High Speed 2

Review of the business case for HS2

Review prepared by HS2 Action Alliance

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HS2 ACTION ALLIANCE

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Executive summary

The assessment of the proposed new high speed railway between London and the West Midlands, High Speed 2 (HS2), made by HS2 Ltd and Department for Transport (DfT) is seriously defective. It greatly overestimates the expected benefits from HS2.

Poor appraisal technique, failure to consider realistic alternatives or plausible but less favourable demand scenarios, together with using out-of-date bases for estimating benefits and demand, combine to produce a case for HS2 that substantially overestimates its benefits. Even using HS2 Ltd's high-growth demand projections, these issues call into question some 60% of the £32bn benefits – reducing the net benefit ratio (NBR) from well over 2 to about 1.

In forcasting demand, HS2 Ltd and DFT ignore evidence that the market for domestic travel has matured. Not only do they continue to assume a gearing of long distance domestic travel on economic growth, but they use out of date growth factors. The effect of adjusting for either of these reveals a substantial over-estimate in demand – to both the background growth on WCML (133% by 2033), and demand induced by the shorter HS2 journey times (133% uplift).

Significantly lower demand has a devastating effect on the economics of HS2. HS2 Ltd report that just over a 20% shortfall in their forecast reduces the NBR from 2.4 to below 1.5.

The time saving benefits use out of date values and assumptions. Importantly they do not reflect the growing impact of telecommunications and computing technology on how time is used on trains, causing the benefits of HS2 to be substantially overstated. The use of an unrealistic alternative to HS2 leads to further overestimation eg for crowding benefits.

The appraisal fails to take proper account of uncertainty, develop credible alternatives to HS2, or recognise the substantial benefit that upgrading the existing infrastructure has over creating a new railway (which is that it can be implemented incrementally). The result is to give a falsely favourable view of HS2 based on a single high transport growth scenario.

An adequate case for the £11.9bn subsidy for HS2 has yet to be made.

Demand forecasts

There is strong evidence that the market for domestic travel has reached maturation, with growth in overall domestic travel only at the level of population increases for the last 15 years. Substantial increases in real incomes over this period have not been matched by increases in domestic travel. Market maturation also applies to long distance domestic travel.

Total and long distance rail travel have over the same period also grown strongly, gaining modal share. But there is little evidence for a long-term relationship with economic growth. Rail's growth may be explained by improvements in services and the adoption of effective yield management-based pricing structures that market surplus off-peak capacity effectively.

It is plausible that overall long distance domestic travel will grow only in line with population, and that rail's share of this will soon reach a limit. Population growth to 2033 is expected to be about 17%, in contrast to HS2 Ltd's 133% projection of background growth for WCML.

The main determinant of the high demand projections is the assumed gearing of long distance rail growth on economic growth. In applying this approach HS2 Ltd use out-of-date growth factors causing demand to be greatly overestimated – particularly longer rail journeys.

The further 133% uplift in demand forecast by HS2 Ltd due to reduced journey times, relies on an outdated view of the value of time savings. There is strong evidence time savings will have much less value and attract fewer extra passengers. The uplift is calculated as a multiplier on background demand, so any reductions in that growth feed through to the uplift. Recent experience of service improvements and journey time reductions on WCML also suggest that the forecast 133% uplift for HS2 is too high.

There are issues with the internal consistency of HS2 Ltd's demand forecasts. HS2 Ltd forecasts the underlying demand growth on WCML as 133% yet forecasts a 62% increase in long distance rail travel overall. While the 62% is in line with other reputable forecasts, it is hard to square with HS2 Ltd's projected 120% growth for the long distance journeys of all intercity, London & South East and West Midlands operators. There are also others issues.

Benefits estimation

The scale of benefits is dependant on the level of demand. Lower demand projections, either from reflecting present or imminent demand saturation, or from using more recent estimates of key parameters, reduces the benefits. But even aside of concerns about demand there is evidence the benefits are overstated – by some £19bn, almost 60% of the £32bn projected.

The largest benefit (nearly £9bn) is savings in the on-board journey time for businessmen. DfT account all time saved as an increase in productive time, despite clear evidence people work on trains. With recent improvements in mobile technology (phones, broadband and computing), the barriers to fully productive work in the middle of long distance journeys are fast disappearing. It is unsafe to assume any improvement in productivity in 2025.

Other business time and reliability savings are overestimated in general, due to using out-of-date data on business rail traveller earnings – from when they were part of the top earnings elite (£70k/a in 2009 money). There is no adjustment for the nearly five-fold increase in business travellers projected for 2033, who must have lower relative earnings.

The same and related technologies are also improving the utility of on-board leisure time. HS2 Ltd should also have reduced the value attributed to these time savings.

The second largest benefit (nearly £5bn) is reduced overcrowding. But this is entirely an artefact of using the 'do minimum' comparator for HS2. Demand is deliberately projected without considering supply, resulting in notional major overcrowding. Using a realistic alternative, for example that developed for DfT that uprates the WCML, crowding actually increases with HS2 and would therefore constitute a cost, not a benefit.

Appraisal

HS2 is assessed using a form of social cost benefit analysis. The key result, the NBR, is the ratio of the welfare benefits from HS2 as a proportion of the Government subsidy needed.

The benefits of HS2 are typically enjoyed by those of higher incomes. No justification is given for such a regressive use of public funds, which encourages greater travel. An alternative is to create capacity on a commercial basis when there is sufficient demand to pay for it.

There are major uncertainties concerning the future level of demand for HS2, which make the use of a single assessment scenario entirely inappropriate. HS2 Ltd's case might serve as a high demand scenario, but other lower demand scenarios are required.

The treatment of alternatives to HS2 is also flawed. The 'do minimum' comparator inflates benefits, as it has insufficient capacity for the demand projected for it. HS2 Ltd and DfT fail to develop the best alternatives for use as the comparison base. DfT do develop a much cheaper and better value for money case – Rail Package 2 (RP2) that uprates the WCML, but it is not used in the assessment. This failure seriously undermines the appraisal.

RP2, and similar schemes, are dismissed by DfT as not providing surplus capacity. This is despite accommodating forecast demand with less crowding than HS2. DfT require surplus capacity to be created, without demonstrating there is need for it, or that its value exceeds its cost. DfT do not explore the opportunities for extra local and freight services with RP2.

The creation of different demand scenarios will reduce the case for HS2, as it is not robust to lower levels of demand. The case for the alternative of uprating the existing railway would not be similarly affected. Unlike a new railway, uprating can be done incrementally as a response to emerging demand, avoiding the uncertainties in long term forecasting.

Introduction

HS2 is a major rail infrastructure project. It is part of a strategy to build a new high speed network connecting London with the Midlands and the North. But even this first phase represents a substantial draw on public funds, requiring an investment of over £17bn.

HS2, on DfT's own figures for the first phase, represents an £11.9bn public subsidy and would positively encourage travel. It is also a regressive subsidy. Is this the right priority for public money?

This report is prepared by HS2 Action Alliance in response to the business case developed by HS2 Ltd and DfT in support of HS2. It addresses the materials published in March 2010 by HS2 Ltd and DfT, together with data released under Freedom of Information Act (FOI) requests, and clarifications provided in meetings and correspondence.

The report focuses on:

- Demand forecasts
- Benefits estimation
- The method of appraisal

It does not cover costs, or the recent claims made about transformational benefits and reducing the economic disparity between the North and South of the country. A report on the latter two issues will be published shortly.

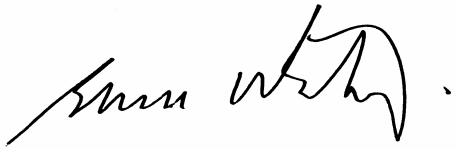
We are providing copies of the report to both DfT and HS2 Ltd, and inviting them to respond to the various issues we have raised. The published materials are extensive and we have not been able to get answers to many questions. We welcome any points of factual correction or explanation concerning the case for HS2 that they may wish to make, and will produce a revised version to reflect any changes should they prove appropriate.

This review is intended to brief those interested in the case for HS2.

The first phase (from London to the West Midlands) will not be operational for another 15 years, some five to eight years after Government claim WCML will be at full capacity. This review demonstrates that:

- The demand projections for HS2 are substantially overestimated, and represent a high-growth demand scenario rather than a central one
- Benefits are also overstated – we estimate by almost 60% (from £32bn to £13bn) – which reduces the net benefit ratio to about 1 from well over 2.
- The assessment basis is flawed. DfT neither takes proper account of uncertainty, nor uses credible alternatives in the assessment of HS2, nor values the earlier and incremental implementation possible with improving the existing rail infrastructure.

Such an expensive project should not proceed without a sound business case.



Bruce Weston,
Director, HS2 Action Alliance
8 December 2010

Overview of conclusions

The key conclusions of this review are summarised below. The detail is in the relevant sub sections of the report that follows.

1. Demand forecasts

1.1 HS2's forecasts ignore evidence that domestic travel has been reaching maturation

HS2 Ltd's forecasts assume a continuing relationship between economic growth and domestic transport demand, including for long distance rail. HS2 Ltd's modelling assumes that long distance rail demand will grow faster than GDP.

There is evidence that the relationship between economic growth (or income) and domestic travel has been breaking down and that they are now decoupled, with economic growth no longer reflected in additional domestic travel. If this were reflected in HS2 Ltd's forecasts, they would project transport growth (including rail) related to population rather than GDP.

1.2 HS2's demand projections are based on out of date demand/income elasticities.

HS2 Ltd does not use the most up to date estimates of rail demand income elasticities, and the reasons for not doing so are inadequate. Were the latest estimates to be used this would substantially reduce forecast rail demand.

1.3 The demand estimates made for HS2 are high compared to other reputable forecasts and appear inconsistent with HS2's own aggregate forecast

HS2's forecasts do not appear to be internally consistent. While it forecasts only a 62% increase in long distance rail demand (similar to other reputable forecasts), the detailed forecasts for specific flows appear in aggregate to give a substantially greater increase – about twice the 62%.

1.4 Uplift in demand from HS2 journey time improvements is excessive on the basis of history.

HS2 Ltd forecasts an additional 60,000 passengers a day on top of the 85,000 that are estimated to transfer from WCML to HS2. This is made up of entirely new journeys (38,000) and transfers from air (11,000) and car (11,000). This is too large an increase when compared with the greater service improvements recently achieved for the WCML.

1.5 Overestimated scope for gaining passengers from domestic air

HS2 Ltd forecast a substantial transfer of passengers from domestic air to HS2. This relies on a major expansion of the air services that would compete with HS2. These air flows are actually declining and are unlikely to enjoy substantial growth without additional London runways.

1.6 Overestimated scope for gaining passengers from cars due to occupancy assumptions used

HS2 Ltd forecast a substantial transfer of passengers from cars to HS2. This assumes an inappropriately low car occupancy for long distance journeys, and a decline in this occupancy that ignores the influence of inter-modal shift on the level of occupancy for residual long distance car journeys. As a result HS2's gains from cars are overestimated.

1.7 Growth and insufficient capacity being available in the 'do minimum' case

HS2 Ltd's base case ('do minimum') has insufficient capacity for the 133% increase in demand projected (without HS2), as the capacity limitations of this case are deliberately not taken into account. The projected levels of crowding for the 'do minimum' case are

consequently unrealistic for a long distance railway. To realistically accommodate the demand additional capacity would be needed.

1.8 Technical developments ignored

For a railway that does not commence commercial operation until 2026, with an assessment period stretching to 2085, taking no account of the technical developments that already offer alternatives to travel is imprudent. The Government itself is seeking to promote alternatives to travel, especially for business.

1.9 Different demand scenarios not created

Neither HS2 Ltd nor DfT has developed different demand scenarios against which to test the robustness of the case for HS2. This is essential for a major project of this sort that will not start for 15 years at the earliest and is assessed over a further 60 years.

1.10 HS2 Ltd's modelling has problems and is internally inconsistent

HS2 Ltd's demand forecasts appear to have internal inconsistencies and may also be inconsistent with the predictions from the National Transport Model. These inconsistencies may explain how HS2 Ltd overall forecast for long distance rail travel (62%) is in line with other authoritative forecasts, but the growth predicted by HS2 Ltd for WCML is more than twice this figure.

2 Benefits estimation

2.1 Reduction to business journey time on trains wrongly assumes all time saved is unproductive

DfT values business time savings as the cost of the time to the employer of the time saved. This presumes that all the time saved would otherwise be wasted time and now would be put to productive use. With the existing state of technology this is no longer supportable for time on board long distance trains, especially for a railway starting in 16 years time. Correcting this reduces estimated benefits from £8.9bn to £0.

2.2 Reductions to leisure traveller (and commuter) journey times on board trains

DfT use a different basis for valuing time savings for leisure travellers. However similar considerations as for business travellers imply that the benefits will be overstated. We assume this will reduce the £2.5bn benefit to half (£1.2bn)

2.3 HS2 will not reduce crowding against a realistic alternative to HS2.

The crowding benefit for HS2 is entirely an artefact of using the unrealistic 'do minimum' case as a comparator. Using Rail Package 2 (RP2) that uprates WCML as a comparator converts this benefit to a cost, as HS2 will involve more crowding than RP2. This at minimum eliminates the entire £4.8bn crowding benefit.

2.4 Service frequency improvements (that reduce waiting time) are overestimated as they are based on an unrealistic alternative

The improved service frequency for HS2 is an artefact of using the unrealistic 'do minimum' case as a comparator. Using Rail Package 2 (RP2) that uprates WCML as a comparator reduces this benefit, as RP2 has a higher service frequency than the 'do minimum' case. We estimate that this may halve the benefit from £2.6bn to £1.3bn.

2.5 The value of business time is overestimated because out of date values are used

HS2 Ltd use 10-year old data on business rail travellers' earnings, when business rail users were typically from a very highly paid minority. No account is taken of the greater numbers of business rail travellers that has already occurred and is forecast to increase by nearly a further five-fold by 2033. This implies a materially lower average should be used (a third less).

2.6 Wider Economic Impacts are overestimated as one element is geared to business time savings.

WEI is overestimated in line with the overestimate in the value of business time savings, reducing the £1.6bn from imperfect competition to £0.4bn.

2.7 Incremental fares may be overstated as competition between high speed and conventional services is discounted

HS2 Ltd assumes that there will be no competition between HS2 and the 'classic' railway. Competition may be expected to reduce passengers on HS2 and total revenues (and hence incremental fares), but increase costs. Failure to correctly anticipate competition has resulted in economic underperformance for other major transport projects.

2.8 Benefits conclusion

Taking into account the quantified overestimations in benefits described above (with no change in forecast demand) reduces total benefits from £32.3bn to £13.1bn ie by nearly 60%. This would reduce the NBR to just below 1 excluding WEI, and just above 1 including WEI.

3 Appraisal

3.1 Not a commercial business case

The business case that HS2 Ltd constructs is a social cost benefit analysis, not a commercial business case. From a national perspective there is no commercial case as it requires a substantial subsidy, with costs exceeding the incremental fares.

3.2 No case is made for a regressive subsidy

The £11.9bn subsidy required to build HS2 brings benefits to businesses and rail users and therefore is regressive. There is no justification given for this, or why the subsidy should be used to encourage additional travel.

3.3 DfT does not handle uncertainty correctly, assessing HS2 only on an optimistic forecast.

The assessment of HS2 is done without the benefit of systematic and integrated consideration of uncertainty, which should have involved lower demand growth scenarios. This is despite failures with HS1, commitments given to a Select Committee and DfT's own guidance.

3.4 HS2 Ltd and DfT fail to handle alternatives correctly

The case for HS2 is entirely undermined by a failure to develop appropriate and realistic alternatives against which to compare HS2, and perform this assessment. Candidate alternatives are rejected without any robust basis.

3.5 Excluded property blight cost

DfT do not include the costs to property owners of blight, despite it being readily monetarised, and compensation being included as a cost.

Review of the business case for HS2

The review has three sections: the demand forecasts, the estimated benefits of HS2 and the methods of appraisal adopted. Key issues have been identified and each subsection begins with a summary of its conclusions (in the grey shaded box). These summaries have been drawn together in the preceding overview.

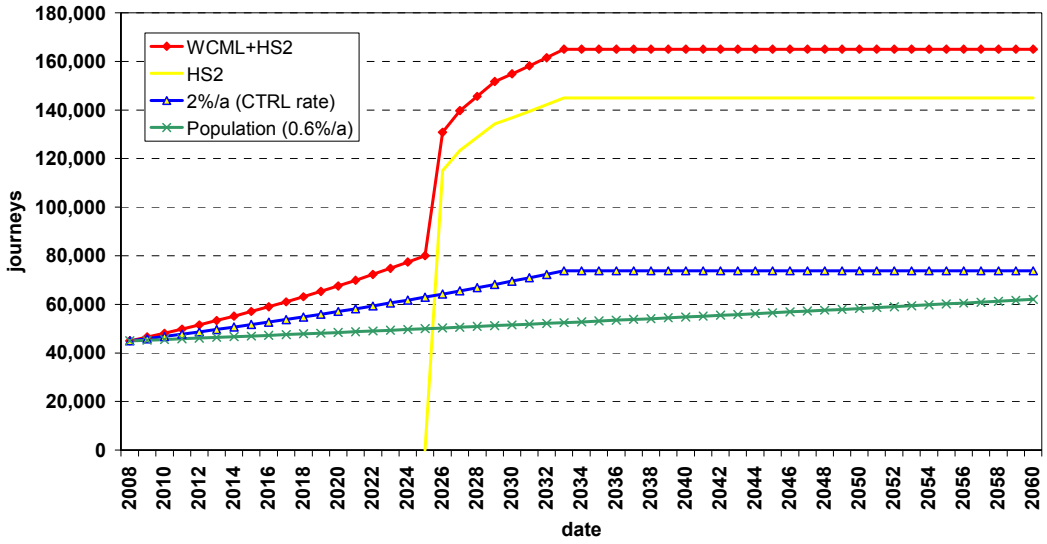
1 Demand forecasts

HS2 Ltd forecast substantial increases in the demand for travel over the next 23 years. They estimate from a 2008 base:

- A 267%[1] increase in demand for long distance travel on the West Coast Main Line (WCML) and HS2 route, by 2033. This is made up of
    - a 'background trend' increase of 133% by 2033 – or 3.4%[2] per annum, plus
    - an uplift of an extra 84% of entirely new trips plus extra modal shift of 25% from air and 25% from cars, generated by HS2
- An increase of 44%[3] in long distance car trips by 2033
- A 178%[4] increase in domestic air passengers by 2033

The graph below puts the HS2 Ltd forecast for WCML/HS2 demand in the context of the Channel Tunnel rail link (CTRL) and population growth forecasts (the latter increasing by 16% to 2033).

HS2 Route Demand



based on Bluespace Thinking

[1] The 267% increase in passengers by 2033 from Command Paper page 91 and 92. See Table 1.
[2] HS2 Ltd cite 3.3%, but this does not quite match the demand figures given in the Command Paper page 91.
[3] HS2 Baseline Forecasting Report section 1.28 page 7
[4] HS2 Baseline Forecasting Report section 1.31 page 7

Demand on HS2 Ltd's forecasts reaches a plateau in 2033, from when no further increases are projected – this represents a recognition that demand is unlikely to increase indefinitely due to market maturation or uncertainty in the forecasting methodology[5].

The following table summarises the forecast made by HS2 of the demand for long distance on the WCML/HS2 route.

Passenger demand in 2033: WCML plus HS2 (source HS2 Ltd)

		passenger journey/day (k)	percentage increase
2008 base		**45**	
'Background trend' increase		60	133%
HS2 uplift :	new journeys	38	84%
	modal transfer from air	11	25%
	modal transfer from car	11	25%
2033 total		**165**	**267%**
of which:	transfer to HS2	85	
	HS2 uplift	60	71% of transfer
	total on HS2	**145**	
	remain on WCML	20	
Passenger journeys from Command Paper pages 91/92			

The sub sections below raise a number of concerns with the demand forecasts.

1.1 HS2's forecasts ignore evidence that domestic travel has been reaching maturation

HS2 Ltd's forecasts assume a continuing relationship between economic growth and domestic transport demand, including for long distance rail. HS2 Ltd's modelling assumes that long distance rail demand will grow faster than GDP.

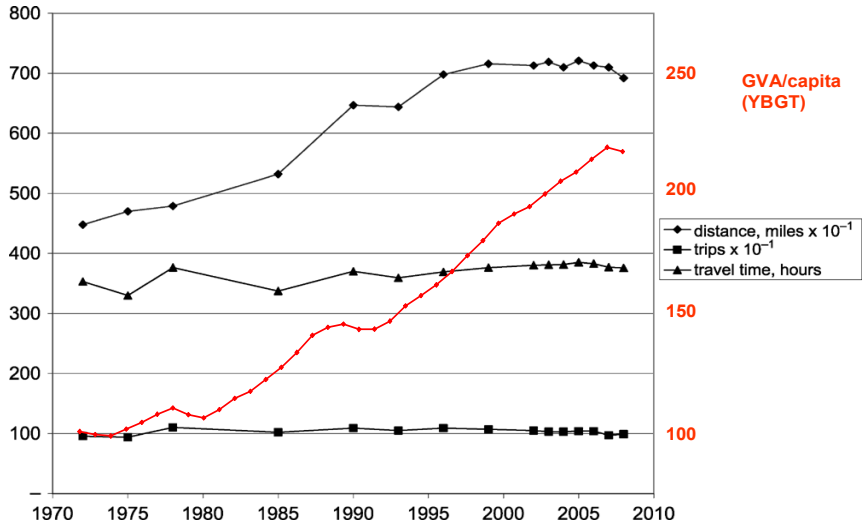
There is evidence that the relationship between economic growth (or income) and domestic travel has been breaking down and that they are now decoupled, with economic growth no longer reflected in additional domestic travel. If this were reflected in HS2 Ltd's forecasts, they would project transport growth (including rail) related to population rather than GDP.

A review of the evidence is set out below.

Using National Travel Survey data, there is no longer a relationship between economic growth and total domestic travel (from all modes) with per capita total domestic travel static for 15 years (see graph below). Long distance domestic travel has similarly matured. This is dominated by the reduction in the growth of car travel, but also coach travel and, in recent years, domestic air travel. This no doubt relates to the growth of international travel, road congestion, the influence of improved telecommunications, as well as some element of simple market saturation.

[5] HS2 Demand Model Analysis section 3.2.6 page 31

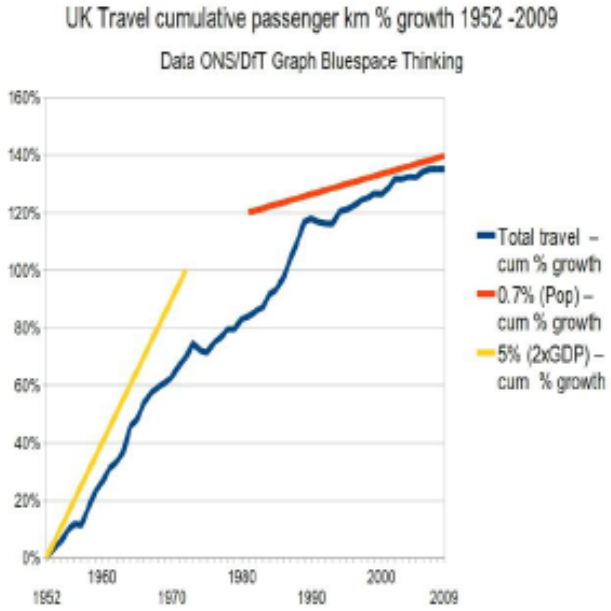
Travelling time, journey numbers and distances per person (compared with real GVA/capita)



Source: Dr Metz based on NTS 2008 Table 2.1 with GVA/capita trend added

The graph also shows that income (GVA) per capita has continued to grow, and the apparent relationship with distance travelled has not existed for the last 15 years.

Bluespace Thinking have analysed this relationship for a longer period. The figure below is reproduced from evidence[6] accepted by the Select Committee on Transport for the Inquiry into Transport and the Economy.



This shows the growth in total domestic passenger travel since 1952. It started by increasing at about twice the rate of GDP, but has progressively declined to be about the rate of population growth in recent years. For long distance travel, the 2009 DfT National Travel Survey shows that trips/person over 50 miles (strategic routes) have not increased since 1995, average long distance trips over 100 miles have remained at 7 to 8 /person/year (dropping to 6 in 2008).

[6] evidence the Select Committee for Transport, October 2010, TE07

For some decades passenger transport has been dominated by car usage, and changes in car usage drive the aggregate numbers. However, as discussed above, domestic air transport was already in decline before the recent recession. Similarly, since 2005 travel has reduced (see the section on 'Is rail different' below).

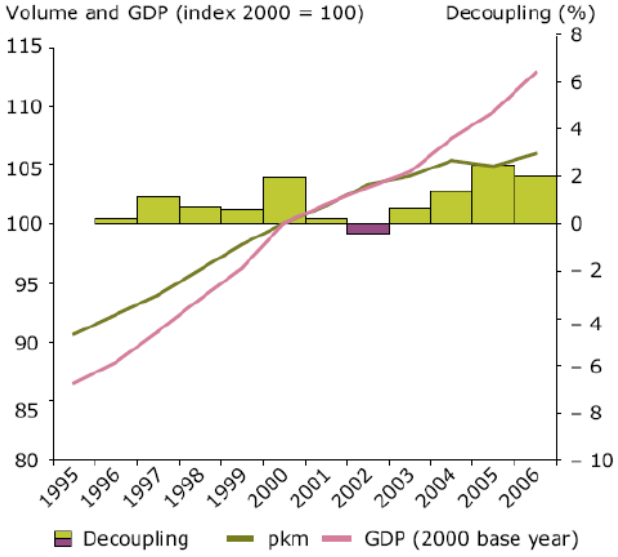
European experience

The phenomenon of domestic travel saturation is not unique to the UK. Work by the European Environment Agency[7] reported that decoupling between GDP and total domestic passenger traffic has been occurring (based on Eurostat (2008) data). This is shown in the next graph

Commenting on this phenomenon, Crozet in an OECD discussion paper observed:

'……In Germany, the UK, Italy and France, domestic passenger traffic has been more or less flat since the early 2000s.'[8]

GDP and passenger distance travelled



Squaring the evidence

Why do many transport demand modelling professionals say that there is still a strong relationship between domestic transport and income? The answer is that there is.

The work by Metz, Griffiths and EEA focus on the longitudinal trend, and observe that aggregate increases in income are decreasingly reflected in increases in domestic travel.

However cross-sectional analysis shows that there are persistent differences in the amount of domestic travel by income, ie variations in the amount of travel across the population are highly associated with the level of income. Indeed analysis conducted on National Travel Survey data by the Independent Travel Commission[9] showed that the relationship between long distance travel and income exists and was as strong for the last part of the period from 1995 to 2006 as it was at the beginning.

[7] 'Transport at the Crossroads' EEA Report 3/2009
[8] 'The Prospects for Inter-Urban Travel Demand', Y. Crozet — *Discussion Paper 2009-14* — OECD/ITF, 2009, section 2.2
[9] Long Distance Travel in Britain: Prospects in a Time of Uncertainty', Independent Travel Commission, March 2010, page 23

The table below shows the relationship between income and long distance travel, produced by Prof Cochrane[10].

Table 5 – Comparison of long distance trip generation by income band
(Sources: NTS data tabulated by Scott Wilson and Rand Europe for DfT LDM Studies, Cochrane)

Income Quintile	1	2	3	4	5
Domestic Long Distance trips per person per calendar month	0.8	1.0	1.5	2.0	3.3

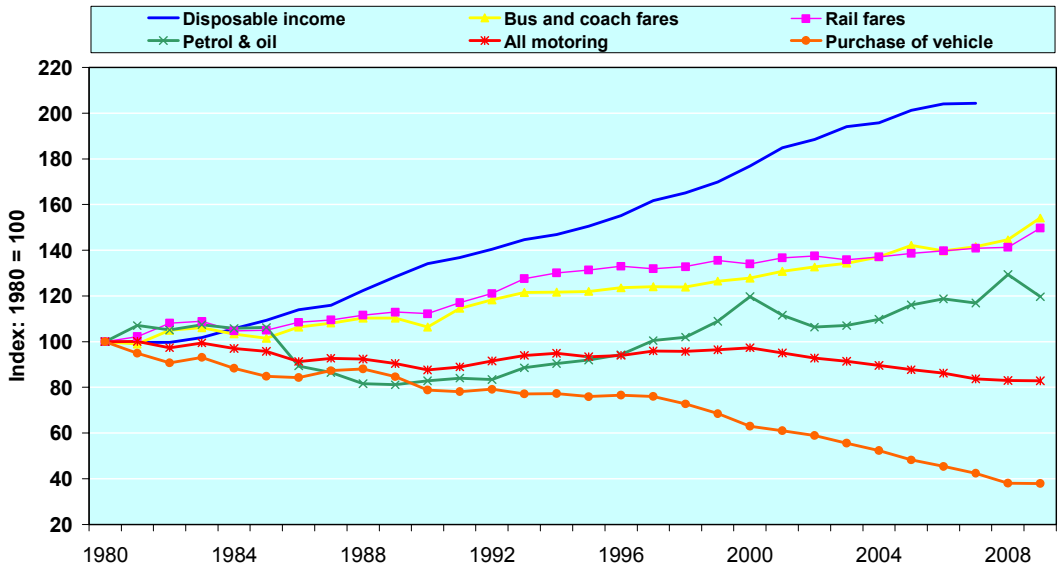
However, the stability of cross-sectional features, despite a weakening aggregate association through time, simply suggests that as people in lower income groups become more affluent they do not take on the travel habits of those of previously of higher earnings. In other words the cross-sectional elasticities are larger and different from the longitudinal ones. A way of picturing this is that different social and income groups have typical travel patterns that saturate at different levels. This is plausible if we conjecture that the proportion and types of jobs by income group are relatively stable, and that personal mobility is often a requirement of having the relatively higher paid occupations.

However, it is the elasticity found in the aggregate longitudinal data that is relevant to forecasting, not either the cross-sectional one, nor one obtained from a pooling of the two sorts of data. We believe that the PDFH elasticities are derived from pooled data (but do not have proof).

The DfT position

DfT have explained[11] that the inconsistency between HS2 Ltd's forecast of continued travel growth per person and the recent lack of growth is due to increasing car costs. The graph below (from Transport Trends 2009) examines this in more detail.

Changes in the real cost of transport and income



[10] Reproduced from 'Combining Rimes Series Rail Demand and Cross Sectional Mode Choice Models for British High Speed Rail' R Cochrane, 2010
[11] HS2 AA and Bluespace Thinking meeting with HS2 Ltd and DfT 29 June 2010

The above graph shows that overall motoring costs (red line) have actually been decreasing, but fuel costs (green line) have indeed increased since about 1989, albeit by much less than disposable incomes, and with little overall trend since 2000.

However, the petrol and oil costs shown *do not* reflect improvements in vehicle efficiency that reduce the fuel costs of motoring. An index running cost is also published but it includes insurance, car tax and maintenance, which are largely a cost of ownership. Fuel costs approximate to the short run marginal cost, and hence are appropriate to explaining short run variations in travel demand (ie if you have a car, how much you use it).

DfT's contention seems less than convincing, as we would expect travel distance increases in years with reductions in petrol prices – which do not occur.

Is rail different?

It is well known that demand for rail has been increasing. Long distance rail travel has grown particularly strongly. So how has this been achieved if the overall travel market is saturated?

Since 1995, National Travel Survey figures show that rail usage has gone up (by 3.7%/a) and coach and car have declined (by an average of 2.6%/a for private and long distance coach, and by 0.3%/a for car). While there has been sustained growth in rail travel, it seems it must be growth in rail's share of a saturated market.

Travel trends 1995 to 2008 (National Travel Survey 2008, Table 3.2)

	miles per person			annual average rate of change
	1995/97	2008	change	
walk/cycle	243	235	-8	-0.3%
car/van/motorcycle	5,786	5,560	-226	-0.3%
private coach	134	110	-24	-1.6%
local bus/underground	328	387	59	1.4%
long distance coach	94	56	-38	-4.2%
surface rail	321	495	174	3.7%
air/ferry/light rail	75	80	5	0.5%
all modes	**6,981**	**6,923**	**-58**	**-0.1%**

The key question is whether we should believe that long distance rail usage will keep on growing faster than increases in GDP, as the HS2 Ltd demand models predict?

Only rail demand has continued to increase. But there is no long term relationship between rail and real per capital income:

- for decades until the early 1990s rail passenger numbers were static while GDP and GVA per capita increased considerably, and
- recently rail passengers on WCML and other intercity services continued to increase despite the recession. Intercity services annual growth is given in the table below as is real GDP.

Although both long distance rail travel and GDP increased over the period from the mid-1990's to 2008, this is an accidental relationship, as rail growth was driven by service improvements.

Intercity rail growth and real GDP

year	passenger km growth over previous year[12]	real GDP increase (ABMI series annual)[13]
2005/06	6.4%	2.2%
2006/07	9.6%	2.8%
2007/08	6.2%	2.7%
2008/09	2.6%	-0.1%
2009/10	3.7%	-5.0%

Bluespace Thinking has explored the relationship between GDP and rail travel (including with lags) and found none. The analysis is unpublished but available upon request

To project increases of rail demand to 2033 on a claimed relationship to GDP (or per capital income and population) seems unsafe. What is clear is that rail has increased its modal share because of the investments of the last 15 years and the resulting improvements in services. If service improvements reduce or stop, so might the growth in passenger numbers.

Conclusion

There are strong reasons to think that domestic travel is a mature market, with such growth as will occur in aggregate being related to population growth rather than GDP. Even should one conclude that the evidence on saturation is inconclusive, it is plausible that the relationship between economic growth and domestic travel will continue to weaken, making the use of unadjusted demand/income elasticities from past periods unsafe – except in the context of producing a 'high growth' scenario as a sensitivity, not a central case.

At its 17 August 2010 meeting, the HS2 Analytical Challenge Panel raised the importance of the issue of market saturation.

1.2 HS2's demand projections are based on out of date demand/income elasticities.

HS2 Ltd does not use the most up to date estimates of rail demand income elasticities, and the reasons for not doing so are inadequate. Were the latest estimates to be used this would substantially reduce forecast rail demand.

The HS2 forecasts are an uplift from the 'do minimum' forecast journeys for the service changes that are associate with HS2. The 'do minimum' demand growth is driven by increases in GVA partly off-set by price increases.

HS2 Ltd's demand forecasts are based on Passenger Demand Forecasting Handbook (PDFH) 4.1[14]. The table[15] below shows the difference between the income elasticities in this and those of PDFH 5.0.

[12] National Rail Trends 2009/10 Yearbook, Table 1.1b
[13] ONS, calendar year
[14] High Speed Rail London to the West Midlands and Beyond: HS2 Demand Model Analysis' February 2010, section 3.2.5 page 31
[15] Taken from Tag 3.15.4d, DfT Jan 2010, Table 2 page 10

Comparison of income elasticities for intercity train travel in PDFH 4.1 and PDFH 5.0

	PDFH 4.1	PDFH 5.0
To London	2.00 + 0.0032 per mile	1.9
From London	0.84 + 0.0032 per mile	0.9

DfT recognise that the elasticities for long journeys are excessive. The draft guidance says:

'We agree that the PDFH 4.1 recommendations produced unfeasibly large elasticities over long distances. However, in light of the ongoing research described above we are reluctant to suggest changes to our demand forecasting methodology that may be superseded within a matter of months. '

The reason offered for not adopting the PDFH 5.0 values is hardly one that should apply to decisions about multi-billion pound investments. It is plainly appropriate to use the best available information – until better is made available.

The draft guidance recommends the use of a cap on PDFH 4.1 values of 2.5 for trips to London and 1.5 from London. In fact the HS2 demand assessment uses a cap of 2.8[16], and there is no mention of using a cap for trips starting from London. This guidance does not recommend adopting PDFH 5.0 values, but they may be used as a sensitivity, however HS2 Ltd not yet done such a sensitivity, although the Analytical Challenge Panel recommended this at the August 2010 meeting.

The approach taken leads to massive over-estimation of demand compared to that obtained from using the PDFH 5 elasticities. Taking London Glasgow, 2.5% annual growth in GVA would generate an increase of 7.0% to London and 4.8% from London, as opposed to 4.8% and 2.3% with PDFH 5 elasticities. Putting aside other factors, over a 15 year period the approach taken would double growth compared to version 5.0.

The result of these distance related elasticities is to forecast very large increases in long journeys.

The draft guidance was expected to be adopted in April 2010, but this has not yet happened, and still awaits the Secretary of State's approval.

The guidance still in force recommends the use of PDFH 4.1, but with a different sensitivity test using the values in the table below[17]. We understand that the 'from London' value of 1.7 is a typographical error and should read 0.7 (as in its quoted source).

	from London	to London	non London
London TCA	1.3	1.3	1.3
South East	1.2	1.2	1.2
Rest of country <20 miles	n/a	n/a	1.2
Rest of country 20-80 miles	n/a	n/a	1.2
Intercity 80-130 miles	0.7	2.0	1.2
Intercity >130 miles	1.7	1.4	1.2

Table 2: Recommended elasticities to GDP per capita (non-seasons)
Source: MVA, *Rail Passenger Demand Forecasting Research*

The PDFH elasticities are larger for trips to London than trips from London, both in Version 4.1 and 5.0 of PDFH. This would imply if GVA growth is at a uniform rate between regions,

[16] High Speed Rail London to the West Midlands and Beyond: HS2 Demand Model Analysis' February 2010, section 3.2.6 page 31
[17] Tag Unit 3.15.4, DfT page 10

trips to London would grow much more quickly (about twice the annual rate) than trips from London. However, HS2 Ltd report a different result[18], as shown in the following table that gives the distribution of trips by origin. Although it is for HS2, the effect of the journey time improvements might be expected to affect trip to or from London equally (although they may not as the journey starts and destinations may not mirror each other).

Regional User Benefits	Business	Other
London	36%	36%
South East	6%	5%
West Midlands	18%	18%
North West	22%	22%
Scotland	8%	7%
Other	11%	11%

Figure 4.2a Proportion of HS2 benefits by origin of trip

This shows a preponderance of trips with London as a final or intermediate destination (at least 48% for business and 47% for others, as against at least 42% and 42% from the southern end. The 11% 'other' are hard to categorise in this manner. But the imbalance is not as the income elasticities suggest. This might relate to either:

- The time savings representing a larger proportion of trips originating in London than those starting further up the route (hence getting a larger proportional uplift)
- Lower GVA growth for the northern origins off setting the higher GVA/capita elasticities.

The first cause would explain that HS2 demand patterns differ from the 'do minimum' case. The second would explain the 'do minimum' journeys being more balanced than the elasticities alone suggest.

To equalise the trips originating in the south to those from the north through differences in GVA, with PDFH 4.1 elasticities, Birmingham's annual percentage GVA/capital growth needs to 50% that of London, Manchester's 54% and Glasgow's 63%!

With PDFH 5.0 values, other places would have only 47% of London's annual percentage GVA/capita growth to counter-balance the difference in elasticities.

Experian[19] forecast (for 2006 to 2031) regional annual GVA growth rates (including the effect of population growth) for the North West and West Midlands of 2.1% and 2.2%, against 2.7% for Greater London, ie 78% and 81% of the London rate respectively.

It seems unlikely that the 'do minimum' case will have balanced flows.

Professor Dargay[20] has published the results of her recent analysis for the Independent Travel Commission. This distinguishes between long distance journeys under and over 150 miles which are specific to journey type, but without a 'to or from London' distinction. The table containing the elasticities derived from the National Travel Survey data and used in her model are reproduced below.

[18] High Speed Rail for Britain: A Report by High Speed 2 (Main Report) page 174
[19] 'Regional Household forecasts and Scenarios', Experian Ltd, March 2008
[20] 'The prospects for longer distance domestic coach, rail and car travel in Britain,' Prof J Dargay, January 2010, page 35

Table 17: Long-run income elasticities for long distance travel used in the forecasting model

Purpose	Distance (miles)	Car	Rail	Coach	Air
Business	<150	0.51	2.09	0.00	*
	150+	0.81	2.27	0.00	2.30
Commuting	<150	0.47	2.01	0.00	*
	150+	0.75	2.36	0.00	*
Holiday	<150	0.57	0.96	0.00	*
	150+	0.92	0.84	0.00	1.97
Leisure	<150	0.47	0.75	0.00	*
	150+	0.71	0.65	0.42	1.89
VFR	<150	0.80	0.38	0.00	*
	150+	1.05	0.63	0.47	2.45
All	All	0.69	1.25	0.15	2.16

* air is not considered for travel under 150 miles

The over-150 mile elasticities are larger or smaller than the shorter ones depending on purpose. The overall elasticity (1.25) is lower than that implied by PDFH 5.0.

So the result of not using the latest demand elasticities is to inflate demand increases. The effect of different values for journeys originating in London from those with London as destination will be to create unbalanced flows for the 'do minimum' case.

1.3 The demand estimates made for HS2 are high compared to other reputable forecasts and appear inconsistent with HS2's own aggregate forecast

HS2's forecasts do not appear to be internally consistent. While it forecasts only a 62% increase in long distance rail demand (similar to other reputable forecasts), the detailed forecasts for specific flows appear in aggregate to give a substantially greater increase – about twice the 62%.

The table below puts the HS2 background demand forecasts (those for demand without HS2 and the demand generated by it) in the context of others.

Forecasts of long distance rail travel demand

Source	Date	Period	Increase	Annual rate
(DfT[21] - all	2007 (July)	2006-2027	65%	2.4% (1.8% from 2017))
DfT[22] - all	2007 (July)	2006-2030	73%	2.3%
Network Rail[23] - all	2010 (August)	2008-2034	70%	2.1%
Prof J Dargay[24] for ITC - all	2010 (January)	2005-2030	35%	1.2%
HS2 Ltd (Atkins) -WCML	2010 (February)	2008-2033	133%[25]	3.4%
HS2 Ltd (Atkins) – long distance TOCs +#	2010 (February)	2008-2033	120%	3.2%
HS2 Ltd (Atkins) -all	2010 (February)	2008-2033	62%	1.9%

ITC is the Independent Transport Commission

all long distance TOCs plus long distance component from London & SE TOCs and West Midlands TOCs

[21] 'Delivering a Sustainable Railway: Summary of key research and analysis' July 2007, slide 27
[22] 'Delivering a Sustainable Railway', Cm 7176, Dft, July 2007, paragraph 6.6, page 60
[23] 'Planning ahead: The long distance planning framework', August 2010, section 2.10 page 6
[24] 'The prospects for longer distance domestic coach, rail and car travel in Britain,' Prof J Dargay, January 2010, Table 37
[25] 'Command Paper 7827', March 2010, section 5.38 page 91, growth without HS2 uplift

The non HS2 Ltd forecasts are for long distance (over 50 miles) rail travel in general, not specifically on the WCML route. In fact the forecast made by HS2 Ltd for all long distance rail is amongst the lowest of long distance forecasts, with 62%[26] growth from 2008 to 2033.

However, little is offered to explain why WCML forecast growth (133%) is so much higher than the average (62%). HS2 Ltd explains that the base year (2007/08) precedes the main effect of the December 2008 timetable change, but passenger kilometres only increased by 5.7% between 2007/08 and 2008/09[27].

The West Midlands and North West are both expected to have below average increases in population from 2008 to 2033. While the predicted growth for London is above average, it is at one end for the major intercity services. It is unclear why WCML passenger numbers are expected to increase so much compared to other services.

Rail journeys over 50 miles comprise 56% of all rail passenger mileage and those over 100 miles 35%[28].

In fact HS2 Ltd forecast[29] high levels of growth in passenger kilometres for long distance journeys on long distance operators in general, as shown in the table below. Long distance operators have a collective growth of 120%, as also shown in the above table. Franchised long distance operators total mileage comprise 41% of total franchised passenger mileage[30].

Table 2.9 – Passenger Kilometres by Long Distance Train Operating Company (PLD)

TOC	2008	2021	% growth	2033	% growth
Grand Central	164,665	235,654	43%	454,904	176%
ECML	13,795,072	20,567,768	49%	33,261,706	141%
FGW	3,098,024	4,487,837	45%	7,591,533	145%
Hull Trains	437,230	952,070	118%	1,558,916	257%
Midland Mainline	3,722,147	5,042,973	35%	8,488,982	128%
VWC	12,365,448	20,310,562	64%	31,273,422	153%
Cross Country	8,623,260	9,910,504	15%	12,552,910	46%
Trans Pennine	4,188,294	5,418,262	29%	6,989,095	67%

In the following tables (2.11 and 2.12) HS2 Ltd provide information which shows that the increase in the long distance component of travel in all London South Eastern operators plus West Midlands operators is 130% to 2033. The overall average for long distance operates plus these remains at 120% (because of relative size and rounding). The total mileage of long distance operators together with the other TOCs covered in HS2 Ltd's tables comprised 80% of total rail passenger km in 2008/09.

We do not therefore see that the average of 62% is compatible with the projected TOC growth given by HS2 Ltd. We believe there are some serious issues with HS2 Ltd's modelling, as discussed at section 1.10.

1.4 Uplift in demand from HS2 journey time improvements is excessive on the basis of history.

HS2 Ltd forecasts an additional 60,000 passengers a day on top of the 85,000 that are estimated to transfer from WCML to HS2. This is made up of entirely new journeys (38,000) and transfers from air (11,000) and car (11,000). This is too large an increase when compared with the greater service improvements recently achieved for WCML.

[26] High Speed 2 Strategic Alternatives Study – Strategic Outline Business Case' Table 3.1 page 12
[27] National Rail Trends 2008/09 section '8.19 Virgin Trains'
[28] National Travel Survey 2009, Table 0309
[29] HS2 Baseline Forecasting Report section 2.73 page 23
[30] National Rail Trends 2008/09, Tables 8.1-8.19, total TOC mileage (not just historic 'intercity' services)

The increases in demand from the reduced journey times expected from HS2 generates an increase in those travelling on HS2 of 71% on those that would transfer from 'classic' rail to the HS2 services. This uplift is in addition to the background increase (see Table 1). Those that remain on the southern part of the WCML are essentially those requiring the stations between London and Birmingham International.

The PDFH methodology handles changes in journey time through an elasticity, so the absolute size of increase depends on the base demand and the percentage change in journey time.

It is relevant to look as the results of the WCML route modernisation, as it achieved major improvements to the service that resulted in large increases in demand. On the WCML there have been major improvements to the services from May 2004 to the December 2008 timetable: shorter journey times and more frequent services. Taking the standard off peak hours from London, there have been large reductions in 'generalised journey times' (GJT):

- Birmingham journey time cut from 99.5 mins to 84 mins, with a service interval decreased from half hourly to 20 minutes – a 20 minute reduction in GJT
- Manchester journey time cut from 164 mins to 128 mins and GJT reduced by 56 mins
- Glasgow journey time reduced from 334 mins to 275 mins (ie 58 mins), and services increasing from 9 trains a day to 13.

GJT is time on the train plus half the interval between services (with an allowance if a transfer is involved) – ie journey plus waiting time.

Virgin West Coast achieved massive improvements in punctuality. They had only 72.1% of trains arriving within 10 minutes of the scheduled arrival time in 2004/5 but 84.6% for 2009/10[31].

These reductions in GJT and improvements in punctuality have created considerable modal shift. There was a 74% increase in passenger journeys over 5 years[32] . To put figure in the same coin as the HS2 forecast (ie without the 'background trend' increase in demand), the uplift reduces to 48% above trend[33]. This compares with the 71% above trend forecasted by HS2 Ltd, for what must be a smaller improvement to journey times and reliability for journeys with starts or finishes north of Birmingham.

1.5 Overestimated scope for gaining passengers from domestic air

HS2 Ltd forecast a substantial transfer of passengers from domestic air to HS2. This relies on a major expansion of the air services that would compete with HS2. These air flows are actually declining and are unlikely to enjoy substantial growth without additional London runways.

The number of domestic air passengers that may switch to HS2 depends on what the demand for air will be in 2033. HS2 Ltd project 178% increase in domestic air passenger numbers to 2033[34]. However HS2 Ltd states[35] it is assumed that the third runway at Heathrow goes ahead and an additional runway is built at Stansted.

[31] National Rail Trends

[32] NRT 2004/05 (14.9m), and 29 Dec 2009 Virgin Trains (25.4m). However, this also includes an increase from Virgin Trains acquiring additional services from franchise re-mapping in 2007

[33] Assuming a background trend increase of 3.3% (as projected by HS2 to 2033). NB all journeys on long distance operators increased by 31% over the same five years, with an equivalent rate of increase of 4.6% per annum. Virgin Train's growth includes an increase form franchise re-mapping rather than real growth.

[34] HS2 Ltd Main Report. Section 2.3.37 page 48

[35] HS2 Baseline Forecasting Report Section 4.2 page 29

HS2 Ltd estimate that 8% of journeys on HS2 will come from transfers from air, which means 11,000 journeys/day transfer from flights from NW and the lowlands of Scotland. The 11,000 journeys/day is equivalent to 57% of the 19,500 journeys per day flown in 2009 between these places and all London airports (Heathrow, Luton, Stansted, Southend, London City, and Gatwick). It is 117% (ie more than total) of the 9,400 passengers per day (in 2009) between Heathrow and the NW and Lowlands of Scotland.

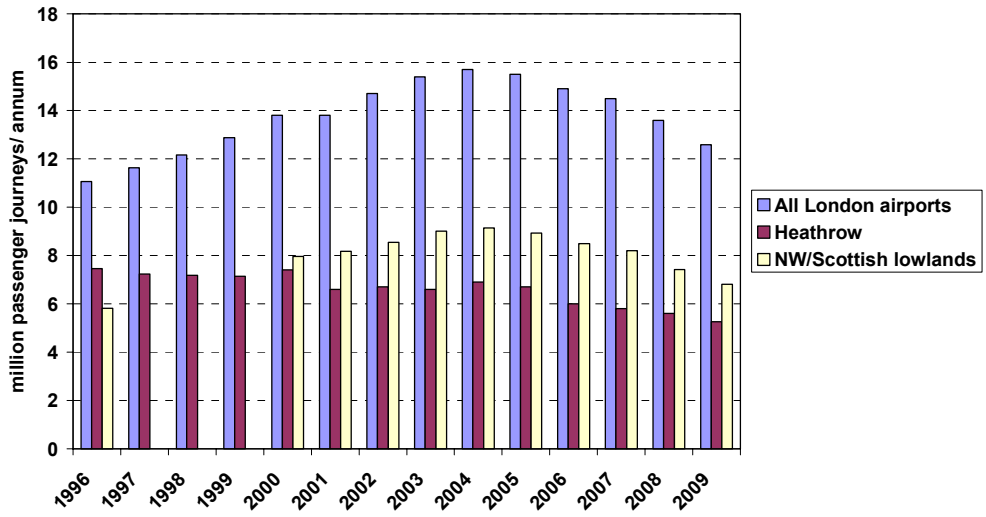
Domestic air travel is expected to get cheaper, while rail more expensive. This makes it less likely that the residual domestic air passengers will swap to rail when HS2 becomes available.

Long haul flights are more profitable for airlines and airport operators and are unlikely to be sacrificed for domestic air growth. Boeing are aiming to serve the point to point long haul market with it's next generation of aircraft (the 'Dreamliner'), rather than the hub and spoke approach that led to ever larger planes[36].

Domestic flights to/from London are no longer above the level of a decade ago (CAA figures[37]), peaking in 2004. Flights between all London Airports and the NW and Scottish Lowlands are currently 30% of the UK domestic total. This market is not growing: growth tailed off in the early 2000's and has declined from a peak in 2004. Domestic air travel generally peaked in 2005, since when passenger numbers have fallen. This is despite GDP continuing to grow until 2008. The same applies to trips between London and the North West and the Scottish Lowlands. Total domestic passenger flights peaked in 2005. (See graph).

Domestic air services may well continue to grow for other routes eg that between Aberdeen and Exeter[38]. Places that have poor surface travel routes can be expected to enjoy growth in air services and gain passengers. However, these journeys are not served by the HS2 route.

London domestic air passenger numbers



It is generally agreed that rail may replace air where journey times are less than about 3 hours, with rails percentage falling off sharply above 2.5hrs[39].

The HS2 Ltd estimate that 11,000 journeys per day transfer from flights from NW and the Lowlands of Scotland on the basis of the train journey being half an hour shorter than

[36] Marc E. Babej and Tim Pollak. Boeing Versus Airbus *Forbes*, 24 May 2006
[37] CAA UK airport statistics, Table 10 2 Domestic terminal passenger traffic, Table 12 2 Domestic air PAX route analysis
[38] CAA UK Airport Statistics. Table 12 2 Domestic air PAX route analysis
[39] Michael Mann op cit

previously (reducing to about 4 hours according to HS2 Ltd[40], or 3hr 39 mins for the fastest current service for Glasgow (ie the 4h 09m service). This is optimistic given the time threshold.

The over-estimation of gains from air will also cause the carbon benefit from HS2 replacing domestic air travel to be exaggerated.

1.6 Overestimated scope for gaining passengers from cars due to occupancy assumptions used

HS2 Ltd forecast a substantial transfer of passengers from cars to HS2. This assumes an inappropriately low car occupancy for long distance journeys, and a decline in this occupancy that ignores the influence of inter-modal shift on the level of occupancy for residual long distance car journeys. As a result HS2's gains from cars are overestimated.

Webtag starts from the average car occupancy of 1.63 in 2000, and projects this average occupancy to decline at about 0.5% per annum until 2036. This will understate future car occupancy, and hence the susceptibility of car passengers to swap to rail. The occupancy is understated for two reasons:

- Long distance car journeys have a higher than average car occupancy. Work done for DfT[41] shows that car occupancy increases with distance. HS2 will only compete with car journeys in excess of 100 miles, for which the actual occupancy is over 1.81 (which is the value for journeys of 160-240km, so the average for all long distance car journeys is higher).

- The higher the car occupancy, the less likely that journey would transfer to rail. Growth in long distance rail travel is partly at the expense of car journeys. Hence future rail growth will partly off-set any tendency to reducing car occupancy, as multi-occupant car journeys are generally less likely to shift to rail (as, amongst other reasons, the incremental cost is higher). This means that the car occupancy reduction factor (of about 0.5%/a[42]) is inappropriate.

A substantially higher car occupancy than HS2 project for long distance journeys increases the cost of transferring to rail, because it assumes that car travel costs are about 30%[43] higher per person than they would be. To illustrate if the occupancy were two instead of one, the cost per person of going by car would half, while the cost per person of going by train remains the same.

1.7 Growth and insufficient capacity being available in the 'do minimum' case

HS2 Ltd's base case ('do minimum') has insufficient capacity for the 133% increase in demand projected (without HS2), as the capacity limitations of this case are deliberately not taken into account. The projected levels of crowding for the 'do minimum' case are consequently unrealistic for a long distance railway. To realistically accommodate the demand additional capacity would be needed.

HS2 Ltd predict 133% growth by 2033, in the absence of HS2. With the 'do minimum' case, such growth would result in a load factor of 81%. One section of WCML is shown as having

[40] HS2 Ltd 'Demand Model Analysis' Section 4.2.7
[41] Nation Travel Survey data tabulated by Scott Wilson and Rand Europe
[42] DfT Tag Unit 3.5.6 (also 3.5.6d), table 4 gives average occupancy 1.63, table 6 gives reduction rates of 0.45% for work and 0.56 for other purposes. There is no analysis of occupancy by journey distance.
[43] Assume long distance car occupancy is 1.81 in 2033, as opposed to 1.38 (1.62 reduced by 0.5%/annum from 2000 to 2033)

a load factor of 91% for the 'do minimum case[44].

An 81% load factor is unrealistic, the more so for a service where the majority of trips are into London and back rather than are balanced in origins. On the basis of the income elasticities this would be a major imbalance.

HS2 Ltd explain[45] a greater than 80% load factor as 'standing on most trains throughout the day' (and 60-80% as 'standing on some trains throughout the day'). Network Rail observe that occasional passengers needing to stand for part of their journeys on intercity trains

'…will discourage discretionary rail trips and hamper future growth prospects. '[46]

Hs2 Ltd decided that the demand modelling should takes no account of the effect of crowding in suppressing demand[47] for the 'do minimum' case, making it an entirely unrealistic basis against which to compare HS2. We have found no evidence that a crowding reduction is applied to HS2's demand, which suggests that it will be overestimated for this reason.

HS2 Ltd forecast a 61% load factor for HS2. However, this ignores the load factors on other sections of the route besides the high speed line. While the 61% is higher than the current load factor (49%), which itself (with anticipated growth) has triggered the purchase of more rolling stock, HS2 involves heavier crowding on more northerly parts of WCML.

The heavier crowding reflects enhancements to capacity being much smaller for the classic compatible services running north of Birmingham (with 550 seats/train against 594 on 11-car Pendolino and only modestly increased service frequency), than those from Birmingham (which can run 1,100 seat trains). This means that the load factor on the route section into Manchester, for example, is forecast to be 77%.

Teresa Villiers and Philip Hammond predict that WCML will have run out of capacity 'in seven to ten years' – well before HS2 could be available.

Were demand to grow as strongly as HS2 Ltd predict, would it be necessary to create more capacity than that is included in the 'do minimum' case? HS2 could not start alleviating capacity constraints until 2025 at the earliest. If we assume that demand grows at 3.4% per annum[48] the load factor would have reached 62%, as growth is probably back-end loaded, it may be under 60%. This would still be substantially above the current (2008) 49%, but little different from that projected for HS2 (61%). It may therefore be possible to accommodate demand up until 2025 – but not to 2033.

However, to meet the demand forecast for 2033 (an increase of 133%), it would be necessary to do more:

- further lengthen WCML train sets (the fleet could be extended to all 11-car (not all sets are extended under the 'do minimum' case);
- provide 12-car formation is discussed in the Rail Alternatives paper[49], which only identifies problems with Liverpool Station, and the need for additional platforms at Euston); and
- WCML could be de-bottlenecked to allow more services to be run (that is discussed as Rail Package 2)).

[44] High Speed Rail for Britain: A report by High Speed 2 Ltd , Figure 4.1c Forecast of average daily load factors on long distance WCML services in 2033
[45] 'HS2 Baseline Forecasting Report' 5.3 page 33
[46] Network Rail October 2007 Strategic Business Plan Current Passenger Demand section 3, page 8
[47] HS2 Ltd state this at 'HS2 Baseline Forecasting Report' section 2.64 page 19
[48] the equivalent annual rate to give 133% by 2033
[49] High Speed 2 "Strategic Alternatives" Study: Rail Interventions Report

Upgrading WCML could, if implemented early and incrementally, accommodate the emergent demand growth without excessive crowding. However, it would substantially reduce the incremental benefits of HS2, as it would no longer eliminate crowding. Furthermore, the improved service frequency from de-bottlenecking would reduce the GJT improvements of HS2. Waiting for trains is not productive in the way that travelling on them can be.

So the 'do minimum' case may just accommodate demand to 2025, but cannot to 2033, which means that the reference case for assessing HS2 should not be the 'do minimum' one but Rail Package 2 (or preferably an optimised form of it). As a consequence any realistic assessment of HS2 requires its assessment against the rail upgrade alternatives.

For reasons discussed under 'benefits', avoiding overcrowding may have a higher than previously considered value, as crowding may negate potential improvements in the productivity and utility of time on board long distance trains.

We believe that the problem with HS2 Ltd's analysis partly relates to the haste with which it was conducted. The DfT work on alternatives to a new railway progressed in parallel with that for HS2 Ltd, and the conclusions of the alternatives study were not incorporated into the analysis by HS2 Ltd. As a result the base comparisons for the HS2 business case were against a straw man rather than a realistic alternative.

1.8 Technical developments ignored

For a railway that does not commence commercial operation until 2026, with an assessment period stretching to 2085, taking no account of the technical developments that already offer alternatives to travel is imprudent. The Government itself is seeking to promote alternatives to travel, especially for business.

HS2 Ltd's demand forecasts have no specific consideration of new technology, for example video conferencing, and high speed broadband that will obviate the need for some travel. This is in part a fair reflection of evidence to date. While the internet may facilitate home working, and remote shopping, there is also evidence that it is generative of long distance travel in that it can wider the range of business and leisure contacts, and permit living further from the office location (as longer but less frequent travel becomes an option).

There is also the view that video conferencing is only useful where the participants have an established relationship. However major businesses (Cisco, Arup) are already using this technology as a matter of policy. It has great potential for improving productivity and reducing costs.

Technology has the potential to displace travel – particularly for business. Avoiding travel is now a Government objective. As Philip Hammond said:

'……Norman Baker, is working……..at reducing the demand for travel, particularly for business.

Encouraging home working; promoting the use of high-speed broadband for both business and leisure purposes and encouraging the uptake of video conferencing as an alternative to long distance travel. '[50]

It would seem that the Government expect that the new technologies will obviate some of the need for travel, but have not incorporated this in its demand projections, in which HS2 is substantially generative of travel.

Given the timescales of HS2, at minimum the potential for technology to displace business travel should be incorporated into HS2's assessment.

[50] IBM START Conference, speech by Rt Hon Philip Hammond, 10 September 2010

1.9 Different demand scenarios not created

Neither HS2 Ltd nor DfT has developed different demand scenarios against which to test the robustness of the case for HS2. This is essential for a major project of this sort that will not start for 15 years at the earliest and is assessed over a further 60 years.

All that has been done to address uncertainty is some limited sensitivity testing, which considers the influence of reduced growth rates, an earlier cap on growth and the effect of demand shortfalls. Although this shows that the case for HS2 is sensitive to demand, with a shortfall against forecast by 20% causing the NBR to decline from 2.4 (excluding WEI) to 1.5, uncertainty about demand is not incorporated in the summary assessment of HS2. See section 3.3.

It is inescapable that there are major uncertainties about making predictions of travel demand for 25 years into the future (from 2008 to 2033). To address the uncertainties it would be appropriate to use demand scenarios (eg high, central and low) in a probabilistic assessment of HS2's business case, rather than perform sensitivity tests.

1.10 HS2 Ltd's modelling has problems and is internally inconsistent

HS2 Ltd's demand forecasts appear to have internal inconsistencies and may also be inconsistent with the predictions from the National Transport Model. These inconsistencies may explain how HS2 Ltd overall forecast for long distance rail travel (62%) is in line with other authoritative forecasts, but the growth predicted by HS2 Ltd for WCML is more than twice this figure.

Besides the apparent inconsistency between HS2 Ltd's overall forecast of long distance rail growth and the growth forecast for the components of this demand, discussed at section 1.3, there are further issues about the consistency of HS2 Ltd's results:

- They seem to be inconsistent with recent results from the National Transport Model
- HS2 Ltd's regional results do not seem consistent with its own national totals, of which they are supposed to be components

The extent of increases in long distance travel predicted by HS2 Ltd seems in conflict with the recently (March 2010) published National Transport Model (NTM) predictions to 2035[51].

The NTM report says that cars were 81% of all movements (total travel irrespective of journey distance) in 2003, and the total passenger km (including drivers) by car would increase by 26% by 2035. It also says that the percentage of cars' share of domestic travel would reduce to 77%, reflecting population growth being concentrated in urban areas where congestion and the shortness of journey make other modes attractive. Bluespace Thinking (in correspondence to DfT) deduced that this implies overall passenger distance growth of 32% (81% x 126% / 77% = 132%). It also noted that the average distance per trip increased by only 4% in the NTM report.

This increase of about one third (32%) contrasts with HS2 Ltd's statement that

'*Long distance travel is forecast to triple by 2033: there would be 7 million trips/day over 50 miles across the regions under consideration*. '[52]

The regions are those considered for being served by HS2. On the basis of the information about the distances travelled by length of journey in the NTS[53], tripling journeys over 50 miles would by itself increase total travel by 58%.

[51] Road Transport Forecasts 2009: Results from the Department for Transport's National Transport Model, 30 March 2010
[52] HS2 Demand and Appraisal Report , March 2010, paragraph 11.2.10 page 115

HS2 Ltd has not confirmed that the tripling is correct, but have confirmed the 7 million trips per day (in the HS2 Technical Seminar, 14 October 2010).

The 7 million trips per day is equivalent to 2.1 billion/annum (assuming 300[54] days per year). This in itself constitutes about 188% of 2008 long distance journeys (calculated from assuming a GB population of 60million and using the numbers of long distance trips per person of NTS table 0307). Given the 7 million estimate is only for part of the country, it also cannot be squared with a national increase for long distance travel of 44% for cars and 62% for rail and 178% for air reported elsewhere in HS2 Ltd's documentation. On the NTS figures these three increases add 46% to long distance travel.

The 7 million long distance trips per day is therefore implausible given the NTM and NTS data, and the national total growth for long distance travel given by HS2 Ltd itself.

The issue is that the sum of the parts seem to add to more than the totals. There seems to be a mismatch between the aggregate numbers that HS2 Ltd report, that may be compatible with other estimates, and the disaggregated results that seem to add to more than HS2 Ltd's own reported totals. If HS2 Ltd's forecasts of global long distance demand are not actually a reflection of the detailed results used in HS2's assessment, the apparent consistency between HS2 Ltd's forecasts and other reputable estimates is misleading.

[53] NTS 2009, table 0309
[54] Factor given by HS2, 'HS2 Demand Model Analysis' section 9.2.5 page 80

2 Benefits estimation

HS2 Ltd's case for HS2 gives the following breakdown of benefits[55]:

Benefits	(£m)
A) Conventional Appraisal	
Time Savings (including crowding)	
Business user savings	£17,600
Commuting & Leisure user savings	£11,100
Other Benefits	
Other User Impacts (Accidents, Air Quality, Noise)	less than £100
Total transport user benefits – conventional appraisal	£28,700
B) Wider Economic Impacts	
Labour Market Impacts	
Increase in labour force participation	£0
People working longer	£0
Move to more productive jobs	Not Included
Exchequer consequences of increased GDP	£0
Agglomeration benefits	£2,000
Increased competition	£0
Imperfect competition	£1,600
Total additional to conventional appraisal	£3,600
C) Total (excluding financing, social & environmental costs & benefits)	£32,300
All in £m, appraised over 60 year time period, discounted to 2009 values, 2009 prices	

Figure 4.2b HS2 benefits (following DfT transport appraisal and Wider Economic Impact guidance)

Incremental fares are treated as an off-set to the subsidy that Government must provide to achieve the net social or welfare benefits associated with time savings, improved reliability, reduced crowding, and from the effects of GDP improvements identified through the assessment of Wider Economic Impacts (WEI). These cover the effects on HS2 users, other transport users, and those arising more generally through WEI.

Composition of benefits

Out of the £28.7bn benefits we are told that time savings are worth 'over £13bn', and that the reduction in crowding (from the 'do minimum' case) is worth some £5bn[56].

We get help in the composition of benefits from a spreadsheet issued under an FOI request[57] that shows the split of benefits for rail users by user type and type of benefit. The letter giving the FOI response advises that the spreadsheet analysis concern the outputs of the long distance model, and does not cover the impacts of additional local services. The results of the Southern and Midlands models are in fact added to the totals for the long distance model. They comprise an additional 9% of benefit for business users and 12% for others over the long distance totals, but no breakdown is given.

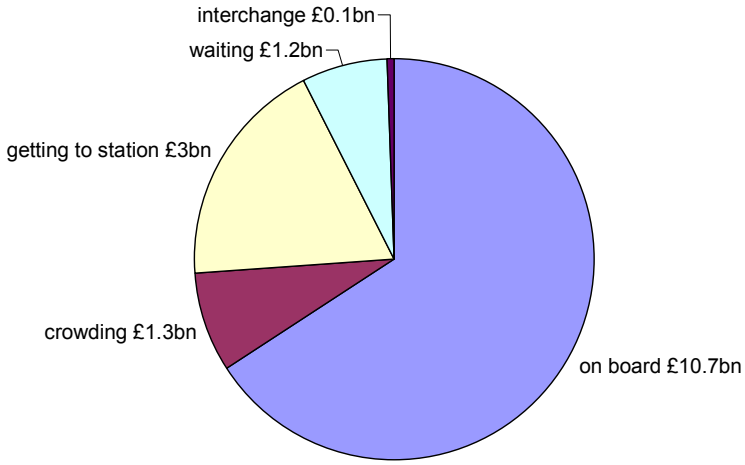
[55]. High Speed Rail for Britain: A report by High Speed 2 Ltd., page 176
[56] 'HS2 Demand Model Analysis' section 10.4.3, page 97
[57] FOI request by Dr J Savin, FOI10-039. DfT reply 4 June 2010

The table below gives the breakdown of transport user benefits using the spreadsheet as source, but this agrees with such information as can be found in the published documentation.

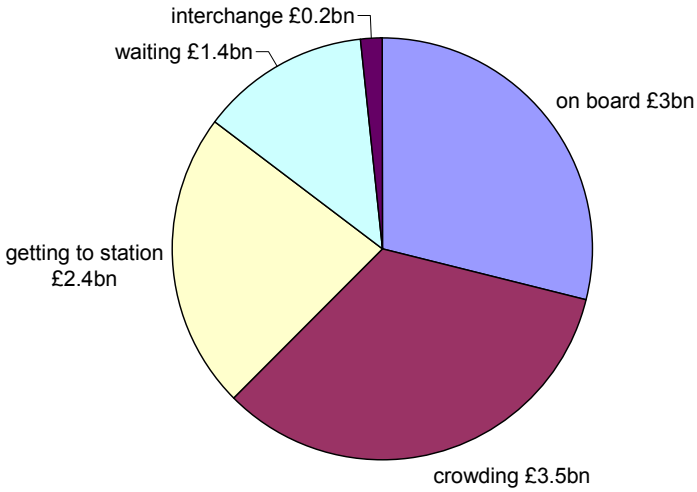
transport user	long distance rail model	South & Mids rail	road	total
business	£14.8bn	£1.5bn	£1.3bn	£17.6bn
other	£9.3bn	£1.1bn	£0.7bn	£11.1bn
total	£24.1bn	£2.6bn	£2.0bn	£28.7bn

Using the same spreadsheets the benefits for rail users are distributed as shown below. We have used this breakdown as a basis for adjusting the benefits for specific issues with HS2 Ltd's estimates.

Business benefits for rail (£16.3bn)



Leisure (incl commuting) benefits for rail (£10.4bn)



We know that the benefits include an element for improved reliability, which is not identified separately in the spreadsheet, but we have reason to believe that it is included within on board time saving.

The above charts show that while on board time saving is the largest benefit for business travellers, reduced crowding is the largest for leisure travellers. Reductions in the time (and cost) of 'getting to the station' are major benefits for both business and leisure travellers. This presumably relates to reduced journey times from the journey start point or final destination by reason of the Crossrail interchange at Old Oak Common giving better access than Euston to the West and West London, some of Central London, and East London.

HS2 Ltd assess the benefits to new travellers and those that are attracted from road or air because of HS2 as half[58] the benefits of those transferring from rail. This is normal in transport assessments, implicitly assuming that the new travellers on rail are uniformly distributed between those who only need the smallest additional incentive to travel by rail to those for whom it is still a very marginal decision to travel on HS2 when it is in place.

The sub sections below raise a number of concerns with HS2 Ltd's estimations of benefits, and where practicable attempt a quantification of the adjustment needed.

2.1 Reduction to business journey time on trains wrongly assumes all time saved is unproductive

DfT values business time savings as the cost of the time to the employer of the time saved. This presumes that all the time saved would otherwise be wasted time and now would be put to productive use. With the existing state of technology this is no longer supportable for time on board long distance trains, especially for a railway starting in 16 years time. Correcting this reduces estimated benefits from £8.9bn to £0.

The DfT guidance on business time savings treats all time savings for journeys on trains as an increase in productive time, assessed at the full cost of the time saved. This takes no regard of the fact that businessmen do work on trains, and technology is widening the range of work activities that can be conducted in a train. Mobile phones and broadband create a level of connectivity comparable to office or home.

The DfT are aware of this, both from everyday experience and studies that they have funded. It is already generally accepted:

- The Mott MacDonald IWT Consortium wrote in, 2008[59]:

  'Rail Business travellers in the UK are now using travel time highly efficiently. Marginal reductions in travel time (10, 15, 20 minutes) are not guaranteed to lead to much extra productive time at work, whether in the 'usual workplace' or elsewhere.'

- Lyons, Jain and Holley (January 2007) say[60]

  '….With the pace of technological change and the potential time uses afforded by mobile technologies it could prove unwise to unquestioningly persist with today's appraisal assumptions about travel time use if the possibility remains that such assumptions may increasingly become invalid over time.'

Not all the time on board a long distance train can be productive (eg finding a seat, getting out papers computer etc, and reversing the process at the destination, is not productive). However, it is not the average productivity of time on board long distance trains that matters, as reductions to journey time affect the time available in seat, not the getting ready to work and packing up time. It is unlikely that time in the middle of long distance rail journeys need be anything but fully productive by 2025, when HS2 starts.

[58] HS2 Baseline Forecasting report 2.65, page 19
[59] 'The Productive Use of Rail Travel Time and Value of Travel Time Saving for Travellers in the course of Work' The Mott MacDonald IWT Consortium, 2008
[60] 'The use of travel time by rail passengers in Great Britain', Glenn Lyons, Juliet Jain and David Holley, January 2007

Strictly surveys on how productive the time is (or has been) are not entirely to the point. Businessmen may choose not to work all the time on board train, but they may also choose not to at the normal workplace or when they work from home. If there is no impediment to working productively, why assume indefinitely into the future that as a behavioural fact they will be unproductive on board train, or relatively so to other places. There may be occupations where there are specific reasons why travelling time is relatively unproductive, eg service engineers, but for 'briefcase travellers' this will not be true.

This is the largest saving accredited to HS2, as journeys on the high speed route would be about 30 minutes less than on the WCML.

HS2 Ltd are trying to wriggle on this, raising irrelevant arguments about what people say they would otherwise do with the time (stated preference work threw up the old chestnut 'stay in bed longer!). If business travellers can be and are productive on the train, unless they would be more productive elsewhere, shortening this time has at best no benefit to the employer.

DfT is aware of the criticisms against its assumptions that all time saved adds to productive time. It argues that there is no authoritative evidence to take a different position, but may apply a sensitivity test. High Speed Rail is probably the only project for which the utility of time savings on long distance journeys is crucial.

Using the above breakdown of business benefits, the time savings from reduced journey times are £10.7bn savings for business travellers. If this time saving benefit includes improved reliability, reliability probably accounts for about of sixth[61] of the benefit, so perhaps 5/6 of the £10.7bn, or £8.9bn should be deducted from the HS2 benefits.

If the benefits of HS2's time savings are much reduced, this implies that the journey time elasticity HS2 Ltd used to assess the demand uplift from the 'do minimum' level will be more elastic than they should be. As a consequence the uplift (60,000 passengers/day) will have been overestimated. Correcting this would in turn reduce estimates of incremental fares.

2.2 Reductions to leisure traveller (and commuter) journey times on board trains

DfT use a different basis for valuing time savings for leisure travellers. However similar considerations as for business travellers imply that the benefits will be overstated. We assume this will reduce the £2.5bn benefit to half (£1.2bn)

For leisure travellers and commuters, 'willingness to pay' is the basis for valuing time savings, which relates to the degree of disutility of travelling time. Different values are identified for different travel activities – ie waiting for transport is costed at 2.5 times actually travelling, walking to access public transport is valued at twice the value of travelling[62], but there is no value specific to useful time on long distance trains. Leisure time savings for long distance journeys will be of reducing value for essentially the same reasons as for business.

The Centre for Transport & Society, UWE, Bristol, and Centre for Mobilities Research, Lancaster University in 2007 found[63]:

'Most rail passengers either make some use or very worthwhile use of their time travelling by train, suggesting that rail travel has positive utility for many travellers. Only 18% of passengers agreed with the statement that their travel time was wasted. Only 3% of rail passengers spent most of their time being bored or anxious.'

[61] We believe that about 2 minutes improvement in reliability is accredited to HS2, which is accounted as worth 6 minutes, source: Presentation by Prof R Cochrane, TUSG meeting date??? We do not know the basis for the 3 times multiplier.

[62] Tag Unit 3.5.6D, paragraphs 1.2.19 and 1.2.20 (DfT)

[63] 'Travel Time Use in the Information Age: Report', Mackie, Wardman et al, Centre for Transport & Society, UWE, Bristol, and Centre for Mobilities Research, Lancaster University, October 2007

While leisure and commuting time on trains cannot be used as flexibly as time at home or some other free time, it may be used in an increasingly broad range of activities that must be substantially eroding previous disutility.

The data on which the current 'willingness to pay' based time values is NTS 1995-2000[64]. This predates the general impact of mobile technology, including low cost lap-top computers, mobile broadband and WiFi. The new technologies are continuing to evolve and become more affordable, increasing the usefulness of time to higher level and to a proportion of passengers. It is also important to appreciate that the influence of new technology will only be fully felt on long rail journeys without crowding.

The journey time savings are worth £3.0/bn or £2.5bn if reliability is deducted. This should be reduced, although we have no specific evidence for the scale of the reduction. Even were a new study conducted now, it would tend to provide an overestimate the future disutility of such time. Provided there is no crowding, the reduction might be close to 100% in future. For illustrative purposes we assume that it halves to £1.2bn.

2.3 HS2 will not reduce crowding against a realistic alternative to HS2.

The crowding benefit for HS2 is entirely an artefact of using the unrealistic 'do minimum' case as a comparator. Using Rail Package 2 (RP2) that uprates WCML as a comparator converts this benefit to a cost, as HS2 will involve more crowding than RP2. This at minimum eliminates the entire £4.8bn crowding benefit.

HS2 is accredited with £5bn (£4.8bn from the FOI derived spreadsheet) for reducing crowding for all rail transport users. As explained at section 1.7 above, this is an artefact of using the 'do minimum' case that has an unrealistic load factor. With a realistic alternative, Rail Package 2 (RP2), HS2 actually increases crowding for long distance travellers that use HS2, with a load factor of 61% in contrast to that of 53%[65] for RP2.

Because the upgrading alternative to HS2 (RP2) can be implemented incrementally and with relatively short lead-times, load factors can be managed to consistently avoid most overcrowding. The current purchase of four new sets and lengthening most of the fleet from 9-car Pendolinos to 11-car ones is an illustration of this process that gains 32% more capacity. Examples of further capacity increases are lengthening the rest of the fleet to 11-car (in RP2), lengthening the fleet to 12-car (not in RP2) and de-bottlenecking WCML to create more train paths (which is the focus of RP2). This means that there are additional benefits that may be available to the upgrading alternative before HS2 could be complete.

It is difficult to be precise about the total impact on crowding, as there will be benefits to other non-HS2 services. Local services are increased using the freed-up capacity on WCML with HS2, and the residual long distance services on WCML are projected to have a low load factor (30%[66]), albeit only a small percentage (12%) of long distance travellers benefit. The HS2 Ltd analysis does not distinguish between benefits to HS2 users and to those using other rail services.

From the long distance model there are £1.3bn of business benefit and £3.5bn of other rail user benefit. Using Rail Package 2 as a comparator these crowding benefits would be turned to disbenefits (as HS2 has a higher load factor than for Rail Package 2)

In the circumstances, in the absence of detailed modelling, simply discounting the crowding benefits accredited to HS2, £4.8bn, is conservative.

[64] 'Values of Travel Time Saving in the UK' Institute for Transport Studies, January 2003
[65] High Speed 2: Strategic Alternatives Study – Strategic Outline business case', section 3.5.1.5, page 38
[66] HS2 Demand Model Analysis, Figure 10.2b, page 91

As with business travellers, this implies greater inelasticity to time on board, a reduced uplift in demand from HS2, and reduced incremental fares.

2.4 Service frequency improvements (that reduce waiting time) are overestimated as they are based on an unrealistic alternative

The improved service frequency for HS2 is an artefact of using the unrealistic 'do minimum' case as a comparator. Using Rail Package 2 (RP2) that uprates WCML as a comparator reduces this benefit, as RP2 has a higher service frequency than the 'do minimum' case. We estimate that this may halve the benefit from £2.6bn to £1.3bn.

Assessment against the 'do minimum' case effectively compares HS2 with the current WCML services frequencies. With a realistic alternative (eg Rail Package 2), WCML would have some of the bottlenecks removed, allowing a higher service frequency. This would reduce the waiting time savings accredited to HS2.

Part of HS2's assessed benefit is to users of freed-up capacity providing more local transport. An effect of de-bottlenecking the WCML for fast services with RP2 is that it would correspondingly make improvements to local and freight services possible, by removing the interactions (eg by grade separation) between fast and slow that reduce train paths and lengthen journey times. This may create the potential to run additional and improved local and freight services on the slow lines. There is no evidence that this was considered by DfT.

The benefit is composed of £1.2bn for business and £1.4bn for leisure travellers. We are not able to quantified precisely the reduction to benefits, and assume that it is halved.

2.5 The value of business time is overestimated because out of date values are used

HS2 Ltd use 10-year old data on business rail travellers' earnings, when business rail users were typically from a very highly paid minority. No account is taken of the greater numbers of business rail travellers that has already occurred and is forecast to increase by nearly a further five-fold by 2033. This implies a materially lower average should be used (a third less).

In addition to incorrectly assuming that all time on trains is wasted for the purpose of valuing time savings, unit values for business time are excessive because they are based on out of date data and escalated by earnings growth.

HS2 Ltd have used DfT webtag values to assess the value of business time savings. These are based on 2002 earnings applied to 1999-2001 travel data from the National Travel Survey[67], and are escalated throughout the assessment period (to 2085) in line with estimates of productivity and real wages growth.

Because historically rail has been used by high income travellers, the 2002 value of business time (of £36.96/hour) is considerably above average earnings. Bluespace Thinking assessed this as equivalent to a salary of £70,000/a in 2010 money. Only 10% of the population earned more than £46,278/a in April 2009, and only 10% of 'Managers and Senior Officials' earned above £80,000. Regional earnings for this group are considerably lower.

However, long distance rail passenger growth has been considerably faster than population growth. HS2 Ltd projected long distance business journeys on rail to increase to 460% of their 2008 level (at 24%[68] of 45,000 journeys/day) by 2033 (to 30%[69] of 165,000 journeys/day), against a population increase of just 16.6%[70]).

[67] Tag Unit 3.5.6 section 1.2.5 page 2 (DfT)
[68] National Passenger Survey, Virgin Trains, Autumn 2009, page 22
[69] HS2 Demand Model Analysis Section 10.4.8 page 99
[70] Population projections 2008 base' ONS, 21 October 2009, Table 1

The increases in journey numbers imply a relative fall in the average income of rail-using businessmen, as a small high earning group could not be responsible for all the projected journeys. The average earnings of business travellers can be expected to reduce in relative terms, moving toward the population average.

If we assume that business travellers on trains have average (mean) for 'Managers and Senior Officials' which is £47,186/a, this implies a reduction of a third in the value of all business time savings.

HS2 Ltd and DfT accepted that there are issues concerning these assumptions (when HS2AA met with them on 29 June 2010).

2.6 Wider Economic Impacts are overestimated as one element is geared to business time savings.

WEI is overestimated in line with the overestimate in the value of business time savings, reducing the £1.6bn from imperfect competition to £0.4bn.

HS2 Ltd, applying DfT's approach to WEI has identified three areas of benefit:

- £2bn of agglomeration benefit from better local transport, either resulting from reduced road congestion of better connectivity from reuse of freed up capacity
- A small agglomeration benefit from reduced long distance journey times (as assessed by Graham and Milo). This was not included in the business case, as it is outside the DfT framework, but would contribute little (less than £10m/annum).
- £1.6bn from time savings and reliability benefits to business where businesses operate in conditions of imperfect competition.

This last term is assessed as 10% of the business benefits. If the business benefits are smaller by reason of sections 2.1, 2.4, and 2.5, this £1.6 bn will reduce accordingly to about £0.4bn.

The substantive issue of WEI and transformational benefits is discussed separately. To date the only evidence put forward by Government to benefits beyond those identified within the DfT framework are those by Graham and Melo. However, we are aware of work sponsored by Greengauge 21, and similar studies done for Northern development agencies. This currently does not form part of the DfT's business case for HS2.

2.7 Incremental fares may be overstated as competition between high speed and conventional services is discounted

HS2 Ltd assumes that there will be no competition between HS2 and the 'classic' railway. Competition may be expected to reduce passengers on HS2 and total revenues (and hence incremental fares), but increase costs. Failure to correctly anticipate competition has resulted in economic underperformance for other major transport projects.

HS2 Ltd assume that there will be no competition between HS2 and 'classic' services. They assume that fares will be the same as the conventional services that it replaces. However, competition between HS2 and conventional services, either in the form of the residual long distance services on WCML or from Chiltern, will push fares down and reduce the number of passengers on HS2. HS2 trains will compete against cheaper and less crowded 'classic' services, including ones running on WCML using some of the freed-up capacity.

Competition may reduce the £15bn of incremental revenues depending on whether long distance rail travel is price inelastic, with a fares reduction inducing more rail travel overall but insufficiently to off-set the reduction in fares. Competition would undoubtedly increase costs,

to pay for running the competing 'classic' services using the 'released' capacity. This cost is additional to that included in HS2 Ltd's business case. Relevant evidence for this is provided in Tag Unit 3.14.4, section 11.2, Tables 3 and 4. Table 4, which shows the 'own fare' price elasticities, is reproduced below.

	Seasons	Other	Commute	Business (full/reduced)	Leisure (full/reduced)
London Travelcard Area (LTA)	-0.35	-0.75	-0.35	(-0.8/-0.65)	(-1.3/-1.1)
South East to LTA	-0.35	-0.8	-0.35	-0.35	-1.05
LTA to South East	-0.6	-0.8	-0.6	-0.35	-1.05
Rest of country to/from LTA	-0.75	-1.05	-0.75	-0.8	-1.25
Non London: PTE <20miles	-0.6	-0.85	-0.6	-0.5	-0.9
Non London: non-PTE <20miles	-0.7	-1.0	-0.7	-0.6	-1.05
Non London : Inter urban >20miles	-0.8	-1.0	-0.8	-0.6	-1.1
Airport (non Heathrow)	-0.7	-0.7	-0.7	-0.5	-0.9

Table 4: Typical own fare elasticities – other public transport fares held constant

Prof Dargay[71] estimates that business and commuting travel is price inelastic while leisure is elastic (as the table above from webtag shows). Dargay concludes that the overall own price elasticity for long distance rail is 1.0, which suggests that additional journeys exactly off set reduced fares. However, this is a national figure, and may not apply to WCML specifically.

As business travel is projected by HS2 Ltd to grow more quickly than leisure travel (increasing from 24% of travellers to 30%), this implies that demand overall will become more inelastic, but we do not know whether price elasticity for WCML would be inelastic overall.

Business (and commuting) is a disproportionately large element in full fare peak travel, with the elastic leisure users concentrated in reduced fare eligible services. Given the current range of fares (anytime first class return London-Manchester £399, anytime standard class return £262, and cheapest advanced standard class return £22), the elasticities of travellers on full priced tickets will be more important to overall revenues. The increase in business travellers will therefore have a disproportionate effect on the overall elasticity.

The reason for this wide distribution of fares is that trains that provide for a full day at the destination are busy and charged full price (morning and evening peak), whereas very early, very late and trains in the middle of the day are less popular and priced at a level to attract travellers so make some contribution to costs using what would otherwise be spare capacity.

We assume that competition would have the effect of causing travellers on peak time (full fare) services to spread themselves between the lower priced slower 'classic' services, and the high speed ones. Travellers would still need to purchase full price tickets for either of these services, but they would (in significant numbers) choose the lower full prices of the 'classic' services. The overall growth in demand for such services would not off-set the reduction in price because travellers on these sorts of services have price inelastic demand.

On off peak services similar competition would occur, but demand would increase so as to create a net increase in revenue.

[71] 'The prospects for longer distance domestic coach, rail and car travel in Britain,' Prof J Dargay, January 2010, page 49 and Table 27

However, running competition against peak HS2 trains is more financially attractive than offering a complete full all day 'clock face' service, so we might expect competition to be concentrated on providing the full price peak services, rather than against off-peak services.

Competition will become more serious when the high speed track is extended north of Birmingham, as there will be more scope for direct competition rather than having complementary services (conventional and high speed trains will no longer share track north of Birmingham). This greater competition will be more damaging to the economics of building the railway.

HS2 Ltd's demand modelling does not consider the impacts of competition, indeed they assume that there will be none, as:

'…HS2's approach has effectively assumed a regulatory framework that allows joint (social) optimisation of both high speed and classic rail services."[72]

To try to justify HS2 on the basis of competition being suppressed indicates that HS2 Ltd recognise serious problems with its economics. However, it would require more work to estimate the actual impact on the level of revenue and costs.

A failure to properly take account of competition is a recurrent and generally recognised weakness in major transport infrastructure projects:

- The actual response of ferry operators was not anticipated in the Channel Tunnel assessment, and assumptions on both traffic growth and the price attainable proved seriously optimistic.
- The occurrence of low-price air services competing with CTRL was similarly not anticipated
- the preference of commuters for the 'classic' Kent commuter services over the higher priced high-speed ones was not anticipated (to the extent that trains have been shortened due to the shortfall in demand).
- Even in Japan the introduction of high volume low cost flights between Tokyo and Osaka were not anticipated when planning the Shinkansen bullet train.

2.8 Benefits conclusion

Taking into account the quantified overestimations in benefits described above (with no change in forecast demand) reduces total benefits from £32.3bn to £13.1bn – ie by almost 60%. This would reduce the NBR to just below 1 excluding WEI, and just above 1 including WEI.

As the table below shows, business rail user benefits reduce from £16.3bn to £3.7bn. The principle benefit to business travellers, on-board time savings is highly vulnerable if examined critically, as it is based an insupportable supposition that all time on board trains is wasted. The third largest business benefit is an artefact of the inadequate 'do minimum' comparator.

For leisure (and commuter) rail travellers total benefits reduce e from £10.4bn to £5.0bn. The largest benefit is reduced crowding, which is unsafe for the same reason as for business travellers. The second largest is on board travelling time that is vulnerable for the same reasons as for business. However it will probably still have some residual 'disutility', if up to date evidence were used to estimate its value, although we would expect it to be subject to further erosion in future.

[72] HS2 Ltd 'Outline for HSE Technical Annex' (091123-ACP technical note.pdf)

Illustrative summary table of effect on rail user benefits (based on HS2 Ltd forecast demand)

Benefit	value (£bn)	issue	discussion section	adjusted (£bn)
Business				
on-board time saving	8.9	DfT assumes all time is wasted	2.1	0
reliability	1.8	(sixth of on board time saving)	2.1	1.8
crowding	1.3	artefact of using 'do minimum' case	2.3	0
access time saving	3.0	assume is from Crossrail connection	2	3.0
waiting time	1.2	reduces with realistic comparator	2.4	0.6
interchange	0.1			0.1
total	16.3	(excludes road users)		5.5
total with reduced time value		over valued - unit value reduced by 1/3 for travellers being less elite	2.5	3.7
Leisure (including commuting)				
on-board time saving	2.5	over-valued	2.2	1.2
reliability	0.5	(sixth of on board time saving)	2.1	0.5
crowding	3.5	artefact of using 'do minimum' case	2.3	0
access time saving	2.4	assume is from Crossrail connection	2	2.4
waiting time	1.4	reduces with realistic comparator	2.4	0.7
interchange	0.2			0.2
total	10.4	(excludes road users)		5.0
Overall total	**26.7**			**8.7**
business road	1.3			1.3
leisure road	0.7			0.7
total road users	2.0			2.0
All transport users	**28.7**			**10.7**
WEI				
agglomeration	2.0			2.0
imperfect competition	1.6	reduce for revised business savings	2.6	0.4
total WEI	3.6			2.4
Grand total	**32.3**			**13.1**

If the benefit values reduced as indicated in the table above, the NBR would be below 1 excluding WEI, and marginally above 1 including WEI.

Probably the largest robust element of HS2's claimed benefits is the reduction in total journey that we think is associated with the interchange at Old Oak Common providing easier access to some parts of London (and onward travel) than Euston.

We believe that competition will worsen the revenues and increase costs compared to assuming competition will not occur, as HS2 Ltd has.

With reduced levels of demand, the benefits and incremental revenues would be smaller.

3 Appraisal

The DfT's approach is in principle reasonable, and is that used for assessing other rail transport investments:

- It combines a partial social cost benefit analysis (for impacts apt for expression in terms of money) with other criteria that, while capable of objective assessment, are less readily monetarised eg environmental impacts. The decision maker is left to consider the particular combinations of value for money and other factors in making a choice.
- The methodology and many of the assumptions or parameters to be used for assessing transportation schemes are published by DfT in webtag (guidance on the DfT web site). This promotes consistency and the use of validated assumptions, however as discussed above, some of these assumptions are out of date and inappropriate to HS2.

The principle monetarised costs and benefits are capital costs, running costs, incremental fares, consumer benefits in the form of time savings, reduced crowding, and better reliability. When WEI are included, this brings the welfare aspects of economic impacts within the benefits. Factors such as the cost of capital, which would be important in a commercial appraisal are not considered. Cost and benefit streams are summarised in terms of their net present value. The discount rates used are in accordance with Treasury advice.

The key summary statistic is the Net Benefit Ratio, which is effectively the ratio of the social benefits generated by the project to the subsidy required from government.

The assessment does not include the impact of the project on property values due to property blight, although this is in principle readily monetarised.

Key non-monetarised areas of assessment for HS2 are:

- Sustainability:
  - Carbon and climate change ((although this is expressed in terms of the current value of carbon emissions, it is not included as such in the business case)
  - Noise
  - Air quality
  - Landscape/townscape
  - Heritage
  - Wildlife and biodiversity
  - Water and flooding
  - Soil and land resources
  - Waste generation
  - Resource usage
- Equality of opportunity (including regeneration opportunities)
- Safety, security and health

However there are weaknesses in DfT's approach which may lead to poor decision making.

DfT continue to apply a 'predict and provide' approach to rail demand, despite its abandonment for roads, and recent effective abandonment for air (with a policy for no new runways for London airports). While not developed in this submission, with increasing environmental concerns and the creation of a portfolio responsibility for 'non travel', a reconsideration of this policy for rail seems overdue.

HS2 Ltd and DfT effectively produce two versions of the business case:

- Based on traditional social cost benefit analysis
- As above plus a consideration of the welfare impacts of WEI

DfT/HS2 Ltd benefit and cost appraisal for HS2

	Business	**other**
Transport user benefits	£17.6bn	£11.1 bn
Other (excl Carbon)	Less than £0.1bn	
total	**£28.7 bn**	
Capital cost	£17.8 bn	
Operating cost	£7.6 bn	
Total cost	**£25.5 bn**	
Additional revenue (fares)	£15.0 bn	
Indirect tax	-£1.5 bn	
Net cost to government (subsidy)	**£11.9 bn**	
NBR (NATA)	**2.4**	
WEI agglomeration	£2.0 bn	
WEI imperfect competition	£1.6 bn	
Total WEI	**£3.6 bn**	
NBR with WEI	**2.7**	

3.1 Not a commercial business case

The business case that HS2 Ltd constructs is a social cost benefit analysis, not a commercial business case. From a national perspective there is no commercial case as it requires a substantial subsidy, with costs exceeding the incremental fares.

The business case for HS2 is not a commercial business case, the analysis is done in accordance with DfT's assessment framework which incorporates a social cost benefit analysis which is commonly referred to as the business case.

Putting aside issues of cost of finance etc, the fact that the present value of capital and running costs exceed that of the incremental fares shows that from a national perspective, there is no commercial case. No attempt has been made to construct a narrow commercial case for HS2 – ie one that ignores the lost revenues of other rail franchises.

HS2 is not unusual in requiring a subsidy. In 2009, the US Congressional Research Service reported[73]:

'……. Experts say that virtually no HSR lines anywhere in the world have earned enough revenue to cover both their construction and operating costs.'

3.2 No case is made for a regressive subsidy

The £11.9bn subsidy required to build HS2 brings benefits to businesses and rail users and therefore is regressive. There is no justification given for this, or why the subsidy should be used to encourage additional travel.

[73] 'High Speed Rail (HSR) in the United States' David Randall Peterman, John Frittelli, William J. Mallett, December 8, 2009

The 'business case' is effectively the case for Government subsidising a new railway. However, no case is made as to why users of HS2 should not be expected to cover the full costs in the fares that they pay. Given that the great majority of assessed benefits go to business users, and that rail users are predominantly from high earning groups (see table[74] below), it seems to be regressive to use public money to subsidise a transportation mode predominantly used by the affluent.

Table 1 Rail trips by socio-economic group - NTS

NTS – Rail trips	Trips per person and year			Index		
Year Socio-econ group	1995/7	1999/1	2004	1995/7	1999/1	2004
Prof/managerial	26	39	37	100	151	144
Intermed non-manual	29	37	34	100	129	118
Junior non-manual	24	26	29	100	110	121
Skilled manual	8	9	13	100	115	160
Other manual etc	8	9	11	100	110	133
Retired	4	5	5	100	125	138
Other econ inactive	10	10	15	100	100	151

That HS2 is deemed suitable for the £11.9bn subsidy is the more puzzling when the government has determined that people – particularly businessmen – should be encouraged to adopt alternatives to travel. Norman Baker has been specifically charged with this portfolio responsibility. The 'business case' for HS2 depends on it being generative of additional travel.

Neither DfT not HS2 Ltd have considered the alternative of only providing increases in capacity when the incremental fares are sufficient to pay for the additional capacity. This might involve managing demand (to prevent excessive crowding) through increasing fares until there is a commercial case for the extra capacity, This would have the advantage of making those who travel pay the full cost of the service, and not inducing additional travel through subsidy.

3.3 DfT does not handle uncertainty correctly, assessing HS2 only on an optimistic forecast.

The assessment of HS2 is done without the benefit of systematic and integrated consideration of uncertainty, which should have involved lower demand growth scenarios. This is despite failures with HS1, commitments given to a Select Committee and DfT's own guidance.

We have argued above that the demand estimates HS2 Ltd has made for the 'do minimum' case (133% increase) and HS2 (267% increase) are implausibly high. It seems firm ground that there is considerable uncertainty about demand, and very plausible that demand is unlikely to prove higher than HS2 Ltd have estimated, and are very likely to be considerably lower.

The World Bank in a review of high speed rail[75] cautions:

[74] 'UK DfT Rail Passenger Demand Forecasting', J Segal, A Mason, N Jackson, J Cartmell, in Association For European Transport and contributors 2007.
[75] 'High Speed Rail: The Fast track to Economic Development', Paul Amos, Dick Bullock, Jitendra Sondhi, July 2010.

'… high-speed projects have rarely met the full ridership forecasts asserted by their promoters and in some cases have fallen far short.'

But no serious attempt has been made to reflect uncertainty concerning the demand projections. The sensitivity analysis conducted[76] simply shows how dependent the NBR is to different assumptions of demand growth, date of demand ceasing to grow, and lower levels of demand, without incorporating this into the overall assessment.

No demand scenarios are developed to give assurance that the business case for HS2 is robust, or to show the expected benefits when different demand forecasts are combined probabilistically.

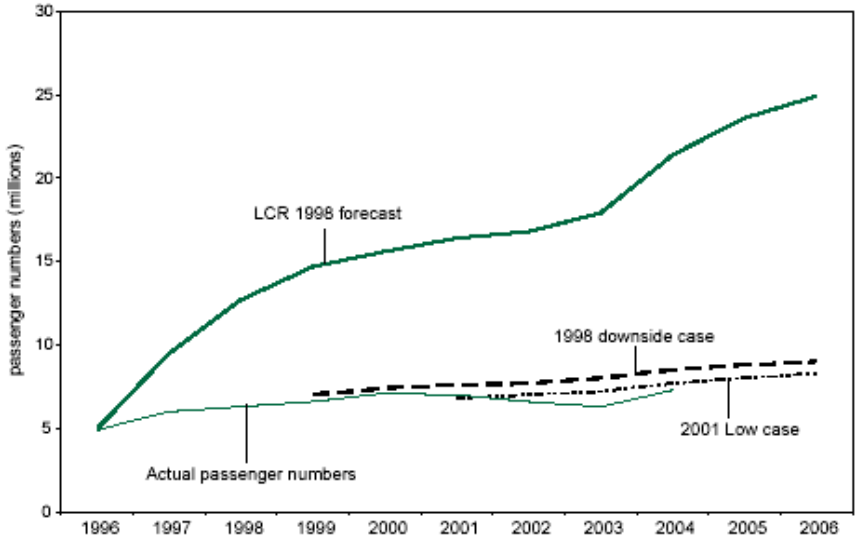
The development of three scenarios is recommended by DfT in its own guidance[77].

The absence of considering scenarios with less optimistic growth forecasts is surprising as the Select Committee on Public Accounts in their Thirty-Eighth Report, which was concerned with HS1, recorded:

'6. The Department told us that it has now learned from all this experience, and that the next time it considered undertaking a major transport project, it would factor more severe downside assumptions into its business case analysis.'

The evidence that the Select Committee were considering showed that actual passenger numbers on CTRL were lower than the 1998 and 2001 'downside' and 'low' cases respectively (see the graph below), constituting just over a third on the central forecast.

CTRL (HS1) passenger numbers



Source: C&AG's Reports (HC 302 of Session 2000/1, Fig. 6; HC 77 of Session 2005/6, Fig. 8)

In the work for HS2 no 'downside' or 'low' case has been produced. On the basis of the other considerations given, the demand scenario actually produced is an optimistic 'high' case and should not be presented as a 'central' case. The undertaking that DfT gave the Select Committee has plainly not been fulfilled with HS2.

The 2007 White Paper recognised the problems of long term forecasts and the need for flexible solutions:

[76] HS2 Demand Model Analysis, Appendix 2, Section A2.2
[77] Tag Unit 2.7.1d section 1.10.10 page 9, and Unit 2.7.1 section 1.8.10 page 8

'Forecasts have been wrong before, and any strategy that tried to build a rigid investment programme based on fixed long-term forecasts would inevitably be wrong again.

To overcome this challenge, the guiding principles in this strategy are:

- *To invest where there are challenges now, in ways that offer the flexibility to cope with an uncertain future; and*
- *To put in hand the right preparatory work so that, as the future becomes clearer, the necessary investments can be made at the right time.* [78]

That the alternatives to a new railway largely avoid the risks of long-term forecasting is a major consideration in their favour. DfT's assessment fails to appreciate this as it makes no serious attempt to consider the impact on uncertainty on the choice of how to develop capacity.

The impact of including consideration of less optimistic demand forecasts, and the superior robustness of the alternatives that upgrade the existing infrastructure would be to reduce the attractiveness of HS2.

We understand from a presentation made to the Analytical Challenge Panel on 17 August 2010[79] that HS2 Ltd plan to model demand on the basis of PDFH 5.0, as a sensitivity test to the business case. The Panel (at this meeting) expressed the need to develop a range of scenarios, with probabilities. Some members felt that the overall long distance travel elasticity on GDP might be as low as 1, and that it might be the basis of a sensitivity test.

3.4 HS2 Ltd and DfT fail to handle alternatives correctly

The case for HS2 is entirely undermined by a failure to develop appropriate and realistic alternatives against which to compare HS2, and perform this assessment. Candidate alternatives are rejected without any robust basis.

As discussed at section 1.7 above, the 'do minimum' case is not realistic, as it involves excessive crowding which is not taken into account in the demand estimation. It is therefore not suitable as the alternative against which HS2 is assessed.

Neither DfT not HS2 Ltd properly develop or assess alternatives to HS2, which causes the assessment to be misleading. This is a persistent problem. The Foster Report[80], observes inadequate assessment of alternatives to the Intercity Express Programme

'I am not convinced that all the credible alternatives to Intercity Express Programme (IEP) have been identified, worked up and assessed on an equal footing with it……..

The team's preliminary analysis suggests that these alternatives could achieve better value for money than IEP, realising a greater proportion of the currently desired IEP benefits with reduced expenditure over the coming 15 to 20 years, and especially during the next decade.'

For HS2 the weaknesses in the option development and the selection process are:

- The 'do minimum' case is inadequate – it cannot meet the projected demand and so when compared with HS2 causes key benefits (on crowding) to be overestimated
- The HS2 Ltd alternative is only for a new railway (not an improved existing one) and the DfT developed alternatives are not used or required to be used in the selection process
- DfT alternatives do not include a least cost option that meets the projected demand in a credible manner
- The assessment rejects alternatives that have better Net Benefit Ratios than HS2 on an invalid basis (that they do not provide surplus capacity – yet they do meet the demand required)

[78] 'Delivering a Sustainable Railway', Cm 7176, Dft, July 2007, page 9
[79] Response of 12 November 2010 to B Weston concerning FOI request FOI10/111
[80] 'A Review of the Intercity Express Programme', Sir Andrew Foster, June 2010, page 22

- There is no assessment involving incremental benefits over incremental costs of HS2 compared to the best alternative

3.4.1 DfT did not create a least cost option

HS2 Ltd did not develop a realistic alternative that accommodates forecast demand, except the construction of a new railway that would operate at conventional speeds.

DfT were asked to develop alternative by the Secretary of State (Lord Adonis). These alternatives were based on uprating the existing road and road routes. However, they did not feature a minimum intervention approach (ie a least cost approach) that is consistent with the demand forecast for it – which would have considered further lengthening of the trains on WCML (as developed in Rail Package 1, but neither costed nor incorporated into other packages).

It is reasonable to expect both 'least cost' and 'best alternative' options to have been developed.

3.4.2 DfT fail to assess HS2 on an incremental basis against the 'best alternative'

DfT did, however develop Rail Package 2 (RP2) that meets forecast capacity requirements at lower cost and with a higher net benefit ratio than HS2. Philip Hammond has explained that RP2 is inferior to HS2 because the overall benefits are smaller for RP2. However, what needed to be demonstrated was that the extra benefits (from HS2) were worth the extra costs (of HS2).

Normal project assessment would look at the *incremental* benefits of HS2 over RP2 to show whether the additional benefits would do just this. This has not been done.

HS2 and alternatives: net benefit ratios

	Against 'do minimum' case (source: HS2 Ltd)		
	HS2	Rail Package 2	Road Package 2
Present value of benefits (£bn)	28.7	7.35	4.8
Present value of net cost (£bn)	11.9	2.03	1.40
Net Benefit Ratio (exl WEI)	2.4	3.4	3.4
WEI (£bn)	3.6	0.43[81]	0.3[82]
Net benefit ratio (incl WEI)	2.7	3.63	3.66

Using RP2 as a comparator has a more severe effect on the business case for HS2 than simply reducing HS2 costs and benefits by those of RP2 for two reasons:

- The benefits of HS2 include an uplift from the additional passengers forecast only to travel by rail if there is HS2. These extra travellers are accredited with 50% of the benefit of existing rail travellers. Travellers on HS2 therefore have about 35% more benefit in total than just those that transfer from 'classic' rail. Consequently the £7.35bn of RP2 benefits compared to the 'do minimum' might result in nearer a £10bn reduction in HS2 benefits if RP2 were the comparator.
- To actually accommodate the projected demand without excessive overcrowding, elements of RP2 would need to be implemented in advance of HS2's potential start date, as a result of which some of RP2's costs would be invariant between HS2 and RP2

[81] ' High Speed 2: Strategic Alternatives Study: Strategic Outline Case', page 52, assuming WEI values are lowest for this package (as has least impacts generally)
[82] Estimated from op cit page 55

Plausibly the reason DfT did not use RP2 was simply that it did not have time to do the necessary work and meet the publication timetable, However, one might speculate the reason is related to the possibility that using RP2 as the comparator would have resulted in pushing HS2's NBR below 2. There are two reasons for this latter interpretation:

- The reference to RP2 (and the other alternatives packages) producing insufficient *surplus* capacity, over and above that required to meet the forecast demand (discussed at section 3.4.3 below)) as the basis for not considering these options
- The exclusion of RP2 from the table summarising the alternatives in the White Paper[83]. The White Paper bundles the alternatives together and so does not specifically identify RP2.

In the light of other issues with the HS2 business case, the change of comparator is also more serious to HS2's business case that it might first seem, because RP2 particularly affects the areas of benefit that are robust to considerations of the utility of time on board long distance trains: crowding and train frequency.

HS2 is accredited with £2bn of benefits to road users. The DfT road alternatives include Road Package 2 (shown in the table) that has a better NBR than HS2 and produces a larger benefit than HS2. The better road improvement schemes have considerably higher NBRs than rail ones, including HS2, on DfT's assessment approach. However, they are not progressed in preference to rail schemes, as DfT no longer apply the 'predict and provide' approach to road improvements.

There is some tension in including the value to road users rather than the cost of otherwise delivering that improvement through an appropriate road scheme, the same benefits are given more weight if they arise in conjunction with a rail scheme than with a scheme that only delivered those road user benefits. The cost of best alternative means of delivering the road user benefits gives a value of substantially less than a third of the £2bn value of the road user benefits.

3.4.3 Alternatives rejected on the basis they give Insufficient surplus capacity

DfT justify rejecting the rail (and road) alternatives on the basis that they do not provide the capacity required. This is counter-intuitive, when each of the rail alternatives developed meets all the forecast demand with lower levels of crowding than HS2.

What is in fact meant is that the alternatives do not deliver *surplus* capacity[84] that is available to satisfy requirements for additional local rail services and freight trains, despite no case being made that these additional services are needed. In effect they are insisting on not merely predicting demand and planning to meet it (without managing it), but to over-provide against the prediction, ie to 'predict and over-provide'.

In fact the alternative rail packages do create additional capacity on the slow lines, but no account is taken of this in the DfT assessment. If this requirement is material then the benefits of this capacity should have been valued.

This new requirement has not been identified as having a basis in the existing non-monetarised criteria or stated policies. In the absence of a pre-existing policy, it is simply profligate.

3.5 Excluded property blight cost

DfT do not include the costs to property owners of blight, despite it being readily monetarised, and compensation being included as a cost.

[83] Command Paper 7827, Table 2.4 page 51
[84] Clarified in attachment to letter of 20 September 2010, from J Mitchell, Policy Manager for High Speed Rail, DfT

DfT assessments deliberately leave out a social cost that can be monetarised – the reduction in value of properties near line of route[85]. This cost is not included anywhere in DfT's assessment framework. The costs of compensation are included, but these are relatively small.

Blight is not due to a redistributive effect (with losses offset by gains elsewhere), but a result of degrading the local environment. Philip Hammond has argued that this is balanced by not including increase in property values to those near stations. This is questionable, as the property price increases will be partly redistributive (properties in the vicinity of stations used less as a result will be worth less) and partly how the transport and WEI benefits work through the economy. In any event it seems curious to include a cost if the government happens to pay for it, but not if private individuals do.

Property blight data is not readily available because currently the individual and not public purse meets the costs of the blight that transport infrastructure projects generate.

It is, however, not difficult in principle to estimate the costs of property blight, as relatively simple techniques can establish divergences in property value trends for a locality. An unsuccessful attempt was made in the 1990s, as reported by the Interdepartmental Work Group on Blight[86] However, modern positional software has been extensively used to map dwellings and other buildings, making the identification of the large numbers of properties needed to provide reliable analysis easier. A study to quantify the effects of blight is being planned for HS2[87].

Just as social benefits (eg time savings) are included in the cost benefit assessment, the social cost of blight should also be included – irrespective of who pays it.

[85] HS2 Ltd gives this explanation of the assessment that they had made in a meeting on 17 August 2
[86] 'Interdepartmental Working Group on Blight : Final Report', December 1997
[87] by HS2 Action Alliance working with Councils, eg Buckinghamshire County Council, Warwickshire, South Northants