling stock would need to be purchased: one for use exclusively on HS2 (a 'captive' set) and the other for use on both HS2 and the conventional network (a 'classic-compatible' set). The costs for the captive set have been derived on the basis of existing fleet types, and with a low optimism bias. For the classic-compatible set, a 50% premium and a larger optimism bias have been applied—this appears intuitively to be a conservative assumption for the hybrid fleet, although it is uncertain how much such sets would cost.

3.29 The final cost category is operating costs—ie, the costs associated with the day-to-day running of the high-speed services, which include factors such as the cost of the train crew. It is less clear what benchmarking has been undertaken in relation to these costs—they appear to have been derived from appropriate industry assumptions (eg, in relation to station staff, and using HS1 operations and maintenance costs), but it is unclear what assumptions are

[33] This adjustment for optimism bias is based on cost escalation of projects from inception to delivery, and hence ought to implicitly cater for changes in design that may arise as a result of the consultation and hybrid bill.
[34] HS2 Ltd (2011), 'Economic Case for HS2: The Y Network and London–West Midlands', February, Table 7.

being made in relation to efficiency improvements in rail operating costs over the period between now and the start of operations.

3.30 Asset renewal rates are currently included in ongoing costs, although it is not clear where the renewal costs have been derived from, or whether the renewals profiles are reasonable.

Q: How have asset renewal rates been derived?

There is considerable uncertainty surrounding the costs of the full Y network—HS2 Ltd has used a 'higher level approach'.[35] This relates in particular to the costs of delivering a service pattern on the Y network, with no work having yet been undertaken on train diagrams, which would enable detailed assumptions to be made about rolling stock purchases and operating costs. This might be a concern if the case for HS2 rests on its ability to enable the full Y network to be built.

Q: What progress has been made in improving the robustness of the cost estimates for the Y network?

It is unclear how HS2 Ltd has calculated the cost savings that it is intending to make as a result of lower levels of train service being required on the conventional network. For example, it assumes £78m of savings per annum from the withdrawal of Pendolino services on the WCML, but it is not clear that this is a full saving (since it essentially assumes that Pendolinos are reused to displace fully an equally expensive service elsewhere on the network).

Q: How have the cost savings on the conventional network been estimated?

Wider economic impacts

3.31 WEIs affect the wider economy and not necessarily the transport users themselves. They include effects such as agglomeration. The WEIs of HS2 are assessed in the Economic Case as £4 billion, with a conservative rough estimate of a further £2.3 billion from the Y extension to Leeds and Manchester.

3.32 The WEIs for HS2 appear to have been calculated in line with standard appraisal guidance. The agglomeration benefits are based on outputs from the demand modelling. The imperfect competition benefits are derived as 10% of business user benefits, as per standard appraisal guidance. The imperfect competition benefit reflects the fact that prices in an imperfectly competitive market exceed costs, implying that the value of benefits exceeds the reduction in costs.

3.33 HS2 Ltd approaches the issue of WEIs using bottom-up analysis, in line with DfT guidance.[36] Other studies of high-speed rail in Europe and elsewhere have looked at impacts top-down, for example using evidence on job creation and property prices in local economies.[37] Such studies have produced estimates of the beneficial impact on city and regional economies of up to 3% of local GDP. The HS2 estimates are well below this level, but nonetheless illustrate the upside potential involved in such calculations.

3.34 The WEIs have not been subject to any of the sensitivities tested elsewhere in the appraisal.

[35] HS2 Ltd (2011), 'A summary of changes to the HS2 economic case', April, p. 18.

[36] A bottom-up approach means that elements are estimated separately and then aggregated. This compares to a top-down approach, where a single estimate of the total WEIs would be calculated.

[37] See, for example, Marques, L. (2009), 'Portugal's High Speed Future: Developing a National and International Network', The Future of European Rail Conference, March 17th.

Agglomeration

3.35 The agglomeration benefits identified in the Economic Case account for £3 billion of the £4 billion of WEIs. HS2 Ltd has informed Oxera that most of these benefits arise from freeing up capacity for short-distance commuter services. Since these WEIs are predicated on capacity rather than travel time, the benefits arise not as a result of high-speed services per se, but rather owing to the ability to release capacity for additional commuter services. However, as already stated, no equivalent WEIs have been included in the assessment of the strategic alternatives.

3.36 The assessment of agglomeration impacts was informed by a report by Daniel Graham and Patricia Melo, economists at Imperial College London.[38] The report focused on the agglomeration benefits from improved travel times of high-speed rail itself and found that these benefits would be 'very small indeed'.[39] This is consistent with the agglomeration benefits included in the Economic Case being derived primarily from additional commuter capacity rather than inter-city time savings.

Q: Has there been analysis equivalent to that of Graham and Melo (2010) for the agglomeration benefits from additional commuter capacity? If so, does it provide indications of the robustness of the estimate of £3 billion agglomeration benefits?

Non-monetised factors

3.37 Some factors are omitted from the BCRs calculated in the Economic Case owing to a lack of hard quantitative evidence. These factors are potentially significant and may therefore be expected to yield additional impacts. However, monetisation of these benefits in the BCRs may be difficult or inappropriate (although some of the written submissions to the TSC attempt to place values on some of these—see Appendix 1). As such, these factors will need to be considered elsewhere in the overall business case for high-speed rail. This is in line with comments made by HS2 Ltd—for example, with regard to land-use changes (such as investment in new office space and housing developments being constructed in the vicinity of high-speed interchanges), it stated that:

> While these [land-use changes] have not been included in the monetised business case for HS2, they are deemed to be important considerations in the decision making process.[40]

3.38 Some of the other factors not monetised in the Economic Case are described below.

– The number of direct jobs created by the construction and operation of HS2. If these jobs were included in the appraisal, it is not clear whether there would be an impact on the BCR, given that about 85% of the jobs would be in construction, and therefore likely to be temporary, with even the permanent ones possibly being displaced from elsewhere. (Although displacement from one area to another may not change the overall BCR, it may affect regional inequalities.) The Appraisal of Sustainability (AoS) also states that jobs lost at other railway stations due to the HS2 scheme will be likely to be replaced elsewhere, but the evidence base for this assumption is not provided, so it might be more appropriate for these lost jobs to be subtracted from the total number of jobs created.

– The ability of workers to access higher-productivity jobs may be enhanced because of reduced journey times from high-speed rail.

[38] Graham, D.J. and Melo, P. (2010), 'Advice on the Assessment of Wider Economic Impacts: a report for HS2', March.
[39] Ibid.
[40] HS2 Ltd (2011), 'Valuing the benefits of HS2 (London–West Midlands', April.

- The local development/regeneration impacts around HS2 stations, including:
  - land-use changes leading to greater concentration of employment around high-speed rail hubs, which could yield additional productivity benefits;
  - home/building demolition and adverse ecological impacts;
  - the net additional floor space (office, residential, retail, hotel, education, industrial) associated with HS2 has been forecast, but is not included in the appraisal. In addition, this is calculated as the future floor space with HS2 compared with the future floor space in the absence of HS2, and therefore does not seem to account for the existing floor space that would be lost as a result of the construction of the high-speed rail link.
- The benefits of increased potential for freight traffic due to released capacity on the WCML; the AoS explains that there is scope for freight on the Southern section of the WCML.
- The AoS quantifies the costs of operational airborne noise at residential areas only, thereby excluding a detailed appraisal of construction noise, airborne noise at other sensitive locations, vibration, ground-borne noise, and noise from HS2 stations and depots.

3.39 The overall impact of these effects is difficult to ascertain.

Q: Are there some WEI factors that are not in standard guidance that could have been included?

Q: Is it possible to suggest a likely order of magnitude for these omitted benefits?

WEIs of the Y network and strategic alternatives

3.40 There is no formal published appraisal of WEIs of the Y network, nor of the extent to which the extensions to Leeds and Manchester would displace or add to benefits from the HS2 line. The approach reported in the HS2 Economic Case merely assumes that there will be additional wider benefits equivalent to half of what would be expected if they were in similar proportion to the extra conventional transport benefits for business from the extensions.

3.41 The equivalent benefits for the strategic alternatives do not appear to have been calculated.

Environmental impacts

3.42 The operation and construction of a high-speed line will have impacts on both the local and wider environment, one of the most important being that on carbon emissions. This will be driven by the energy efficiency of high-speed services relative to conventional services and other modes, the extent of modal shift, the level of new trip generation, and the use of freed-up capacity for other modes/conventional services.

When assessing operational and embedded carbon emissions, the primary sources of emissions are often the same cost factors that have the most uncertain estimates. This leads to a wide range of potential aggregate carbon impacts from HS2. Assuming the central cost estimates under two different sets of assumptions, this range is from +£870m to –£2,022m (in 2009 prices). This range becomes even wider if, under the same assumptions, the low and high projected costs are used instead of the central case.

It is unclear whether the strategic alternatives have been subject to an appraisal of their carbon impacts.

Q: Would it be possible to reduce the estimated range of potential carbon emissions?

3.43 The quantification of carbon emissions in the AoS uses July 2009 guidance published by the Department of Energy and Climate Change (DECC).[41] In the revised approach to appraisal published by the DfT, the carbon valuation has been updated to reflect the values published by DECC in June 2010.[42]

Q: Will the estimated carbon values in the AoS be updated to reflect this change?

The extent of modal shift is a key factor in determining the level of carbon emissions. A shift in passengers from domestic aviation to high-speed rail would lower aviation emissions if the aviation services were reduced as a result (or smaller or more efficient planes used for the remaining passengers). Therefore, the AoS considers a number of scenarios related to the impact on aviation services from high-speed rail. One scenario considered is that there would be no change to aviation emissions if the reduction in passenger numbers on any one flight were not enough to discontinue the service. Another scenario proposed in the AoS is that slots previously used by the flights predicted to be displaced by HS2 remain vacant. However, this is unlikely to occur due to the excess demand for capacity at the main airports in the South East (Heathrow and Gatwick).

Q: Is it correct that there may be a net increase in carbon emissions because there is no reduction in the number of flights and additional HS2 services?

The estimation of the greenhouse-gas effects of HS2 uses the July 2009 DECC guidance, which includes projections of traded and non-traded costs of carbon up to 2050.[43] The appraisal then assumes that the cost remains at the 2050 level for the rest of the operational life of the scheme (ie, until 2086).

Q: If changes in the cost of carbon beyond 2050 are considered, would this significantly affect the estimates?

3.44 The case for high-speed rail is affected by the impacts on carbon emissions that are quantified, although these do not appear to be included in the BCR. Given the very limited anticipated substitution from air to rail (6%) and car (7%), the substantial volume of new trips (22%) suggested for HS2, and the lower rates of emission from slower trains, the classic rail options could well involve lower overall emissions. This would bring the comparison of BCRs closer together for the Y network and generate an advantage for the classic rail options to Birmingham.

Many of the ecological, biodiversity and other such assessments are undertaken at a high level only, since the detail required to carry out a full assessment is unavailable, according to the AoS report.

Q: Will these assessments be carried out when more data becomes available in order to have a better indication of the impacts, and would these assessments be likely to have a significant impact on the BCR of the scheme?

3.45 The AoS does not explicitly consider the landscape impacts of building a new high speed line, which HS2 Ltd rightly believes would be important. Neither are such effects included in

[41] Department of Energy and Climate Change (2009), 'Carbon Valuation in UK Policy Appraisal: A Revised Approach', July.
[42] Department of Energy and Climate Change (2010), 'Updated short term traded carbon values for UK public policy appraisal', June.
[43] Department of Energy and Climate Change (2009), 'Carbon Valuation in UK Policy Appraisal: A Revised Approach', July.

the calculated BCRs, and the extent to which they would reduce the measured value for money of a new line is therefore unclear.

3.46 Studies do exist of the values attached by people to particular kinds of landscape, and Government has in recent years proposed and undertaken new studies. It should be possible to produce broad estimates of the order of magnitude of landscape costs for a new high speed line.

Q: Have estimates been made of the landscape impacts of a new high speed line, and would these be likely to have a significant impact on the relevant BCRs? Are such assessments planned?

Distributional impacts

3.47 The impact of high-speed rail is unlikely to be uniform across the UK population; rather, the effects will differ across socio-economic groups and regions.

Socio-economic impacts

3.48 In assessing the case for HS2, it would be of interest to consider the potential socio-economic impacts on both users and non-users as a result of construction of the line.

3.49 HS2 could have distributional impacts if only certain socio-economic groups benefit from travel on the proposed route. HS2 Action Alliance claims that 47% of long-distance rail trips are made by the top household income quintile (with a gross household income of over £70,000 per annum on average).[44] Other studies corroborate the assertion that high-speed rail tends to attract individuals from higher-income groups.[45] While the Economic Case does not discuss this point, it estimates that about 67% of the transport user benefits (of the Y network) are likely to go to business users—ie, individuals who tend to be from higher-income groups.[46] If users are predominately from high-income groups, they will in general have a higher ability and willingness to pay for these journeys. This may suggest that a premium-fare strategy is appropriate (as discussed in paragraphs 3.20 to 3.22), and that more weight might need to be placed on the wider economic benefits of providing more capacity for business travel.

Q: Has there been consideration of the types of user, in terms of socio-economic status, who will benefit from travel on HS2?

Q: Are there expected to be significant distributional effects between socio-economic groups as a result of the construction of the HS2 line?

Geographic/regional

HS2 Ltd stresses the need for high-speed rail to be fully integrated into local and regional economic and spatial strategies in order that maximum economic benefits are obtained.[47]

[44] HS2 Action Alliance (2011), 'Review of the February 2011 consultation business case for HS2', May. Based on data taken from Rohr, C., Fox, J., Daly, A., Patruni, B., Patil, S., Tsang, F. (2010), 'Modelling Long-Distance Travel in the UK', RAND Europe. Values of average quintile household income are taken from Office of National Statistics, 'The effects of taxes and benefits on household income, 2005-06'.

[45] For example, a report by Greengauge 21 noted that people who take advantage of high-speed trains for daily commuting are primarily those with higher incomes. Harman R. (2006), 'High Speed Trains and the Development and Regeneration of Cities', *Greengauge 21*, July.

[46] As calculated from the HS2 Central Case Spreadsheet.

[47] HS2 Ltd (2010), 'Demand Model Analysis Appendix 3: High Speed Rail and Spatial Patterns and Strategies in Cities and Regions', February.

This is likely to be an important enabling factor in the government's desire to see the high-speed network changing the economic geography of the country:

> The Government believes that high speed rail can play an important role in promoting valuable strategic change in the economic geography of Britain, supporting sustainable long-term growth and reducing regional disparities.[48]

In practice, there are likely to be higher benefits in the vicinity of high-speed rail hubs, so the 'regeneration' benefits to those areas are likely to be understated. However, these may be offset by economic losses in other areas, including locations not served by the high-speed line—the 'tunnel effect'.[49] Thus, the London and Birmingham economies might benefit partly at the expense of areas not served by the new scheme. The precise impacts will depend on the reallocation of conventional services on the WCML and elsewhere.

Q: What estimates have been made of the adverse economic impacts on areas not served by the new high-speed line?

3.50 The AoS does note that there could be inter- and intra-regional redistributive impacts, and that people may be attracted to locate around HS2 stations in London or Birmingham, at the expense of other parts of those cities or other cities in the UK. In its April 2011 document, HS2 Ltd forecasts the monetised impacts of transport benefits and WEIs by region, calculating that 34% of benefits (by origin of trip) will go to those from London. It also notes that the longer-distance rail users who will be the principal beneficiaries of high-speed rail are likely to be from London, Birmingham, Manchester and their surrounding areas.

3.51 However, a number of impacts of the proposed scheme have been assessed at the route level only. This prevents a clear indication of whether the benefits or costs are concentrated in certain regions. Some of these factors include:

- the change in carbon emissions as a result of modal shift and change in total emissions (the carbon emissions from construction have been assessed by route section);
- planned regional growth (major housing and other developments have been assessed by route section);
- the impact of the scheme on reducing health inequalities.

3.52 When the AoS does assess benefits and costs by route section, it is not clear whether certain regions benefit at the expense of others. Furthermore, the only regions that are assessed in detail in terms of economic impacts are the catchment areas surrounding key stations on the line. Some of the written submissions to the TSC that cover specific regions are summarised in Appendix 1.

Q: What is the relative size of the economic impacts on cities expected to be served by the high-speed network? What proportion of these economic impacts is abstracted from other regions not served by the high-speed network?

[48] Department for Transport (2011), 'High Speed Rail: Investing in Britain's Future', Consultation paper, p. 12.

[49] Gutierrez Puebla, J. (2005), 'Spatial Effects of the High Speed Train', Investigaciones Regionales.

4 Is the standard approach to appraisal appropriate and do other similar projects provide useful lessons?

Is the standard appraisal approach appropriate?

4.1 Current appraisal guidance is designed to be applicable to all manner of transport schemes, whether they are small or big, for cycling or rail. There is therefore a question as to whether this standard approach should be adjusted for assessing a unique major transport project, such as high-speed rail. Oxera understands that, in due course, the appraisal of the high-speed network will be adjusted to reflect the revised approach to appraisal recently published by the DfT. This approach put forward in this revised guidance recommends five separate components to make up the full business case: the Strategic Case, Economic Case, Commercial Case, Financial Case, Management Case. The AoS uses several different appraisal techniques to evaluate the impact of high-speed rail, including WebTAG guidance, strategic environmental assessments, environmental, health and equality impact assessments, sustainability appraisal, and other similar techniques.

4.2 Appendix 2 looks at some more technical issues relating to the approach to appraisal.

Are there lessons from other major transport projects?

4.3 Oxera has briefly reviewed evidence from other major transport projects to examine whether there are any apparent systematic trends that would imply that ex ante project appraisals tend to over- or underestimate any specific parts of the appraisal (see Appendix 2).

4.4 Overall, a number of lessons can be drawn from ex post assessments of other high-speed rail and rail schemes. Planning and taking account of the environmental, economic, and social factors seem to be integral to the success of the scheme. Furthermore, a consideration of the main uncertainties or risks surrounding the costs and revenues can lead to more robust estimates. At the same time, in almost all schemes considered, unforeseen circumstances have arisen and contributed to higher costs or lower revenues than expected, although some schemes have still delivered good VfM. The optimism bias adjustments applied to the appraisal of the High Speed Rail programme are designed to mitigate some of these risks at this stage of the process.

Q: Do the generally favourable ex post assessments of major rail projects (eg, the Jubilee Line Extension) suggest that the bottom-up BCRs are conservative estimates?

Q: Are the bottom-up estimates for the High Speed Rail programme consistent with the top-down estimates from other high-speed rail examples?

5 Summary

5.1 Oxera's review has highlighted that there are several aspects to the business case for high-speed rail, including monetised and non-monetised elements.

5.2 The monetised estimates are surrounded by a degree of uncertainty—indeed, the sensitivities published by HS2 Ltd for HS2 show a range of 0.7–2.7 for the BCR excluding WEIs (see Table A1.1) and this simply looks at each sensitivity in isolation. The overall balance of non-monetised impacts—which include landscape, carbon and changes in land use—is difficult to ascertain, but is likely to become more apparent as the understanding of the impacts improves over time, and as HS2 Ltd adjusts the appraisal to reflect the DfT's revised approach to such assessments.

5.3 Overall, the case for the High Speed Rail programme seems to depend on whether and when the capacity is needed, the selection of the best VfM approach to delivering that capacity, the degree of uncertainty around the monetised benefits and costs of the preferred options, and judgements on the balance of evidence relating to non-monetised items, such as environment and regeneration impacts (which are likely to be substantive in their own right but not fully set out in the Government's assessment).

A1 Further detail: Are the assumptions used robust?

Other transport user benefits

A1.1 Section 3 covered the travel time savings. The remaining transport user benefits fall into the following categories: reliability, crowding, other rail user impacts (which include wait time penalties and access/egress time), road decongestion and other impacts. The first four of these are also influenced by the value of time estimates.

A1.2 The assessment of other transport user impacts includes the benefits associated with local air emissions, noise and accidents/safety, which are valued as being £37m (for HS2), equal to 0.1% of the total net benefits. It is the value of the HS1 link, at £350m, that makes up the majority of the stated benefits of other impacts.[50]

Demand

Forecasting framework

A1.3 The forecasting framework used by HS2 Ltd has primarily been the PDFH, which provides a framework and recommended parameters for assessing demand changes as a result of changes in rail service offering and in external factors.

A1.4 One of the main issues with the PDFH is that it is based on a constant elasticity specification. This means that increases in demand drivers continue to have an unabated impact on demand. As a result the PDFH is generally recommended for use in assessing incremental changes (<10%) in demand drivers.

A1.5 In the modelling undertaken for HS2, the models are based on PDFH v4.1 and PDFH v4.0. A more recent update (PDFH v5.0) has been released by the Passenger Demand Forecasting Council but is not yet part of the DfT's recommended guidance. The DfT is currently in the process of testing these estimates.[51]

A1.6 Other non-PDFH forecasting frameworks exist, including the *Revisiting the Elasticity Based Framework* study carried out by Arup and Oxera on behalf of the DfT, Transport Scotland and the Passenger Demand Forecasting Council.

Effect of other modes

A1.7 The demand and cost of other modes is a further determining factor in the demand forecasts for rail. The air demand estimates are informed by SPASM (the DfT's standard aviation model) and the highway demand informed by the National Transport Model (NTM) and National Trip End Model (NTEM).

A1.8 A sensitivity included in the Economic Case is for a 50% increase in fuel duty above the current forecast. This has the impact of increasing the BCR (without WEIs) to 2.4, which suggests that the cost of road travel is an important determinant of the case for HS2. An increase of 50% appears to be a large increase to test; however, fuel duty is only one component of the overall cost of road travel. Thus, flexing this single component of road

[50] The 'Other Impacts' reported in Table 4 of the Economic Case.

[51] Department for Transport (2011), 'Freedom of Information Response F0007480', April 8th.

travel cost does not fully capture all the road costs that travellers might face. Potentially an increase in the total cost of road travel should have been tested.

A1.9 One of the other components of road cost that experiences greater variability is oil prices. Although there is much debate about forecast oil prices, a further scenario that could have been tested would have been oil prices rising substantially in the long term.

Q: How would substantial long-term oil price rises or falls have an impact on demand for rail? Would this impact be greater than those in the tested fuel duty scenarios?

A1.10 The demand modelling has taken account of the service offering of other modes, including road and aviation. For aviation, forecast air fares have been extracted from the DfT's SPASM model. These forecasts predict declining real air fares, which is in line with the long-term historical trend.[52] However, a sensitivity reported in the Economic Case is for growth in air fares of 37% as a result of high oil prices and carbon trading. This leads to an increased BCR excluding WEIs of 1.8. This sensitivity seems to be a fundamentally different position to the base case of declining air fares. However, the implication is that the level of air fares is not a crucial determinant of the case for high-speed rail.

Q: Are declining real air fares realistic given the prospect of increased environmental taxation on aviation?

A1.11 The demand for air, road and rail are modelled separately. However, there appears to be an asymmetry because rail forecasts take account of aviation and car cost changes, while car and air demand do not take account of changes in the generalised cost of rail.

WEIs

Estimates of WEIs from written submissions

A1.12 A number of submissions to the TSC's inquiry provide alternative estimates of the WEIs that could result from the High Speed Rail programme. These submissions provide a wide range of estimated impacts to certain areas/cities and the whole of the UK.

- The South Yorkshire Passenger Transport Executive[53] cites evidence predicting that high-speed rail will be worth more than £70m per annum in productivity benefits to the eastern city regions of the North East, Tees Valley, Leeds, Sheffield and East Midlands. This is as a result of wider production and labour markets and the attraction of inward investment. This analysis also indicates that the Eastern Network would provide a further contribution of £4.2 billion to the national economy in productivity, imperfect competition and capacity release benefits.[54]

- A report by Greengauge 21, cited in the Core Cities submission, looks at the WEIs associated with changes in accessibility, productivity of businesses and employment patterns, as well as agglomeration effects.[55] It estimates that a national high-speed rail system could generate £14 billion of wider economic benefits (out of total scheme economic benefits of £125 billion) over 60 years. This report also notes that these wider benefits are well distributed across regions: 36% to the Midlands and North of England; 35% to the wider South East, including London; and 26% to Scotland.

[52] Atkins (2010), 'HS2 Baseline Forecasting Report: A report for HS2', February.
[53] Submitted on behalf of the South Yorkshire Integrated Transport Authority and the Sheffield City Region.
[54] This data is taken from a forthcoming report of the Eastern Network Partnership, providing evidence for the HSR eastern network, to be published in July 2011.
[55] Greengauge 21 (2009), 'Fast Forward: A High-Speed Rail Network for Britain'.

– Birmingham City Council cites an independent economic study which suggests that there could be an increase in economic output of between £600m and £1.5 billion in the West Midlands region (the higher levels of benefit are reliant on additions to regional rail services).

– Professor John Tomaney cites a study by KPMG for Greengauge 21,[56] which claims that HS2 would create a single market for services and knowledge-based activities. In turn, this would cause an increase in GVA of between £17 billion and £29 billion by 2040. KPMG also predicts that HS2 will generate additional tax receipts of between £6 billion and £10 billion due to increased economic activity.

– The Greater Manchester Combined Authority predicts that economic output could be increased by £967m per year across the region covered by the Northern Way partnership.

Distributional effects

Socio-economic impacts

A1.13 The AoS evaluates the levels of deprivation[57] and socio-demographic characteristics of each station catchment area and key areas along the proposed route and the WCML. The community integrity and accessibility assessment also takes account of the number of properties in the 20% most deprived areas and in areas with a high proportion of equality groups that would be demolished. However, these pieces of analysis are not linked to the resulting potential distributional impacts from HS2.

A1.14 In line with WebTAG guidance, the key sustainability objectives in the AoS include economic prosperity and economic welfare, but these objectives are concerned with supporting wider economic growth, rather than the distributional impacts. Similarly, and in accordance with the way in which these assessments are usually undertaken, the equality impact screening assessment (EqIA) looks at the effects of HS2 on 'priority equality groups' but it does not directly address the impacts on different income groups.[58]

Geographic

A1.15 There is evidence that those cities where the service sector (including tourism) counts for a large proportion of the economy, are the most likely to benefit from access to high-speed lines.[59] London is thus very likely to benefit, possibly at the expense of less service-oriented cities on the line. In fact, a large proportion of the quantified benefits (34%) in the Economic Case are to long-distance passengers from London, so the regeneration effects (if they exist) would be large in London.

A1.16 The AoS does not assess many distributional implications between regions along the route, although it states that one of the aims of HS2 is to reduce disparities between London and the rest of the UK. For this reason, it would be of interest to assess all of the benefits of the scheme by route section. While some benefits of the scheme are assessed in this way in the AoS, many of the significant effects—such as benefits for commuters/consumers, agglomeration, maintaining/improving access to public transport—are assessed at the route level, and therefore it is not clear if there are disparities in benefits/costs between different parts of the route.

[56] Greengauge 21, (201), '*Consequences for Employment and Economic Growth*', February.

[57] It considers the impact of the scheme on areas of high deprivation, known as Lower Super Output Areas (LSOAs).

[58] This considers gender, ethnicity, disability, age, faith and sexual orientation.

[59] Albalate, D. and Bel, G. (2010), 'High Speed Rail: Lessons for Policy Makers from Experiences Abroad', *University of Barcelona.*

A1.17 A number of submissions to the HS2 consultation and evidence from other schemes suggest mixed evidence about the inter-regional effects of high-speed rail.

- The wider economic benefits of Crossrail have been assessed by borough in London and the South East. The agglomeration effects (as measured by change in output per job) are greatest along the route. In other words, the boroughs which experience the most significant change in accessibility to jobs have the highest change in output per job. However, it is of note that no regions are projected to lose out.

- The North West Chamber of Commerce predicts that high-speed rail will help to close the north–south economic divide by improving access to the North West, enhancing opportunities for investment and economic development.

- Professor John Tomaney[60] looks at whether high-speed rail will help rebalance regional economies based on evidence from five countries where high-speed rail has been introduced, and concludes that the impact of high-speed rail on regional inequalities is fairly ambiguous.

- The Liverpool and North West Chambers of Commerce believe that HS2 will maximise VfM and business confidence to invest outside London and the South East.

- Warwickshire County Council does not consider that the evidence that HS2 Ltd puts forward suggests a reduction in the north–south divide, and considers that this should be assessed in more detail.

Sensitivities

A1.18 Table A1.1 summarises the stated sensitivities for the BCR.

[60] 51M (2011), 'The Local and Regional Impacts of High Speed Rail in the UK: A Review of Evidence'.

Table A1.1 Impact of sensitivities on the BCR (without WEIs)

	Sensitivity	Detail	HS2
	Base case (without WEIs)	Demand capped in 2043, growth rate 1.4%	1.6
Demand growth	Demand cap higher	Demand growth extended by five years	2.0
	Demand cap lower	Demand capped at 2026 level	0.7
	Demand growth faster (I)	Demand cap reached in 2033	1.9
	Demand growth faster (II)	Demand cap reached in 2033 due to higher economic growth	2.0
	Demand growth slower (I)	Demand cap reached in 2055, growth rate 1.1%	1.3
	Demand growth slower (II)	Demand cap reached in 2055 due to lower economic growth	Below 1.3
	Scottish demand capped	Cap Scottish demand in 2021	1.3
Inter-modal impacts	Growth of other modes lower	Capping air and road growth at 2008 levels	1.4
	Cost of other modes lower	50% higher fuel duty and 37% higher air fares	2.7
Fares	High fare increases	Rail fares increase at RPI+2%	0.9
Other benefits	Station redesign	Including benefits of Euston redesign	1.7
Costs	Cost reduction	15% reduction in costs	2.0
	No cost differential	Same cost estimates for captive and classic fleet	1.9
	Lower optimism bias	Optimism bias at 10%, slower electricity costs and greater productivity gains	2.0
	Private sector contribution	Private sector contribution of £2 billion	1.7
Opening year	Later opening	Opening year in 2030	2.0

Source: HS2 Ltd (2011), 'Economic Case for HS2: The Y Network and London–West Midlands', February.

A2 Further detail: Is the standard approach to appraisal appropriate?

Approach to appraisal

A2.1 The DfT's approach to appraisal and prioritisation of transport schemes was reformed in April 2011. Following the reform the guidance recommends that the assessment of a transport scheme comprises several distinct elements—the Strategic Case, Economic Case, Commercial Case, Financial Case, Management Case. These different components of the overall business case all play a role in informing the ultimate decision. This means that the pure BCR of monetised benefits and costs is only one of the factors that decision-makers must consider. The Consultation document has been clear that the BCR of the High Speed Rail programme is only one component of the Government's case for high-speed rail.[61]

A2.2 The approach to appraisal is still supported by the DfT's WebTAG, which gives guidance on the technicalities of conducting appraisal. A few changes were made to this guidance following the reform, including to the treatment of indirect tax and the value of greenhouse gases.

A2.3 One part of appraisal is the Appraisal Summary Table which should include all qualitative, quantitative and monetised impacts. The monetised costs and benefits should be included in the BCR—as calculated in the Economic Case. In the published documentation for high-speed rail the various components of the appraisal are described separately, for instance the Economic Case and the AoS. Each of these contains aspects of the Appraisal Summary Table. For instance, the Economic Case contains the monetised construction costs, the AoS contains an assessment of biodiversity and both contain assessments of noise (Economic Case as a monetised assessment, AoS as a qualitative assessment). The approach taken by HS2 Ltd is in line with the current guidance, although notably there are some factors that could be monetised (such as number of jobs created or building developments), but which are not.

Small time savings

A2.4 Although most of the time savings on high-speed rail would not be considered small, some of the time savings for passengers from released capacity on conventional services or road network may be considered small.

A2.5 There has been an ongoing debate in the transport industry regarding the treatment of small time savings in appraisal. The business case for transport schemes often includes the valuation of very small time savings (minutes or seconds) accruing to many transport users. The debate is between those who claim that transport users place low or no value on very small savings, compared with those who claim that all time savings should be treated equally regardless of their size. This debate was discussed in a 2010 article in Oxera's online publication, *Agenda*.[62]

A2.6 The current DfT guidance remains clear that all time savings should be included and the HS2 business case adopts this approach.

[61] Department for Transport (2011), 'High Speed Rail: Investing in Britain's Future', p. 14, February.
[62] Riley, C. (2010), 'Do small savings in travel time matter?', *Agenda*, November.

Discounting

A2.7 The costs and benefits of HS2 have been assessed in present value terms. This means that costs and benefits further in the future are weighted as less important than costs or benefits today. This is known as discounting and is primarily based on the principle known as time preference—that goods and services available now are preferable to those available later. This applies to society as a whole as well as individuals.

A2.8 The standard appraisal approach to evaluating costs and benefits over time has been followed in the assessment of HS2. The scheme has been appraised over 60 years from opening, with an initial discount rate of 3.5% falling to 3% after 30 years. The full Y network has been appraised over 67 years (60 years from commencement of the full Y and the initial seven years of just HS2).

A2.9 Two potential challenges to the discounting approach can be raised. These relate to the discount rate and the appraisal time period. Oxera has tested in the published model two variants to the default discounting approach.

Discount rate

A2.10 The HM Treasury Green Book values have been used and there would need to be a more fundamental revision of these recommendations that applied to appraisal of all schemes if alternative values were to be considered appropriate.

A2.11 However, there may be scope for reconsidering this value if the trend economic growth rate per capita over the long term was deemed to have changed from the 2.1% that is used in the current estimate. For example, if there was a structural change to long-term growth (not just short-term cyclical variations) as a result of the 2008 financial crisis.

Appraisal period

A2.12 HS2 has been appraised over 60 years and the Y network over 67 years (60 from the opening of full Y, seven from just HS2). This is in line with DfT recommendations. Note, however, that the Green Book provides recommendations for discount rates for longer time periods—see Table A2.1.

Table A2.1 The declining long-term discount rate

Period of years	0–30	31–75	76–125	126–200	201–300	301+
Discount rate	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%

Source: HM Treasury (2003), 'The Green Book'.

A2.13 Since HS2 is a long-life asset one potential alteration to the standard approach to appraisal is to alter the appraisal time frame.

A2.14 Oxera has tested in the published model two variants to the default discounting approach.

A2.15 Table A2.2 below shows the impact on the BCR of changes to the discounting approach. Changing either the discount rate or the appraisal time frame will change the BCR. However, there is no clear reason to deviate from the current guidance.

Table A2.2 Impact of alternative discounting assumptions

	HS2			Y network		
Period of years	Base	Appraisal period extended by ten years	Discount rate of 3.0% then 2.5%	Base	Appraisal period extended by ten years	Discount rate of 3.0% then 2.5%
BCR (without WEIs)	1.6	1.8	2.0	2.2	2.4	3.2
BCR (with WEIs)	2.0	2.3	2.4	2.6	2.8	3.8

Source: HM Treasury (2003), 'The Green Book'.

Are there lessons from other major transport projects?

A2.16 The construction and operation of a high-speed rail line in the UK would not be unprecedented. The UK already has one high-speed line and there are many others across Europe and the rest of the world. This section briefly analyses whether there are lessons to be drawn for ex ante appraisal of HS2 or the Y network from ex post evaluations of other high-speed rail schemes and outcomes of other major transport projects.

High Speed 1

A2.17 High Speed 1 (HS1) is the railway between St Pancras London and the Channel Tunnel. It allows high-speed rail services to operate between London and the continent as well as domestic high speed services from Kent to operate into London. Work on HS1 began in 1998; the first section of the railway (between the Channel Tunnel and Kent) opened in 2003 and section two (between Kent and London) opened in 2007.

A2.18 A number of lessons can be drawn from the ex post evaluations of HS1. First, there seems to have been some level of optimism bias with respect to passenger forecasts. The estimates of passenger revenues were revised downwards three times between the start of the project in 1998 and 2004. These forecasts each included low, medium and high scenarios, and in almost all cases, the high scenarios in the revisions were quite similar to the low cases from the previous forecasts. However, there were a number of unforeseen circumstances that may have contributed to lower-than-expected passenger traffic, including a reduction in travel following the terrorist attacks in September 2001. The over-optimistic passenger forecasts also hindered the plans to raise private finance, since this was based on the prospect of a certain level of forecast revenue. In turn, this led to increased public support for the project and a restructuring of the deal in 1998.[63]

A2.19 On the other hand, there may be some positive lessons from the construction of HS1 and the ex ante cost forecasting that was undertaken. Section one of the link was completed on time and slightly below the target cost (as set out in the 1998 restructuring). The target cost of £1,930m was estimated as the sum of point cost forecasts for all of the component works, which were based on assumptions about various project risks. Due to the uncertainty in some of these assumptions, a contingency was also estimated at £180m. The actual cost outturn for Section one was £1,920m. [64]

High-speed rail in Europe

A2.20 This section reviews major high-speed rail links around Europe and looks at the impacts of these schemes on passenger demand, modal shift, and wider economic and regional impacts. Overall, the success of high-speed rail seems to largely depend on the precise

[63] National Audit Office (2005), 'Progress on the Channel Tunnel Rail Link', HC 77 Session 2005-2006, July 21st.
[64] Ibid.

route selected, and whether the high-speed rail link alleviates congestion and connects the most highly populated cities.

Mobility impacts

A2.21 The introduction of high-speed rail services in France and Spain generated a significant number of trips, and caused modal shift from road and rail. For example, there was a 2.8 times increase in demand for rail on the Madrid–Seville route from 1991 to 1997 and a 2.2 times increase for the Paris–Brussels route from 1994 to 2005, after the respective high-speed rail lines were introduced.[65] However, there is evidence that the generation in travel is mostly from outer areas into the city rather than the reverse; in other words, the journey generation is asymmetric. For example, on the Paris to Rhone-Alps route, flight and train journeys to Paris increased by 144%, but journeys in the inverse direction only experienced a 54% increase due to the high-speed rail connection.[66]

Wider economic and regional impacts

A2.22 The introduction of the TGV in France was accompanied by the implementation of policies to develop and improve regional rail services to ensure that benefits were spread widely and to increase accessibility. These policies seem to have succeeded in bringing benefits to cities in some cases, such as Lyon and Lille. However, there have been low levels of job creation and attraction of few new businesses in cities with deprived economies and where the stations are located outside urban areas; for example, Montchanin. The regional impacts from the introduction of the high-speed rail link in Spain are also ambiguous. While the AVE is not reported to have attracted new firms to the catchment areas of stations, existing firms have benefited from the new transport infrastructure. Sizeable land value and population increases have also been cited as a result of AVE construction.[67]

A2.23 Experience from Germany suggests that there may be positive impacts in the catchment areas surrounding stations, although in the case of Germany both freight and passengers are transported on high-speed rail. For example, there was a 20% increase in demand for office and retail space around the Kassel–Wilhelmshohe station, which opened in 1992, and this has induced other new developments in the surrounding area.[68]

Costs

A2.24 The construction of the German ICE line experienced building delays and complications which caused higher-than-expected construction cost overruns, operating deficits and increasing debt burdens. The operational deficits are considered to be a result of the small average size of German cities and the dispersion of the population around the country. [69]

West Coast Main Line

A2.25 The upgrade to the WCML was completed on December 7th 2008.[70] There are two main documents which reviewed the business case for the project: the business case produced by

[65] Brown, R. (2007), 'Transport Economists' Group Seminar', March 2nd.

[66] Albalate, D. And Bel, G. (2010), 'High-speed rail: lessons for policy makers from experiences abroad', Working paper 2010/03.

[67] Ibid.

[68] Haynes, K.E. (1997) 'Labour markets and regional transportation improvements: the case of high-speed trains, an introduction and review', *The Annals of Regional Science,* **31**, 57–76.

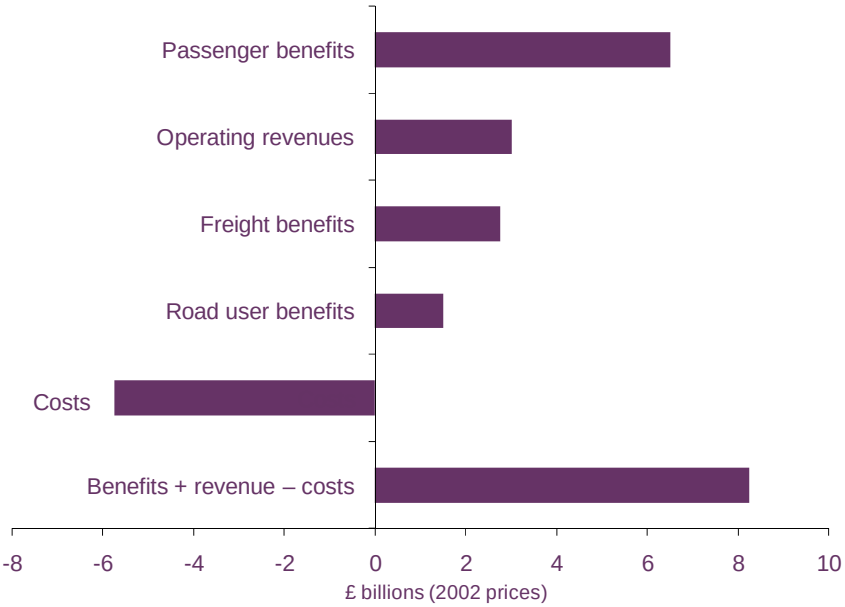
[69] Albalate, D. And Bel, G. (2010), 'High-speed rail: lessons for policy makers from experiences abroad', Working paper 2010/03.

[70] Network Rail (2008), 'West Coast Main Line: Built in the 19th Century. Rebuilt for the 21st', press release, December 7th.

the Strategic Rail Authority (SRA);[71] and the review of the upgrade by the National Audit Office (NAO).[72]

A2.26 The SRA business case estimated user benefits but not the WEIs of the upgrade. However, without quantifying the WEIs from the scheme, the BCR is estimated to be 2.4:1, thus providing 'high value for money'. The business case suggests that service improvements would lead to a 15–25% increase in the number of passenger journeys, of which 60% would be from modal shift from road to rail. In addition, it is expected that the scheme will remove 5,000 lorries per day from the road. Figure A2.1 shows the distribution of user benefits from the scheme.

Figure A2.1 Distribution of user benefits



Source: Strategic Rail Authority (2003), 'West Coast Main Line Strategy', June, p. 45.

The figure shows that over half of the estimated benefits accrue to passengers, both existing and new.

A2.27 The NAO review of the upgrade comments:

> The business case for the continuation of the programme hinged around the non-financial benefits, chiefly savings in passenger journey times and benefits to road-users from freight being carried by rail rather than road and from reduced road congestion[73]

Jubilee Line Extension

A2.28 The Jubilee Line Extension (JLE) was one of London's biggest and most expensive engineering projects. Running from Green Park to Westminster, Waterloo and Stratford, the project also included the building of six completely new stations as well as rebuilding or enlarging five other stations. There were also five major developments associated with the JLE, including the Greenwich Millennium Dome. The JLE was completed in December 1999 and has been operating since.

[71] Strategic Rail Authority (2003), 'West Coast Main Line Strategy', June.
[72] National Audit Office (2006), 'The Modernisation of the West Coast Main Line', November 22nd.
[73] National Audit Office (2006), 'The Modernisation of the West Coast Main Line', November 22nd, p. 22.

A2.29 There were two major ex ante studies of the JLE, including the East London Rail Study and quantified risk assessment modelling, as well as a number of studies completed during construction and two ex post assessments.

A2.30 The ex post assessments indicate that there were significant cost overruns from the JLE. In the year that it was decided to go ahead with the project (1993), the costs were predicted to be £2.1 billion (although there were already a number of upward revisions before this time). However, due to a number of factors, including the collapse of tunnels using the same tunnelling method as the JLE, and the greater complexity of construction in some areas than previously envisaged, the actual costs of the project were £3.45 billion. The JLE was also delivered 21 months later than initially planned, for the reasons mentioned above and due to problematic electrical and mechanical work.

A2.31 However, even with these large cost overruns and delays, the JLE is considered to have delivered good VfM. The JLE was initially approved with a BCR of 0.95 and an expectation that there would be some additional unquantified benefits from the regeneration of the South Bank and the creation of new jobs in Canary Wharf. An ex post evaluation of the scheme estimated that the JLE delivers a BCR of 1.75, even accounting for the cost overruns. This may be a result of the large developments that were created around stations. For example, there was extensive housing and commercial development around Canada Water station which may not have occurred on the same scale without the JLE.[74]

A2.32 An ex post environmental impact assessment concluded that the JLE has had no adverse impact on ambient noise levels at the nearest noise-sensitive properties along both the underground and above-ground sections. Additionally, apart from the initial impacts of above-ground works associated with construction, the operation of the extended line has not had any noticeable impact on urban ecology.[75]

A2.33 Overall, there are a number of lessons that can be drawn from ex post assessments of other high-speed rail and rail schemes. Planning and taking into account the environmental, economic, and social factors seems to be integral to the success of the scheme. As well, a consideration of the main uncertainties or risks surrounding the costs and revenues can lead to more robust estimates. At the same time, in almost all schemes considered, unforeseen circumstances have arisen and contributed to higher costs or lower revenues than expected, although some schemes have still delivered good VfM.

[74] Omega Centre at UCL 'Jubilee Line Extension (JLE)', Project Profile.

[75] Scott Wilson for Transport for London (2002), 'JLE – Post Project Appraisal Environmental Indicator Report', December.

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