Regional and Local Economic Impacts of Rail Investments

Final report

Welsh Government

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Content

Executive Summary

Background and scope

In May 2010 the Welsh Government commissioned a consortium led by Mott MacDonald and supported by Colin Buchanan Associates and the Institute for Transport Studies at the University of Leeds to undertake research designed to:

- Provide an overview of recent investment in rail in Wales and at a strategic level in the wider UK, in the context of general rail industry developments.
- Provide an analysis of recent trends in rail usage, including a profile breaking down such use.
- Review case studies from previous literature on the economic impacts of rail investments in Wales, the UK and wider Organisation for Economic Cooperation and Development (OECD) countries.
- Draw suitable conclusions from the evidence regarding the effects and effectiveness of different types of rail infrastructure investments, identifying where further research may be required.

The main objectives of the research were to identify broad indicators of what rail investments might deliver in a Welsh context in terms of economic benefits.

The research outlined in this report was undertaken as part of the Welsh Government's Economic Research Programme, which is overseen by the Economic Research Advisory Panel.

Methodology

The methodology used has been focussed around desk research. This work has been supplemented with contact with a small number of academics and rail stakeholders in Wales, the rest of the UK and Europe in order to identify and explore the economic and social impact of rail under the following headings:

- Business location/agglomeration
- Household location/labour market
- Regeneration and land values
- Accessibility and time savings
- Logistics, mode choice and mode shift
- Social

Environmental effects were initially considered but due to lack of relevant evidence, these were excluded from further analysis. The research has also sought to categorise the type of investment and its applicability in a Welsh context according to a number of headings: new line/reopened routes; new stations; line speed improvements; service frequency improvements; introduction of direct services eliminating interchange; new rolling stock; electrification; high speed; light rail; increased capacity; rural; urban; passenger; and freight.

It was recognised that while ex-post studies of rail impact would be preferred; these were likely to be in short supply. In the likely absence of detailed ex-post analysis of new rail schemes ex-ante data – usually provided in support of schemes' business cases – was likely to be available.

Initial research sought to develop a literature review of previous case studies from across the world along with a Welsh economic and transport policy context and an initial review of passenger, and some freight, rail demand and recent investments in Wales. The emerging findings lacked the capacity to deliver concrete conclusions due to the scarcity of robust, relevant materials. However, early observations included:

- A lack of ex-post economic impact work on rail generally – and even less material relevant to the economic, social and topographical structure of Wales.
- Most reports available relate to new lines or re-openings (and are generally ex-ante), and/or discuss rail by typology (e.g. high speed) rather than impact on specific geographic/economic space.
- Case study materials tend to focus on increased land values – itself only a proxy measure for economic growth.
- Case study materials differentiate between economic benefits from rail investment in urban areas, inter-urban and rural with the latter clearly focussed on social impacts, some commuting and the relevance to the tourism sector.
- Positive growth in rail demand in Wales outstripping the UK-wide performance.
- Anecdotal evidence on recent rail investments in Wales suggests mixed success.

The main consultees whose input has assisted in the production of this report were:

- Welsh Government officials (transport and economics specialists)
- Flintshire County Council
- Cardiff City County Council
- Arriva Trains Wales
- Network Rail (Freight)
- International rail specialists/academics

Given the limited evidence available from previous studies, the existing material was supplemented by our own high-level case studies assessing the impacts of improvements in rail services on selected corridors. This shifted the scope of the research from a focus upon empirical evidence in studies applicable to rail in Wales to a specific assessment of recent local rail investment in Wales. The benefit of this approach and the use of Welsh case studies is of course the direct relevance and local knowledge of these changes. The disbenefits include a limitation on the research in terms of both the type of investment that can be studied in this way (so no High Speed Rail) and the limitations of available secondary data (so no agglomeration or environmental impacts).

Conclusions

More research (including original surveys and other such data) would be required to produce the ex-post material (and indeed ex-ante material about specific investments) that would allow the development of more substantive conclusions and to explore the relationship between rail and other transport modes.

While it is difficult to draw firm conclusions on the economic impact of future rail investments in Wales, a number of guiding principles are evident, drawing together the analysis from the literature review and the case studies, details of all of which are summarised in chapters 3 to 6, we can suggest:

- Increased rail investment in new lines and service improvements is likely to centralise (or re-distribute) economic activity to the better connected areas. Where economic activity will centralise is dependent on the underlying economic conditions of the areas that have been connected. These impacts may be enhanced when rail is part of a wider regeneration investment.

- Rail services can sustain communities by connecting them to larger urban areas. Rural and peripheral communities with access to good local services that provide realistic commuting options to large employment centres can experience growth in population as a result of rail investment – or it can prevent depopulation from areas that have seen significant declines in local economic activities, by allowing them to survive as commuting centres – as seen in the Valleys. The community as a dormitory settlement may not at face value seem desirable, but the positive outcome is that population decline can be halted and a community sustained.

Applying these principles to rail investments in Wales would suggest the following with respect to high speed rail, regional rail services and north-south links:

- **Demand.** The review of MOIRA ticketing data has provided a useful insight into the effect of service improvements in Wales. Growth in demand following investments has been positive and very strong, even where the scale of the investments has been modest, and the details included in this report suggest positive impacts with an especially positive growth in demand from the North-South service improvements.

- **High speed rail.** A national high speed rail (HSR) network would strengthen the economies of the cities connected to that network, provided that these cities receive a good level of service. Part of this strengthening would result from economic activity, from areas not connected to the network, relocating to these cities. Issues for Wales are likely, therefore, to concentrate upon Cardiff's role as the key attractor relative to other settlements. Elsewhere there is some evidence for new high speed rail links providing economic benefits, with regeneration found in London, Lyons and Lille, house price increases in London and Ashford and evidence of increased economic activity at intermediate stations along the Cologne – Frankfurt high speed line. Most recently the provision of domestic High Speed services from Ashford, Canterbury and other Kent towns has began to influence the economy of the area. From a

Wales perspective, it is clear that to achieve the greatest economic benefits from a national High Speed Rail network, Wales should be either directly connected or provide feeder "classic compatible" train services onto the network. The latter policy currently features in the public plans for the HS2 route as far as Birmingham (phase 1), with onward running on "classic" tracks to Manchester. As the Welsh Government has no devolved responsibility or funding for the national rail network, it would be a DfT responsibility to develop and fund the forthcoming High Speed Rail network, hence the need for the case to be made to DfT for such a link to Wales. We also note in the main study the possibility that HSR might have a negative impact in some areas e.g. by opening the area to increased competition.

- **Regional rail services.** Rail services that connect peripheral communities to larger urban areas on commutable train services can have a stabilising effect on rural populations. This is a key issue in a Welsh context and case study work suggests a positive relation between population growth/stabilisation and rail investment.

- **North-south links.** Experience elsewhere has shown that improvements in long-distance rail linkages largely remove the need for air services if journey times can be reduced to less than three hours. Journey times of around three hours between North and South Wales may be a realistic long-term aspiration and the performance of rail on this corridor against national trends suggest that rail has the capacity to achieve growth through modal shift rather than merely increasing mobility.

- **Local investments.** Our research has allowed us to suggest that relatively modest investments in rail improvements (such as linking services together to provide new direct journey opportunities), compared with major HSR infrastructure costs etc, can have beneficial impacts on the local economy.

- **Urban connections: Cardiff - Swansea:** Our research has suggested that improved links between strong regional centres can either lead to "agglomeration benefits" where the two locations can complement each other to act as a single location; or a redistribution of employment services from the smaller to larger centres. The exact balance between these two extremes is complex and can depend upon relative sizes and degree of competition or complementation between the two centres. With respect to the key issue of improved rail links between Swansea and Cardiff, further analysis is required, drawing upon case studies in the UK.

Case study reviews[1] of selected rail corridors in Wales that had recent experience of rail investments and improvements found:

- **Population.** A positive impact on growth. However, this trend may be associated with national population growth patterns.

[1] Based on time series analysis of socio-economic data

- **Employment.** A slowing in the decline of growth. Case study catchment areas saw a reduced decline in employment growth compared to the base line.
- **Deprivation.** No discernable impact.
- **House prices.** A slowing in the decline of growth. Case study catchment areas saw reduced decline in house prices growth compared to the base line.
- **Gross Floor Area.** A negative impact on growth.
- **Car ownership.** No discernable impact.

It is important to acknowledge that we cannot isolate rail or general transport impacts upon the economy from wider investments and trends. Thus the potential deadweight and endogeneity of impacts upon socio-economic statistics is a key issue.

The wider literature on impacts of rail investments on land use, employment and output is mixed however. For commuter services, a number of studies of light rail systems have found no impact, although other studies do claim to have found effects in some regeneration areas. The conclusions on the impact of light rail on house and other property prices are similarly mixed; studies of major schemes in some of the largest cities, including London, Dublin and Glasgow, found an effect, but studies in Manchester, Newcastle, Sunderland and Sheffield did not.

Analysis of the profile of travellers on case-study corridors provides some evidence to suggest that rail is performing an important task in providing links to jobs, education and other opportunities for those living in communities known to be deprived.

While it is hard to draw absolute conclusions, it would be expected that rail investment that provides services useful to commuters and businesses generates economic growth in the vicinity of the rail line. Access to local services and to education is also an important function fulfilled by rail. Without this wider connectivity communities may not be economically sustainable entities. Some of this growth may be due to re-distribution, but rail investment (as with other transport investment) can be important in terms of sustaining peripheral communities and binding a nation together.

Further research

It is clear that Welsh stakeholders will want to be involved in the debate over high-speed rail and other major potential improvements in the UK's rail network. What the evidence confirms beyond doubt is a clear and growing demand for rail travel in Wales at all levels. Significant projects like HSR appear unproven in terms of their economic benefits being consistent and comprehensive in all the areas studied – again emphasising the importance of endogenous factors. It seems clear however that major urban areas not considered or developed for HSR will be at a disadvantage in terms of their attractiveness to investors. Much more detailed work on this is required if we are to draw firm conclusions in a Welsh context.

The general buoyancy of rail in Wales and the results from our case studies suggest that smaller-scale investments may offer a strong foundation from which to enhance the growth of the Welsh economy. Further research with reference to case studies would appear to be required to address the key question

over whether better links between Swansea and Cardiff can create significant integration between the two cities' economies, which can raise productivity levels in both ("agglomeration benefits"), rather than the alternative prediction of a redistribution from the smaller and more peripheral economy to the larger one. Similar scenarios exist to that of Swansea-Cardiff, with Manchester-Liverpool most closely reflecting a stronger-weaker city pairing, to be contrasted to the more equal and complementary city pairings of Manchester-Leeds and possibly Edinburgh-Glasgow.

Our report highlights numerous areas where further investigation might be considered beneficial to economic policy-makers in Wales and the UK. These include inter alia:

- Consideration as to whether better links between Swansea and Cardiff can create significant integration between the two cities' economies which can raise productivity levels in both with comparative analysis between the paired cities of Edinburgh: Glasgow, Leeds: Manchester and Manchester: Liverpool.

- Refinement and enhancement of the socio-economic datasets used e.g.:
  - A longer or larger data set is obtained – this may enable regression analysis to be undertaken and tests of statistical significance to be produced (see below).
  - Analysis of results by station rather than line.
  - Rail demand by station to be drawn out so that a more direct comparison with employment and population growth by station can be made.
  - Passenger behaviour and business location surveys are undertaken to explore reasons behind encountered trends.
  - A case study is undertaken in relation to the Valley Lines to test the hypothesis that land values/house prices respond to new station provision.
  - Use of an alternative control line/corridor.
  - Widen the evidence base to beyond Wales with such examples as the Robin Hood line in Nottinghamshire/Derbyshire, and the reopening of Airdrie-Bathgate as potential examples.
  - Further work to better integrate these measures with NRTS, MOIRA, PDFH and other transport/rail data.
  - Regression analysis to identify the significant impacts of rail investment for key case studies alongside detailed work to establish net economic and social impact.
- A fuller study (such as back-casting) to analyse increases in rail demand relating to rail service improvements. This would provide firmer evidence as to:
  - The comparison of each line's performance: whether the improvement in the service is linked to a clearly increased propensity of individuals to make rail journeys, as opposed to not travelling or to choosing other modes.
  - Whether the growth seen on the study corridors has exceeded PDFH predictions, and how this growth can be explained by reference to social, economic and demographic changes in the areas served, and/or to changes in rail's service offering.

- An examination of the case for HS2-compatible trains to link London and Birmingham to North Wales coast towns.

- A comparison of the data from NRTS with the socio-economic and demographic profile of *all* the population within station catchments – that is, including those not using rail, would be desirable. This would allow a study to ascertain which travellers are benefiting from the rail service – and which are being missed, such as through car-dependency or through social exclusion.

- The NRTS data can be regarded as a little out of date and may not fully reveal changes in the profiles of rail travellers - particularly the make-up of the North Wales Coast rail market – so there would be a strong case for gathering new data from rail users on the study corridors. This would enable the impact of rail improvements on the *type* of people travelling to be studied, complementing our analysis in the previous chapter of the numbers of rail travellers.

1. Introduction

1.1 Background

In May 2010 the Welsh Government asked a consortium led by Mott MacDonald (including Colin Buchanan Associates and Institute for Transport Studies – University of Leeds) to undertake research designed to:

- Provide an overview of recent investment in rail in Wales and at a strategic level in the wider UK, in the context of general rail industry developments.
- Provide an analysis of recent trends in rail usage, including a profile breaking down such use.
- Review case studies from previous literature on the economic impacts of rail investments in Wales, the UK and wider Organisation for Economic Cooperation and Development (OECD) countries.
- Draw suitable conclusions from the evidence regarding the effects and effectiveness of different types of rail infrastructure investments, identifying where further research may be required.

The research outlined in this report was undertaken as part of the Welsh Government's Economic Research Programme, which is overseen by the Economic Research Advisory Panel.

1.2 Methodology

Our principal method has been desk research supplemented by telephone contact with academics and rail stakeholders in Wales, the rest of the UK and Europe in order to identify and explore the economic and social impact of rail under the following headings (adapted from the original proposal):

- Business location/Agglomeration
- Household location/labour market
- Regeneration and land values
- Accessibility and time savings
- Logistics, mode choice and mode shift
- Social

Environmental effects were initially considered but due to lack of relevant evidence, these were excluded from further analysis.

We have also attempted to categorise the type of investment and its applicability in a Welsh context according to the following non-exclusive headings:

- New line/reopened
- New station
- Line speed improvement
- Service frequency improvement
- Introduction of direct services eliminating interchange
- New rolling stock
- Electrification
- High speed
- Light rail
- Increased capacity
- Rural
- Urban
- Passenger
- Freight

1.3 Limitations

Our tender for this work noted… "From our extensive knowledge as a study team we are aware of the general absence of detailed ex-post analysis of new rail schemes, but that ex-ante data is usually provided in support of schemes' business cases." This view was confirmed by the client in discussion at the project inception meeting where all parties agreed that ex-post studies of rail impact would be preferred but that these were likely to be in short supply.

From the outset the Welsh Government team managing this research were clear that they wanted broad indicators of what rail investments might deliver in a Welsh context in terms of economic benefits. Initial research reviewed over 50 literatures from across the world along with a Welsh economic and transport policy context and an initial review of passenger, and some freight, rail demand and recent investments in Wales. Appendix A includes both a primary (used in Chapter 3) and a secondary (reviewed and discarded for this study) bibliography.

The emerging findings of the first stages of the research were somewhat disappointing for all concerned due to the sparsity of robust, relevant materials and we noted:

- A lack of ex-post economic impact work on rail generally – and even less material relevant to the economic, social and topographical structure of Wales.
- Most of the available reports either relate to new lines/re-openings (and are usually ex-ante) and/or discuss rail by typology e.g. high speed rather than impact on specific geographic/economic space.
- Case study materials tend to focus on increased land values – itself only a proxy measure for economic growth.
- Case study materials differentiate between economic benefits from rail investment in urban areas, inter-urban and rural with the latter clearly focussed on social impacts, some commuting and the relevance to the tourism sector.
- Positive growth in rail demand in the UK with details for Wales to follow (in this report).
- Anecdotal evidence on recent rail investments in Wales suggests mixed success.

For this reason, we carried out our own analysis of the rail demand and wider economic impacts of improvements in passenger services on a number of selected rail corridors in Wales, against a "control" corridor where changes in services had been relatively limited during the time period under consideration.

1.4 Theoretical framework

Overall the amount of firm evidence on the economic impact of rail investment appears to be weak. However, we have used the evidence that has been gathered, along with our existing understanding of how and why different rail investments lead to economic impacts, to produce a theoretical framework (TF) that will provide an overview of the different linkages and effects. The TF should help decision makers to understand what sort of impacts they might expect rail projects to deliver and also help to understand what impacts have the least data available to guide decisions and hence where additional research should be focused.

We have therefore asked "What sorts of economic impacts of rail projects might we expect?" The DfT's New Approach To Appraisal (NATA) guidance under the Economy heading suggests:

- Time savings to business users;
- Reliability benefits to business users;
- Wider economic benefits – agglomeration, labour market, imperfect competition;
- Reducing costs to transport providers.

More recent guidance from Delivering a Sustainable Transport System (DaSTS) under the Support Economic Growth heading has a similar, but different, set of measures:

- Improve Reliability;
- Improve Connectivity – time savings to business and commuting trips;
- Housing Delivery – use of transport to enable housing development;
- Enhance Resilience; and
- Wider Economic Impacts.

We assume that those benefits are generally well understood, but it is perhaps worth describing the Wider Economic Impacts in a little more detail. The traditional reliance on user benefits to describe the economic impacts of railways depends on the (demanding) economic assumption of perfect markets. In particular within those perfect market assumptions is one that says all jobs are equally productive because in a perfect market if that was not the case then labour would flood into the higher paying sector until wages were equalised.

In reality that is clearly not the case, certain locations and certain sectors maintain higher productivity levels over long periods of time. If rail schemes can be shown to assist with delivering that higher productivity then that constitutes a Wider Economic Benefit (WEB). Our team's (Colin Buchanan's) recent work on WEBs for Crossrail, successfully argued that central London - where productivity levels are higher than anywhere else in the UK - was both dependant on and constrained by rail capacity and accessibility. The arguments were broadly two-fold:

- By improving accessibility within central London Crossrail would increase competition between central London businesses improving the efficiency of the cluster as a whole; and
- By overcoming a capacity constraint into central London, Crossrail would enable growth within that highly productive cluster that would otherwise not have been possible thereby increasing UK GDP.

Current DfT guidance provides relatively simple elasticities to show how productivity of jobs increases in line with accessibility to other jobs. Thus the more that employment density and accessibility can be increased the higher employment productivity grows.

In addition to those from the Support Economic Growth heading (described above) other impacts from DASTS objectives which are likely to be important are:

- ***Regeneration*** – regeneration benefits do not necessarily increase economic output but redistribute that output in a more equitable manner, delivering other policy objectives. Railways can be powerful tools of regeneration.
- ***Reduce Regional Economic Imbalances*** – this seems to us to be very similar to regeneration, ie a redistribution of economic growth can deliver other policy objectives.
- ***Safety*** – rail is a very safe mode of travel and mode shift to rail can deliver significant safety gains.

Note that in this analysis we are ignoring many of the other impacts of railways. The main ones might be:

- ***Time savings to leisure travel***. We have included time savings to commuters as these will help the functionality of labour markets, but have ignored leisure travel. In some locations where for instance tourism is a major industry or retail then leisure travel could have significant local economic impacts.
- ***Carbon/Environment***. Rail is an environmentally friendly mode of travel and investment in rail schemes may be driven, in part, by carbon/environmental targets. That is certainly the case, but does not form part of this exercise.

Thus although we focus exclusively on the economic impacts, decision makers need to bear in mind that other issues are also important.

Within this framework and the limitations described above we have attempted to meet the client's objectives for this research project.

1.5 Rail in Wales

The rail network in Wales has experienced a similar pattern of expansion then contraction to that in the rest of the UK. The rural network began to be hit by car and bus competition from the 1930s with even the Great Western Railway applying some early closures (e.g. Dinas Mawddwy-Cemmaes Road, closed in 1931). The 1950s and 1960s brought many more closures, including major routes such as the Cambrian main line via Oswestry towards Welshpool, and many of the routes around Brecon. Even the routes which remained saw rationalisation and reductions in capacity, such as the Central Wales line and later on Wrexham-Chester – where the reduction to a single-track formation now causes serious constraints.

The run-down of the coal mining industry in the 1980s saw many routes which had become freight-only threatened with total closure. To assist with the regeneration of these former coal mining areas, service improvements began to be examined, with the first of many reopenings being the Aberdare branch in the Cardiff Valleys network in 1988. This was followed by other routes such as Maesteg (1992), the Swanline (local services on the mainline between Cardiff and Swansea – restored in 1994) and most recently the Vale of Glamorgan line (2005) and the Ebbw Vale Parkway (2008).

Other cases exist of individual stations reopening, such as at Conwy (1987). Service upgrades have also been implemented, with increased frequencies along the Valley lines into Cardiff and the introduction of the standard interval timetable throughout the core Arriva Trains Wales area in 2005. This is discussed further in the context of our rail corridor case studies.

Wrexham in particular has seen a major improvement in services, with an alternate-hour Birmingham-Chester service progressing to regular direct links to Birmingham International, Cardiff, Bangor, and even London Marylebone via the recent Wrexham and Shropshire open access operation. Increased frequencies are also planned for the Cambrian lines from Shrewsbury to Aberystwyth and for the Ebbw Vale line. Studies are under way into the extension of the Aberdare line to Hirwaun, and the provision of additional peak services between Pontypridd and Cardiff.

Not all recent rail investments have been successful with, for example, the Swanline service performing relatively poorly, in part due to the only alternate-hour service and the loss of many of the employment opportunities along the corridor since the scheme was first proposed. The Welsh Government has identified Valley lines electrification (to include Vale of Glamorgan, Maesteg and Ebbw Valley Railway, as well as the core Valleys network) as a key priority for Wales, alongside increased investment in accessibility, for DfT investment in the forthcoming Control Period 5. The formal Welsh Government response to the consultation on the next High-Level Output Statement (HLOS) will make a strong case for this.

Details of current flows and expected future developments in the rail freight sector in Wales are given in the next chapter, in the context of our review of Network Rail's policy document, its Route Utilisation Strategy.

1.6 Coverage

In this document we provide:

- An overview of the background, including the current role of rail in Wales.
- A review of the policy context at national and regional level.

- A review of relevant literature.
- A review of selected social and economic datasets around the same rail lines, including the control, in order to ascertain economic impacts from the Welsh rail investments.
- Headline results of a desk review of passenger demand for rail in Wales and a case study analysis of the impact of rail investments on passenger demand for selected Welsh rail corridors, plus a review of a control line where there was no investment over the same period.
- A review of National Rail Travel Survey data to ascertain a demographic profile of rail users on the case study corridors.
- Overall conclusions.

2. Policy Context

This section details the various policies which have been developed to deliver investment in the railways not just in Wales but across Great Britain. This chapter highlights some of these policies to detail the types of investment that have been undertaken and the expected benefits.

2.1 UK National Policy

At national level, transport policy remains very much in a state of flux since the Coalition Government took office in Westminster. This being the case, despite many policy documents created by the previous government not yet having been fully replaced, the extent to which such material as the 2007 *Delivering a Sustainable Railway* White Paper can be relied upon is, we consider, limited.

Wider government initiatives of clear potential relevance to UK-level rail planning would, however, include the following:

- Decentralisation and "localism", including devolving some financial decision-making to local and/or regional level, and decentralising land-use planning. Examples include:
  - The Regional Growth Fund, intended to support private-sector investment to create economic growth and sustainable jobs. The Fund is stated as being "*available to support transport infrastructure which, as part of a wider investment, unlocks specific business investments*";
  - Local Enterprise Partnerships, to bring together business and civic leaders to set strategy and take decisions affecting their local areas' economic wellbeing – including on matters relating to planning and transport;
  - Tax Increment Financing (TIF), designed to support infrastructure and capital projects to assist economic growth.
- A simplification of local transport funding into fewer separate streams – essentially:
  - Major schemes capital funding (over £5m);
  - Capital funding for local highway maintenance;
  - An additional block of capital funding for integrated transport projects; and
  - the Local Sustainable Transport Fund, capital and revenue funding to enable local authorities to deliver transport interventions assisting low-carbon economic growth, improved safety and increased levels of physical activity.

It is clear, however, that wider government fiscal policy is likely to lead to significant overall pressure on public finance, with less available in total for both revenue and capital funding.

2.1.1 Local Transport White Paper and DfT Business Plan

One specific policy document which has already appeared has been the White Paper on local transport[2]. This builds on the "localism agenda" and develops the themes listed above. In particular, the document:

- establishes the Local Sustainable Transport Fund (see above);
- underlines stated Government support for developing rail for longer journeys, referring explicitly to Crossrail and High Speed 2;
- emphasises a desire to "[end] *the top-down decision-making and the tendency in Whitehall to develop one-size-fits-all solutions*";

[2] *Creating Growth, Cutting Carbon: Making Sustainable Local Transport Happen* (Cm 7996, 19 January 2011)

- commits Government to enabling most public transport journeys to be undertaken with a smart ticket by December 2014; and
- indicates an intention to review the way in which investment decisions are made, in order to ensure that the carbon implications are fully recognised – implying potential changes to investment appraisal guidance, which could benefit low-carbon modes such as rail.

While the implications for Wales are clearly going to differ from those for the English regions in the light of the devolution which already exists, and once again details of Government policy as regards further devolution of power to Wales in the transport sphere are not yet available, the implication would appear to be that the general move will be towards more, rather than less, decision-making power being held in Cardiff rather than London. Indeed, it seems likely that Welsh regions and local authorities will have more freedom to make their own plans for transport projects which affect them. However, as noted above, whether such planning powers will be followed by the finance necessary to put such plans into practice would appear to be open to question.

Another question which appears to arise in the context of the move towards "localism" is that of the fate of the strategic-level planning which larger transport projects (such as network electrification and high-speed rail) would seem to necessitate: clearly these cannot be decided at local level – indeed at present some require UK-wide rather than Wales-level decision-making – and it is to be hoped that a policy and planning vacuum will not emerge in this important area.

In November 2010, DfT published a "Business Plan" which, as one would expect, is closely aligned to these policies. In addition to the "localism" theme, other issues which it draws out include a stated desire to obtain greater cost-efficiency from the rail network and its operators with a view to addressing the high cost of Britain's rail network, (by international standards), and a less prescriptive approach to specifying the services which train operating companies should provide.

2.1.2 The British railway: HLOS, Value for Money and Network Rail

Within the railway itself, projects forming part of the High-Level Output Statement for Control Period 4 (CP4 2009-2014) continue to be delivered, but, beyond this, the status of many enhancements proposed for CP5 and further into the future is less clear, other than certain high-profile projects such as the Crossrail, North-Western electrification and the ongoing Thameslink programme. These last-named were specifically mentioned during the 2010 "Spending Review" announcement; others remain under review, including, of particular relevance to Wales, the question of the electrification of the Great Western Mainline and the linked issue of the replacement of the country's diesel HST (Intercity 125) fleet.

The McNulty review into value-for-money on Britain's railway is ongoing, though some preliminary conclusions have been published. These indicate a belief that there is scope for substantial cost savings whilst retaining the current overall structure of the privatised industry (which Government policy favours retaining), beyond those already assumed from TOCs and Network Rail. These would be achieved by (quoting from the interim report):

- *greater clarity and better alignment of objectives, particularly in relation to costs;*
- *greater clarity of roles between Government and industry, with Government involved in less detail, and the rail industry accepting greater responsibility for delivering the broad objectives set by Government;*
- *industry accepting responsibility for helping to develop, and then implementing, a comprehensive set of industry-level strategies to meet the broad objectives set by Government, particularly those for cost reduction;*

- *a much stronger focus by the industry at all levels on costs and cost reduction, and on the investment needed to reduce future costs;*
- *structuring the industry for cost reduction – the principal key to delivering cost savings is how organisations and people work together, and there is a pressing need to develop structures which enable/require infrastructure managers and train operators to work together in much closer partnership to meet cost reduction objectives;*
- *stronger incentives which better focus and align the interests of Network Rail and train operators towards delivering lower costs, in line with objectives set by Government;*
- *reform of franchising arrangements to facilitate cost reduction; (Government is already addressing the area of franchising, and this Study has further ideas to put forward);*
- *leadership for cost reduction; making the changes required to realise potential savings will present major challenges, which can be met only if there is strong and aligned leadership from Government and the Industry;*
- *improved planning and decision-making, on whole-system and whole-life bases,*
- *with a stronger focus on costs and value for money;*
- *a more cost-effective approach to standards and rail safety (whilst continuing the drive for improved safety performance);*
- *major improvements in asset management, programme and project management, and supply chain management; and*
- *improved management of human resources.*

The savings discussed (of the order of £600m to £1,000m per year by 2018/19) are on the basis of maintaining services at their current levels. However, and particularly notably for Wales with many rail lines serving areas of low population density, it is also understood that the review may highlight once again the high relative cost of providing rail services in rural areas – with the industry's high built-in and fixed costs being defrayed by lower passenger revenues than on more heavily-used services. This is an area which repeated reports into railway finances have highlighted over decades[3]; while the observations could be regarded as self-evident, at a time of UK Government policy to decrease public spending in most areas, pressure on such services could increase despite record passenger numbers on many such lines. Once again, however, the devolution of responsibility for the Wales & Border franchise to the Welsh Government could be regarded as affording Wales a degree of protection from any such pressures – subject to the ongoing availability of revenue support.

Finally, DfT is also in the process of carrying out a review specifically into the passenger rail franchising process itself. Whilst once again this has not yet finished, it appears likely to seek to draw together stated Government policy with the emerging findings of the McNulty review and lead to:

- Franchises for longer time periods;
- Franchisees having a greater degree of freedom in deciding what services to operate, and how;
- Stronger incentives for franchisees to improve the cost-effectiveness of their operations, lowering the overall cost of the railway;
- New forms of co-operation with Network Rail as infrastructure provider – or even in some cases pilot schemes to investigate the scope for vertical integration, under which the rail operator takes over responsibility for the railway infrastructure; and
- A higher degree of commercial risk passing to the franchisee (though it remains to be seen how far this could be reconciled with a desire to lower the financial cost to the taxpayer of the franchise).

[3] Including Beeching in the 1960s and Serpell in the 1980s; clearly high relative costs in outlying areas are a characteristic of many types of infrastructure network, not only within transport.

Network Rail's principal planning strategy documents are its Route Utilisation Strategies, which is it required under its Network Licence to produce regularly and keep updated. Alongside the Wales RUS described subsequently in this chapter, other RUS documents of potential relevance to Wales include:

- The Great Western RUS (March 2010), covering the mainline to Paddington – however, the most important strategic interventions from the point of view of through links to and from Wales, the electrification of the route and the connected questions of new trains and signalling for the route, remain under Government-level review and as such the RUS is to this extent superseded. Nonetheless, the issues it identifies which are of relevance to Wales include capacity between South Wales and the South Coast, interurban journey times, plus peak train and station crowding in and around the main urban centres.
- Network RUS documents, comprising four documents, of which the most recent and relevant one is that dealing with electrification – once again, however, this is in large part itself now eclipsed by the ongoing policy review into this area at Government level.
- Freight RUS, which is dealt with subsequently in this chapter.

These documents represent the first-generation RUS. Network Rail is now in the process of working towards replacing these with updated documents; the second-generation RUS programme is intended to emphasise the longer-term strategies to be recommended, taking a thirty-year time-frame and with the RUS documents themselves divided along more strategic than strictly geographical lines. However, the first-generation Wales RUS is a relatively recent document, which already has some elements of this approach, and therefore its replacement by a second-generation RUS is not likely to fall due for some time.

2.2 One Wales

It is important to place a study of this nature in the wider context of the economic, social and environmental well-being of Wales and indeed the political commitments of the Welsh Government. These are encapsulated in 'One Wales' – a progressive agenda for the government of Wales (2007). Since this current study has commenced there has been a change in administration at Welsh Government, and as such One Wales represents the programme of the previous administration, with a new programme currently being finalised.

As the title suggests, One Wales set out a programme to promote social justice, sustainability and inclusiveity for the whole of Wales and for its entire people. WAG's vision at the time was of a Wales with a strong and enterprising economy and full employment based on quality jobs. Relevant extracts include:

> "Everyone must have the opportunity to achieve a reasonable standard of living, no matter where they live or what they do. Full employment supports and sustains communities in all parts of Wales and helps to tackle poverty and disadvantage wherever it occurs."
>
> "Recognising the importance of an all-Wales approach to securing economic prosperity, we will do our utmost to create and retain jobs across the whole of Wales, in rural and urban communities alike."
>
> "We will target those areas in greatest need, wherever they occur in Wales."
>
> "We will use all the tools available to us, from public procurement and support for private investment to European Union funding to enable businesses to flourish and expand. In doing so, we will work closely with business and trade unions to ensure that both are fully equipped for the challenges of global competition."

The programme of government provided for four sets of economic interventions:

Creating jobs across Wales – implementation of labour market strategy with the long term goal of an employment rate of 80%. Priorities include: the continuation of key regeneration programmes in the Heads of the Valleys and Mon a Menai (Anglesey) and working alongside the Department for Work and Pensions (DWP) to help people back into work.
Stimulating enterprise and business growth – focusing on stimulating small and medium sized enterprises (SMEs) through business rate relief, single investment fund for business support, increased support for farmers' markets.
Promoting tourism – promoting Wales externally, investing in facilities and employee skills and providing support for the tourism industry as it moves towards short breaks and activity breaks.
Enhancing skills for jobs – developing links between education and entrepreneurship and encouraging procurement which incentivises training opportunities for the unemployed.

2.3 Transport priorities: the Wales Transport Strategy

Proposals for improving regional and national transport include inter alia:

- A programme for improved North-South links, including travel by road and rail.
- Reduced rail travel time between the North and South of Wales.
- A new all-Wales Traws Cambria transport network integrating long distance rail and coach routes with electronic cross-ticketing by 2011.
- Improved safety and quality of stations and platforms in all parts of Wales, introducing new trains and train services.
- Enhanced rail discount arrangements for pensioners.
- Development of a plan to move freight from road to rail.
- Carbon reduction.

These priorities are developed further in the *Wales Transport Strategy*, setting out a series of high-level outcomes that transport policy across all modes should aim to achieve, and the steps required to deliver these. The outcomes cover social, environmental and economic criteria, and identify appropriate targets and/or indicators for assessing progress. The strategy then identifies main priorities to move towards the outcomes specified, namely:

- reducing greenhouse gas emissions and other environmental impacts;
- integrating local transport;
- improving access between key settlements and sites;
- enhancing international connectivity; and
- increasing safety and security.

Specific actions are then set out, together with mechanisms for their delivery and monitoring.

2.4 The National Transport Plan

In 2010 the National Transport Plan for Wales was published to deliver a framework for the creation of an integrated transport system, so delivering the Wales Transport Strategy. The National Transport Plan sits alongside the Regional Transport Plans in delivering the Wales Transport Plan.

One of its main aims is to improve the provision of, and access to, rail services, including improvements for disabled people and vulnerable users, by 2014.

This will be achieved through improving the provision of, and access to, rail services therefore encouraging greater levels of modal transfer. The plan for rail seeks to address the relevant provision and access issues, these include:

a. Remove, on a priority basis, high steps between platforms and trains, particularly on rural stations, by 2011 (a pilot programme is in place in Aberdyfi, with a second pilot at Valley station on Anglesey).
b. Work with Network Rail and Arriva Trains Wales on delivery of the National Stations Improvement Programme, by 2014.
c. Refurbish and invest in rolling stock to improve the actual and perceived security, level of comfort and journey times on trains, by 2014.
d. Improve the provision for cycles on new and existing trains and associated promotion of new services.

The 'National Transport Plan' sets out the Welsh Government's intention to improve reliability and speed of journeys between North and South Wales. The North-South rail line follows a core network across Wales but with a sizeable part of the route passing through England. Improving the speed and reliability of rail travel in the short to medium-term will mean focussing on the capacity pinch-points that limit service provision.

Future planning will require the investigation of how the rail infrastructure can be adapted to accommodate more frequent, cleaner and faster trains and how this can be served by an internal, long-distance public transport network. The plan for rail seeks to address the North/South divide through:

a. Supporting the 'Y Gerallt Gymro Holyhead to Cardiff' fast train service, and a programme of continued improvements in rail services between north and south Wales.
b. Develop plans to enhance the capacity of the section of line between Shrewsbury and Chester via Wrexham to permit faster services between North and South Wales, with potentially higher frequencies by 2011.

The document states that East/West travel in South Wales is dominated by movements between key settlements of Cardiff, Swansea and Newport and their surrounding areas. The most heavily used part of the rail network in Wales is around Cardiff, which is the focal point for the Valleys Lines network. To the west of Swansea, a five-mile single-track section between Gowerton and Loughor is a major pinch-point, constraining timetabling and restricting any potential growth of passenger services along the corridor.

Passenger levels peak with the flow of commuters between the Valleys, Cardiff, Newport and Swansea. In May 2009 a half-hourly service between Merthyr Tydfil and Cardiff was introduced, potentially attracting more commuters and thus reducing the peak pressures on the road network. Other initiatives have included improvements to the rail services, particularly the Great Western Main Line between Swansea and London. This was achieved through, firstly, making improvements to existing services. Secondly, pursuing electrification of the Main Line between Swansea and London - this will not only be better for the environment, but provide quieter, more reliable trains and reduce journey times. Thirdly; delivering a high speed rail network, along with electrification of the Main Line, to reduce travel times.

Rail seeks to improve East/West travel issues in south Wales through:

a. Increase the capacity, quality and performance of the Valleys Lines network, by: Creating additional platforms at Pontypridd, Caerphilly and Barry, with work starting by 2014; Introducing additional carriages to peak time services and adding a new station at Energlyn, by 2014; Developing plans to introduce additional services on the lines from Pontypridd and Caerphilly to Cardiff.
b. Work with Network Rail to redouble the railway line between Gowerton and Loughor.

c. Introduce additional half-hourly services on the Vale of Glamorgan Line, which will facilitate access to Cardiff Airport.
d. Work with the UK Government to develop the plans to electrify the Great Western Main Line as far as Swansea.

The East/West Corridor in north Wales is primarily between key sites and settlements, for example long distance travel between Ireland, Holyhead and England. The initiatives relating to the North/South programme of improvements relate to the East/West corridor in North Wales.

East/West travel in mid-Wales is centralised around small and medium-sized towns and rural communities. The Cambrian Line provides the primary east-west rail link in mid-Wales connecting Pwllheli and Aberystwyth, through Newtown to Shrewsbury and beyond. Services on the Heart of Wales Line provide east-west travel opportunities serving the communities between Carmarthen, Llanelli, Swansea and Shrewsbury. Work will shortly be complete to enhance the Cambrian Line by providing additional and improved passing loops between Aberystwyth and Shrewsbury. This will improve east-west rail links, making it easier for people to replace car journeys with train travel, and better integration between bus and rail services.

Initiatives include:
- Introduce hourly services between Aberystwyth and Shrewsbury, by 2011.
- Develop plans to introduce additional services on the Heart of Wales Line.

The various rail initiatives have been brought together in a single overview document, the *Rail Forward Programme*[4], summarising schemes which contribute to the strategies of the Assembly Government and therefore have its support. It includes schemes across the country which have:
- Been approved;
- Been approved in principle;
- High-ranking potential for early approval;
- High ranking but under further development.

Beyond this, the 'National Transport Plan' states that after 2015 there will be a need for a fast, reliable and affordable public transport service connecting major settlements. This vision will include a 'fast, reliable and frequent' rail service to provide links to London, Manchester and beyond.

2.5 Welsh Rail Policy

The UK and Welsh Governments have created a number of overarching aims for rail, which include:
- Delivering value for money and improving affordability
- Improving performance
- Improving accessibility
- Responding to demand and increase capacity
- Contributing to national productivity and supporting the economy
- Maintaining and improving rail's environment-friendliness.

4 Available at http://wales.gov.uk/docs/det/publications/081204documentrailforwardprogramme2008en.pdf

2.5.1 Wales Rail Planning Assessment (WRPA)

The WRPA was published in July 2007 and was a joint venture between the Welsh Assembly and the Department for Transport (DfT) looking at potential growth in demand between 2006 and 2026 and what might be done to meet this growth. The WRPA highlights a number of committed rail enhancements; these include:

- The Vale of Glamorgan line reopening in 2005.
- Reopening of the Ebbw Valley Line (6 new stations from Ebbw Vale Parkway to Cardiff Central and a bus link from Rogerstone Station to Newport centre (2007).
- Additional Platform at Newport (2007)
- Newport Station redevelopment Phase II (2009)
- Lengthening 42 platforms on the Cardiff Valleys network to accommodate longer trains (on-going)
- Frequency enhancement on the Merthyr Tydfil to Cardiff route incorporating a new station at Abercynon.

This 2007 document suggested that demand for rail would increase dramatically in Wales. A number of factors to influence changes in such demand for rail services up to 2026 were identified and included:

- Economic growth of the market served by rail.
- Future changes to land use linked to the Wales Spatial Plan and Economic Development Strategies.
- Changes to other modes of transport including developments at ports and airports.
- Increased highway congestion.
- Possible introduction of road user charges in Cardiff.
- Demand generated by changes to either the rail network or services.
- Behavioural changes, including life-style and work practices, and technological advances.

It is also believed that market development of rail freight in Wales would increase due to growth of coal, steel, other bulk, automotive, timber and Inter-modal business.

The WRPA objectives are to:

- Develop rail as part of an integrated transport network
- Facilitate multi-modal access to and from the railway
- Remove psychological barriers to rail use including providing up-to-date information on services and facilities.
- Improve physical access at stations and on trains
- Tackle crowding and provide a more integrated service.

The WRPA also carried out a considerable amount of stakeholder engagement. Key issues emerging from this included (National Issues):

- Improving access to the rail network
- Improving train performance
- Improving station and train facilities
- Support the transfer of freight to rail.
- Long-term rail planning

And (Local Issues):

- Levels and type of service
- Demand exceeding existing capacity
- Train lengthening

The WRPA set out a series of short (period to 2014), medium (up to 2019) and long term options (beyond 2019). These options are split by area and set out in Appendix B.

2.5.2 SEWTA Regional Transport Plan

The SEWTA Rail Strategy 2009-2018 should build on current investment in the capacity and performance of the network through:

- Longer platforms to accommodate longer trains
- Improved junctions, reduced signal spacing and dynamic passing loops to improve journey times and reduce delays.
- Improved access to stations – including investment in car parking at key locations.
- Improvements in station environments including safety measures.

A number of these strategies have been developed and are outlined below.

Table 2.1: Summary Strategy

Summary Strategy
Additional rolling stock to strengthen peak trains to provide for passenger growth and to avoid overcrowding and rolling stock renewal.
Station improvements including improved station facilities, information, security and access – including additional parking.
Reliability and capacity improvements: changes to the network to reduce delays and improve the ability to cope with performance problems; specifically at Cardiff Central, Cardiff Queen Street, Barry, Cogan Junction and Llandaff.
Frequency enhancements on existing lines; improving the levels of service on selected routes to meet passengers' expectations and increase the transfer of car trips to rail; specifically new services on the Abergavenny, Chepstow, Ebbw Vale, Rhymney Valley, Taff Vale and Vale of Glamorgan Lines. Additional services to the north of Cardiff are required to cope with the growth in passenger demand and will require a significant investment in the capacity of the network at and between Cardiff Queen Street and Cardiff Central stations;
New stations on existing lines; improving access to the rail network and integrated with the development of improved services; specifically at Caerleon, Magor with Undy, Llanwern, Coedkernew and St Mellons, with those on the main line between Cardiff and Severn Tunnel sited on the Relief Lines;
Network extensions and new stations; to investigate further improving access to the rail network through extending to Ebbw Vale Town and from Pontyclun to Beddau (with stations at Talbot Green, Llantrisant, Gwaun Meisgyn & Beddau)
Rail – Link Bus Services; to extend the reach of the rail services to communities remote from the network, specifically providing access to the Valleys to the north of Cardiff and Newport.

2.5.3 TAITH: North Wales Rail Strategy Study

The North Wales Rail Strategy Study takes forward the 'Wales Transport Strategy – One Wales Connecting the Nation'. There are a number of different sources of guidance as to the direction of rail services in North Wales. These include National Policy such as 'One Wales' and 'Wales Rail Planning Assessment' and the industry strategies such as the 'Wales RUS' and 'Network Rail Strategic Business Plan' and also the regional and local political/community aspirations. It should be noted that electrification of the line was not considered for the study. Passenger feedback identified a number of aspirations, and the key findings identified are in the table below.

Table 2.2: Passenger Feedback Aspirations

Passenger Feedback Aspirations	Key Findings
Direct trains between North Wales and Manchester Airport	The extension of the Llandudno-Manchester service to Manchester Airport is a 'quick win' which generates an extremely good BCR. This is currently being actively pursued by Arriva Trains Wales; The re-doubling of the Wrexham-Saltney Junction line allows either a Wrexham-Chester shuttle service or a Wrexham-Manchester Airport service to be introduced. Both options record excellent BCRs (assuming re-doubling is already funded).
Faster trains between North Wales and Manchester	An additional 'fast' North Wales Coast Line (NWCL) service (in the path when the London train doesn't operate) to/from Holyhead is economically viable; A new half-hourly local service between Rhyl and Chester/Crewe is viable and is the only viable way to serve new stations at Greenfield and Queensferry; The Llandudno-Manchester service can be speeded up by dropping the local calls between Chester and Oxford Road (except Warrington Bank Quay). A new hourly stopping service between Chester and Manchester picks up these local calls and doubles the service frequency between Chester and Manchester. Line speed improvements on the NWCL are currently being investigated by Network Rail. Our initial analysis suggests that a positive business case for investment should be achievable and that line speed improvements should therefore be pursued. All proposals accommodate for one freight train path per hour along the NWCL.
Potential use of the Halton Curve to link North Wales to Liverpool Airport	The Halton Curve service options did not generate positive BCRs – although this can be partially explained by modelling constraints in this particular case. The recommendation is that further more relevant demand forecasting is undertaken to assess this proposed infrastructure enhancement.
Direct trains between Wrexham and Liverpool should be via the Borderlands line (not Halton Curve)	The economic business case for the extension of the Borderlands service into Liverpool could be improved if dual power vehicles are considered. Short term extension into Birkenhead North should be investigated.
Frequency improvements on the Borderlands Line and better connectivity at Shotton	The parallel Borderlands Line Study has demonstrated that increasing the current service frequency to half-hourly generates a positive economic business case. It is only worthwhile calling all NWCL services at Shotton once the Borderlands service is half-hourly.
Faster line speed to generate quicker north/south journey times	The introduction of a new shuttle service between Llandudno Junction and Bangor produces a positive business case, mainly because it facilitates the speeding up of the Holyhead services. New stations at Queensferry, Greenfield, Towyn and Kinmel Bay, Johnstown, Rossett and Deeside Park produce a positive economic business case.
Improve cross-Chester service towards Crewe	

Assume re-doubling of the line between Wrexham and Chester (funding from WAG)

The Strategy for introducing rail service enhancements was developed with short-term enhancements being 0 to 2 years, medium 3 to 10 years and long 11 to 15 years.

2.5.4 SWWITCH: The Regional Transport Plan for South Wales 2010-2015

This document included three rail priorities for South West Wales. Priority 1 is improvement to rail services to the west of Swansea. The policy proposes the redoubling of the line west of Swansea to secure improved services to west Wales with three trains per hour between Swansea, Gowerton, Llanelli and Carmarthen, an hourly service from Carmarthen to Milford Haven and five trains per day to Fishguard Harbour.

Priority 2 is to improve rail services to Cardiff, Bristol and London. Proposals for doing this include reducing the journey times to Cardiff, London and beyond, improving access and facilities at mainline stations drawing on all sources including the National Station Improvement programme funds and EU Convergence funding.

Priority 3 is to improve access to and use of rail services. Proposals for achieving this include:
- Five trains per day on the Heart of Wales Line (HOWL);
- Improving the Swanline service;
- Developing new stations where justified and reviewing the long term role of smaller stations; and
- Maintenance and development of the South Wales Community Rail Partnership.

2.5.5 TraCC Regional Transport Plan (2009)

Trafnidiaeth Canolbarth Cymru (TraCC) is the Regional Transport Consortium for the Mid Wales region, made up of the counties of Ceredigion, Powys and part of Gwynedd (the former Meirionnydd district) and includes parts of the Snowdonia and Brecon Beacons National Parks. The Consortium seeks to work together and with partners to deliver improvements to the transport system in and to the TraCC region.

The Welsh Government requires each of the four Regional Transport Consortia to submit a Regional Transport Plan (RTP). The RTP has undertaken an analysis of the movement problems in Mid Wales – passenger and freight, road and rail, it has identified a Vision for the region, developed transport policies to address identified problems and to build on opportunities. In preparing the RTP TraCC has drawn on a wide range of policy documents – One Wales, the Spatial Plan, the Wales Transport Strategy and the National Transport Plan. Other important policy documents include those on sustainability, climate change, rural health planning and the strategy for older people.

The following schemes have been identified to achieve the 'Rail' aims of the mid Wales region:
- Introduction of an hourly service between Aberystwyth and Shrewsbury, by 2011;
- Develop plans to introduce additional services on the Heart of Wales Line;
- Improve the reliability, quality and frequency of the east/west rail corridor in mid Wales;
- The introduction of a Welsh Transport Entitlement card for bus and rail services, which would include integrated ticketing to allow 'seamless' transfer between services and operation between services and operation by 2014;
- Working with Network Rail and Arriva Trains Wales to deliver the National Station Improvement Programme and refurbishment and investment in rolling stock; and

– To improve the sustainability of freight movements, including supporting a modal shift of freight from road to rail where environmental, economic and social benefits can be achieved.

Table 2.3: Problems and opportunities

Problems	Opportunities
Low performance of the railway network in terms of the percentage of trains on the Cambrian Lines arriving on time.	There is potential to develop the role of rail freight, thus reducing the pressure of heavy goods movements on the road network – particularly for timber, slate waste and supermarket supplies.
Unmanned crossing points on the rail network pose a safety concern and affect the reliability of rail journeys.	There is potential to provide a new rail link running North-South entirely within Wales to improve North-South access and reduce the impact of travel on the environment. A full study is required to investigate the route options and viability of such a service running along the western side of Wales, upgrading existing lines (such as the Cambrian Coast and Heart of Wales Lines) and requiring sections of new line. Whilst this is a longer term aspiration for delivery, planning is required now.
There is a lack of facilities at rail stations including parking, disabled access and interchange with bus services, walking and cycling routes.	There are a number of opportunities with regard to promoting the use of public transport. A significant number of initiatives have been undertaken, for example, on the Cambrian Railways Partnership.

Priorities and transport planning objectives include:

– Maintain and improve the existing transport infrastructure (road and rail)
– Improve and develop the TraCC region's rail network to maximise the benefits of the rail network for local and regional journeys
– Maintain and upgrade the TraCC region's road and rail networks
– Protect the line of the former rail routes and land for other transport infrastructure in order that future opportunities for new services and facilities are not jeopardised
– Develop the strategic networks (road and rail within the TraCC region and links to and within other regions)
– Undertake improvements at railway and bus stations with regard to lighting, access, waiting facilities and information
– Identify a programme of improvements at unmanned rail crossings
– Provide parking (cycle and car) at railway stations and other interchange nodes
– Proposals are currently in hand to provide further passing loops and the introduction of an hourly service on the Cambrian Mainline by 2010
– Providing an acceptable standard of network (both road and rail) is essential for mid-Wales to be economically competitive, develop its tourism role and provide an improved level of accessibility to employment and services
– Consideration of a freight distribution centre and opportunities to use rail for the transportation of freight.

2.6 Freight

2.6.1 Wales Freight Strategy

The Wales Freight Strategy of May 2008 sets out a clear hierarchy of actions to make freight more sustainable and Wales more competitive in the longer term:

- **Minimise the demands on the transport system** – to adopt spatial planning policies which maximise local sourcing of goods wherever possible
- **Promote more sustainable forms of transport** – to encourage modal shift towards rail and water based freight transport
- **Make maximum use of existing infrastructure** – to make the best use of each network and mode of transport for freight

Further to these three over-riding principles specific targets have been identified.

2.6.2 Rail Freight in Great Britain – Freight RUS

The overall size of the surface freight market (rail and HGV) in Great Britain has grown by 8% over the 10 years to 2004 to 1,933 million tonnes lifted, with rail freight having a 5% share of the market in terms of tonnes lifted. This rail market share has remained fairly static over the past 10 years, though as the Freight RUS states 'it is however a static share of an expanding market'. In terms of tonne-kilometres rail freight has a 12% share, an increase from the 10% mode share rail had in 1994. The increase in tonne kilometres is primarily a result of changes in flows for the Electricity Supply Industry (ESI), with the switch over the last decade to long-distance coal flows from Scottish ports to power stations in England following the closure of many English collieries.

2.6.3 Baseline Demand in Wales

The busiest part of the network for freight traffic is around Newport and Cardiff, although there are some minor freight flows elsewhere, particularly the north Wales coast.

Metals – The busiest area is in South Wales; this reflects the production at the major steelwork sites (at Port Talbot, Cardiff and Llanwern) and other sites at Trostre in west Wales and Shotton on Deeside. There are also substantial flows of finished products from Wales to the West Midlands and the North West with scrap metals moved to Cardiff docks. North Wales has some steel export traffic through Mostyn Dock.

Coal - There are flows to the principal power station in Wales which is located in Aberthaw, on the coast between Cardiff and Bridgend. Welsh-produced coal is a major part of the intake at Aberthaw, which is considered to have a long-term future, but some coal is imported to Wales through the Royal Portbury dock at Bristol, and passes by rail through the Severn Tunnel. Uskmouth Power Station near Newport also receives significant quantities of coal by rail. Transport of coal from the opencast mine at Cwmbargoed (near Merthyr Tydfil) by rail restarted during January 2008. This site uses the freight-only branch to Ystrad Mynach on the Rhymney Valley section of the South Wales Valleys route.

Intermodal – There is one major inter-modal terminal in Wales at Wentloog to the east of Cardiff. This site receives deep-sea container traffic from the port of Southampton by rail for onward distribution by road to south and mid-Wales.

Other commodities include oil moved from the refinery at Milford Haven, and a limited quantity of tar flows from Shellhaven to Llandarcy. Automotive products are conveyed to Ford's plant in Bridgend. Aggregates traffic is conveyed from a number of supply sources in south Wales. Forest products (timber) are handled in North Wales near Chirk and nuclear traffic from Wylfa power station, on the north coast of Anglesey, uses Valley as a railhead. Aluminium flows from Holyhead and aggregates from Penmaenmawr quarry have both recently ceased, significantly reducing freight flows on the north Wales coast.

2.6.4 Future Demand - Wales RUS

As noted above, Network Rail has developed a series of Route Utilisation Studies across England, Scotland and Wales. These Strategies look at the expected demand across the rail market over the short-mid-term – the initial generation of RUSs covering a ten-year timescale. The Freight RUS, which was published in March 2007, developed a series of forecasts over a period of ten years to 2014/15.

In the Wales RUS area there are expected to be modest changes to traffic from the base year of 2004/05, with the Freight RUS showing a change of up to 4.9 extra trains per day for the whole of the Wales RUS area, with the effect on the freight tonnes moved per annum being more variable.

The routes identified as having the greatest change are the South Wales Main Line (SWML) and the north/south Marches route to Crewe. Traffic on the SWML is expected to increase to between 6 and 12 million freight tonnes per annum with traffic on the north/south route from Newport to Crewe expected to increase to between 3 to 5.9 million freight tonnes per annum. The Freight RUS noted that 'there were no significant capacity gaps identified in Wales…' – in other words, it expects the existing network to be able to accommodate the growth in freight traffic forecast over the RUS timescale.

2.6.5 Freight Modal Choice Study – Department for Transport

The DfT study into freight mode choice reported in November 2010. This highlighted a range of issues, including factors influencing the choice of rail for freight movements, and markets where rail freight has the potential to grow.

In terms of choice of mode, the following factors were identified as favouring rail freight over other modes:

- Availability of rail access points;
- Large consignments of goods;
- Regular flows of traffic; and
- Longer distances to travel.

Factors limiting the use of rail for freight transport were identified as:

- Limited network coverage;
- High costs of infrastructure provision and maintenance;
- Route capacity and capability constraints;
- Requirement for road transport at one or both ends of the rail journey;
- Transhipment costs and risks; and
- Regulatory and financial barriers to new operators.

The potential for growth for rail freight in certain sectors was discussed. Markets with potential include containers, automotive, aggregates and metals. Others which could also be considered are retail goods, construction materials, agricultural and forestry products, biomass and industrial chemicals.

Specific flows with potential for modal shift have also been identified – within Wales the only specific new flow identified is a possible roll on – roll off service linking Holyhead along the North Wales coast with North West England. It should also be noted that for the majority of the flows which have been identified, industry action is required to shift freight to rail rather than the provision of any additional infrastructure or technology – and therefore it is market-based factors and potential policy-level interventions shifting the balance of cost and convenience in favour of rail freight that would appear to be the key to modal shift.

2.6.6 Strategic Rail Freight Interchange Policy – Strategic Rail Authority

The SRA policy was published in 2004 and outlines the various issues to consider when locating Rail Freight Interchange (RFI) facilities. While the SRA itself is now defunct (its functions having been subsumed by DfT Rail), the conclusions of the report remain relevant. RFI are locations which allow freight to be transferred between modes; they should be located in order to maximise the rail leg of any journey, while minimising its road leg. They must have good connections to both the rail network and the strategic road network. They should also be appropriately located near to their potential markets and to a potential workforce.

The key issues to consider when locating an RFI facility are:

- Rail and road access;
- Ability to work the site 24 hours a day, 7 days a week;
- Availability of an adequate, level site with potential for expansion;
- Proximity to workforce and commercial customers;
- Location relative to existing flows of freight traffic;
- Ability to fill gaps in national provision of rail freight terminals; and
- Fit with Strategic Rail Authority strategies.

The report concludes that in Wales, the need for rail freight interchanges is general satisfied by existing provision in the South Wales area.

3. Literature review: Evidence from outside Wales

3.1 Introduction

3.1.1 How transport can influence an economy

The focus of our work is the regional and local economic impacts of rail investments as evidenced from a desk top review of ex post studies. Despite its high policy relevance the economic impacts of rail investments and transport investments in general is a neglected area in transport planning primarily due to the difficulty in quantifying them. From a theoretical perspective a number of channels exist by which transport can influence the economy. Unfortunately these channels can sometimes work against each other making it unclear a priori how we would expect investment in transport quality to influence an economy. This can be illustrated with two examples: a reduction in business and freight user costs and secondly a reduction in commuting costs.

Firstly reductions in business and freight time and cost savings would be expected to increase the productivity of the travelling business sector and the freight sector thereby lowering output prices. This will lead to an expansion in sales, output and ultimately employment (which could more than offset losses of employment in the freight sector). However, the lowering of transport costs makes the economy more open and it then becomes unclear as to which region of the country will benefit (e.g. in terms of GDP increase and employment). This uncertainty is also known as the two-way road effect. It is possible that all regions of a country will benefit equally or at another extreme it may be the case that economic activity centralises in the core region which now serves the peripheral regions (which specialise in activities fixed in location e.g. agriculture, mining and tourism). The economic impacts of reducing commuting costs are also unclear. A neo-classical theoretical approach informs us that in a competitive environment reductions in commuting costs reduce wages (in the long run), expand labour supply and increase output. Contrastingly, urban economic theory suggests that with a dominant core business district wages (and therefore prices, output and employment) will be unaffected and only house prices will alter. New economic geography on the other hand emphasises that reductions in commuting costs can increase the size of the labour market which can in turn influence productivity, output and employment in a region (Venables, 2007). Such a productivity increase may of course crowd out some output and employment elsewhere in the country (depending on the market conditions).

An added complication is that markets are not perfect. The channels by which transport can influence an economy can become blocked. A business which receives a reduction in travel costs, and as a consequence could sell more products, may not be able to expand employment as it may not be able to recruit people with suitable skills, or it may be operating at capacity and cannot find suitable premises to move to. It is well attested that transport is only one of the influencing factors that affect business decisions, and at times its effect can be quite marginal. Significant transport investment is only likely to stimulate additional economic activity if transport quality is the overriding factor that hampers an economy's growth. Transport investment is therefore unlikely to turn round a failing local or regional economy unless it is part of a package that includes investment in people and other infrastructure (including energy and telecommunications and sometimes premises). Furthermore another channel that can prevent transport investment influencing an economy is the value of small time savings (less than 5 mins). Such time savings have a welfare value, as has been demonstrated by many willingness to pay studies, but they may not be useable to a business – particularly small and medium sized businesses that do not have large vehicle fleets that can be rationalised. In these situations the benefits of reduced travel time savings cannot be fully capitalised by business.

The point of the above discussion is to set out clearly that not only are there competing theories as to how transport may influence an economy but also that the channels by which it can influence the economy can be blocked. This topic area is at the cutting edge of regional science and all predictive transport-economy models in use have their failings. Most transport-economy models do not adequately deal with the two way road effect, do not address the multiple ways commuting can influence an economy, and ignore the fact that markets are imperfect and that the mechanisms by which transport can affect local and regional economies are often blocked.

3.1.2 Our Approach

It is for the reasons outlined above that this review focuses almost exclusively on ex post research, as ex ante work based on predictive models is not very reliable given the position of the state of the art. That is not to say that all ex post work is highly reliable as it is bedevilled with problems associated with defining the counterfactual. The transport investment may for example be accompanied with other large investments (e.g. the Jubilee Line Extension occurred at the same time that Canary Wharf was developed, construction of High Speed 1 and investment around St Pancras and Kings Cross occurred at the same time, etc.), or background changes in the economy may dwarf the impacts of transport investment (e.g. the recent financial problems or alternatively even just a general increase in the growth of the economy). We have, in the main, considered literature from the last 10 years.

Published ex post work also varies in its quality. Changes in population and employment can obviously be tracked by the census, but beyond that extensive monitoring is required, using either sample surveys or secondary data such as applications for planning permission. Such descriptions of local trends are the most basic form of ex post analysis. A more sophisticated form of ex post analysis compares trends in areas influenced by the rail investment with those in similar areas elsewhere. Recent advances in econometric techniques using panel datasets to measure the change that transport investment has had on the economy are the most sophisticated ex post methods available. However, since even major rail investments may be relatively small in their impact, compared with the broader economic forces influencing these variables, finding significant impacts remains difficult. Of course, even a positive finding may simply indicate a relocation of economic activity from elsewhere, or may be due to developments actually undertaken directly as part of the scheme.

We identified the relevant literature for review through a mixture of approaches. We used key word searches in academic literature including journals, Google scholar and European Transport Conference papers. This then identified relevant papers, the references in which identified further papers. The literature review was conducted over Spring 2010 with some new input provided in early 2011. We also contacted a number of stakeholders both in government and the research field, who in turn identified some relevant pieces of research, which led to other studies also being identified. The main consultees whose input has assisted in the production of this review were:

- Welsh Government officials (transport and economics specialists)
- Flintshire County Council
- Cardiff City County Council
- Arriva Trains Wales
- Network Rail (Freight)
- DfT
- International rail specialists/academics

Appendix A includes both a primary (used in this Chapter) and a secondary (reviewed and discarded for this study) bibliography.

Overall, the number of ex-post evaluations clearly outlining the economic impact of rail investments for particular case studies is disappointingly low; the response from stakeholders such as the Department for Transport reinforced this. In terms of types of rail investment, the majority of the literature relates to new lines (or extensions of existing lines), with many of these being high speed or light rail passenger services. Far less information seems to be available on other aspects such as investing to improve service frequency, line speed, or capacity, reliability and comfort on an existing line. In practice, a lot of the investments discussed in the literature comprise of a package of new or reopened lines (over at least part of the system examined, e.g. across Manchester or Glasgow), new stations, improved speeds and frequencies, new rolling stock and electrification, so it is not always possible directly to disentangle the various elements. With regards to economic impacts, the aspect that was covered the most was the relationship between accessibility and land values / property prices. There was less on agglomeration, freight or social inclusion[5]. So we have not been able to give an even coverage to each of the economic themes identified by WAG and presented in the introductory chapter of this report.

Given the general paucity of ex post evidence we have in instances relied on other empirical and ex ante evidence to illustrate the potential economic impacts of transport schemes. Such evidence is explicitly identified in the text. We also explicitly identify the high quality ex post evidence that is based on econometric analysis rather than the medium and lower quality ex post evidence that is just based on a comparison of trends. Unfortunately there are relatively few of these high quality ex post studies. In the main the majority of the studies reported are based on a comparison of trends between a control area and the study area of interest, and this fact should be borne in mind when reading this chapter.

Throughout the study emphasis has been placed on evidence that is more pertinent to the Wales context – thus evidence from the UK is preferred to evidence from overseas, though international evidence is reported where relevant.

The remainder of this chapter is set out as follows. In section 3.2 we briefly consider the evidence of rail investments on demand, whilst in section 3.3 we discuss the evidence by type of economic impact. Given the difficulty of identifying separately the impact of different types of investment, in section 3.4 we simply consider the evidence divided into commuter services into cities (Urban rail, Metro and LRT), inter urban links (High Speed Rail) and rail freight improvements. In section 3.5 we discuss the implications of the evidence for Wales before drawing some conclusions in section 3.6.

3.2 Demand / Mode choice

The impact that rail investments have on demand is relevant to a review of the local and regional economic impacts of rail investment as if a scheme impacts on the local or regional economy, demand changes will occur. The causality however does not run in the other direction as changes in demand can occur in the absence of changes in the economy – if for example the investment has a purely social function or no new economically relevant trips are generated.

One of the main symptoms of a successful investment from an economic perspective therefore is a change in the demand. There is a large empirical database on the impact on demand of new lines (including reopening of existing lines), increased capacity, new stations, line speed improvements, service frequency improvements, new rolling stock, electrification, high speed rail and light rail. British Rail (particularly through the work of its Operations Research Unit) routinely examined the impacts of investment on

[5] aside from that on regeneration

demand, and to a degree that process has been continued by successor members of the Rail Passenger Demand Forecasting Council and summarised in the Passenger Demand Forecasting Handbook (PDFC, 2009). A summary concentrating on regional and local services is also to be found in Balcombe et al (2001). There is therefore ample evidence that rail demand is very sensitive to the quality of service provided and large investments can therefore generate large increases in demand.

The PDFH demand forecasting methodology is based on an assessment of changes in the generalised cost of travel. The generalised cost of travel converts all the quality elements of a journey into a common metric (often money or generalised time equivalent). This has many similarities with the process adopted for transport cost benefit analysis. The distribution of changes in generalised cost (and by implication demand) therefore acts as a reasonable proxy for the user benefits of a transport investment. However, it is tenuous to extrapolate this to an estimate of the regional and local economic impacts that will occur. This is for the reasons outlined in the previous section, but principally it is not clear a priori from an analysis of user benefits as to which region will benefit economically from an investment. This is due to the fact that more competitive firms (in a central core) may crowd out local businesses or firms may re-organise their activities in response to the transport investment. Furthermore changes in user benefits do not give a clear indication of changes in employment. A simple indicator of the wider economic importance of a transport scheme (at a national level) can be obtained by focusing on the user benefits that are attributed to business travel and freight in isolation. This is however a simplistic measure and should not be a substitute for a full economic impact analysis of each investment.

Whilst it is unnecessary to repeat the large volume of evidence in the PDFH on values of quality (including values of time[6], frequency, etc.) and expected uplifts in demand, some specific studies on changes in demand are reported below to demonstrate how sensitive demand is to rail investment. Unless stated these are all ex post studies based on an analysis of trends.

In general for large rail investment in commuter services, Balcombe et al (2001) state that typically approaching 50% of demand will have diverted from other public transport, approaching a quarter of demand will result from new travel patterns and only around 30% diverted from car.

Taking the London Jubilee Line Extension (JLE) as an example, in the months following the full opening, there was a quick build-up in demand (Lane et al., 2004). Over a ten month period in 2000, there was a 25% increase in demand to existing stations and 35% increase in demand to new stations. In the following two years, demand has continued to grow but at a slower pace. It grew by 3% at the existing stations (which was double the system-wide average) and at a much quicker rate of 14% at the new stations. Modelling work (RailPlan) indicates that the JLE saved existing public transport users 14.4 million hours per year (generalised time) in the first year of full operation in 2000. A comparison of actual flows and boardings (for 2002) against predictions for 2010 suggests that the JLE is performing well.

[6] With respect to value of travel time savings (VTTS). There is a large body of literature on the value of travel time stretching back several decades. Given this referring to a single VTTS research study in a report such as this cannot really be done. Instead one needs to refer to a review of VTTS studies. The current PDFH is a distillation and critical analysis of all aspects of valuation of the direct generalised costs of travel by rail including that of time. This is what has been done in the report. In referring to VTTS in this report we also have to bear in mind that it is peripheral to the focus of the study. Travel time savings invariably accrue as a result of most transport projects - but their role in cost benefit analysis is purely as a proxy for the real social and economic impacts of access to employment, access to services, changes in employment, changes in GDP, changes in productivity, etc.

A small survey of passengers using the JLE a year after the introduction found that almost all passengers had switched from alternative public transport modes – over half from other Underground lines (54%) and 20% from the Docklands Light Railway (Lane et al., 2004). On average, there was only a 2% switch from road. Evidence from surveys on the Isle of Dogs and Canary Wharf demonstrates a significant change in mode split with reductions in car travel (cars trips falling from 48% to 30% for Isle of Dogs between 1998 and 2000, and falling from 16% to 7% for Canary Wharf between 1999 and 2003), although in the context of a large growth in the absolute numbers of employees.

For inter-urban links, much depends on whether the link is served by air transport. There is strong evidence that where rail journey times are less than four hours rail begins to take significant volumes of traffic from air, and will typically gain at least 60% of the rail-air market where rail journey time is less than three hours (Campos and Gagnepain, 2009; SDG, 2006); where it is less than two hours rail will almost entirely displace air. The issues of airport access, check-in procedures and cost puts rail in an advantageous position in the context of relatively short journeys. Evidence of diversion from car is more limited, whilst it was found that 15-50% of additional rail traffic comes from changes in travel patterns (COST 318, 1996; Wilken, 2000). In terms of relieving congestion and environmental impact, of course it is the diversion from other modes that is crucial. Whilst the levels of diversion found may make a significant contribution to relieving congestion and to a lesser extent local environmental pollution, the mix of diversion and generation means that there will be little saving in greenhouse gases unless the rail system is powered by electricity generated from low carbon sources (Nash, 2009).

A number of studies exist regarding potential and realised demand for High Speed Rail (HSR). Nash and de Rus (2009) for example report on the modal demand effects of a potential UK HSR (ex ante) and the Madrid-Seville HSR (ex post). The major objective of the UK scheme was to relieve existing routes and provide faster more competitive services between the major cities. The new line if built in full was forecast to attract around 50 million passenger trips per year in 2015 (most only using part of the route). Of these, around two thirds would be diverted from existing rail routes and the rest split almost equally between diversion from other modes and newly generated trips. Most diversion was forecast to be from car, air diversion was forecast to be surprisingly low considering experience from other countries. Considering the ex post Spanish example HSR led to a demand downshift of 50% for air transport between Madrid and Seville - diminishing load factor and flight frequency. Seville airport suffered a 25% reduction in its use.

The preview High Speed South Eastern (HS-SE) services running since June 2009, improves connectivity of Kent to the rest of the UK's rail network. In a survey of users Greengauge21 (2009) found that 59% were commuters, 22% on business and the remainder travelling for leisure purposes. The survey results showed that HSR reduces road traffic, as in overall, 8% of HS-SE users switched from the road. In particular at Ebbsfleet station, there were generated trips of 15%, and with the 11% having switched from car or coach, 26% of users were new to rail. These modal switch figures from road to rail are higher than previously forecast by Greengauge21, and may be due to the absence of a fare premium.

It is worth commenting specifically on electrification. Electrification is mainly justified as a way of producing a particular level of train service at lower energy, maintenance and environmental cost. However, electrification also reduces the cost of improving performance and frequency and very often goes hand in hand with service improvements. In British Rail days, a number of ex-post studies, such as those of the St Pancras – Bedford and Cambridge – Kings Lynn electrifications, found growth in demand greatly in excess of what conventional demand forecasting models would predict, and this effect was labelled the 'sparks' effect. It may be speculated that the very large increases in demand on the Airedale and Wharfedale lines in West Yorkshire demonstrate a similar effect. To the extent that such an effect existed, and its presence remained controversial, it was rationalised as being due to the confidence in the quality of the future public

transport system brought about by such a large investment. Similar effects have been anticipated, but not generally proved, for light rail.

3.3 Impacts upon economic activity and land use

3.3.1 Context

The economic effects of transport investment can be categorised to occur at three different levels. Following Bannister (2007) these can be categorised as the macroeconomic level where changes in output and productivity can be identified at a regional network level. At the intermediary level, where the effects refer to agglomeration economies and labour market impacts, with some additional network and environmental consequences. At the microeconomic level, where the impacts relate to land and property market effects. Regeneration can also be considered a local/microeconomic type effect. In this section we consider each of these – specifically looking at employment, household and business decisions, agglomeration and regeneration.

3.3.2 Wider impacts

In the transport appraisal literature there is considerable discussion regarding wider impacts[7]. This discussion focuses around the additional value that economic impacts in the wider economy have in welfare terms for a cost benefit analysis. Given their prominence we briefly review the UK approach to them as exemplified by the Department for Transport's guidance. We also distinguish between these wider impacts and the focus of this study (the economic impacts of rail investment) as whilst there is some overlap, they are in effect two distinct topics.

Quoting from the DfT (2005): '*Transport investments can, and generally do, affect the economy. They can in particular affect the location and pattern of economic activity, and be used to reduce regional disparities*.' From a cost benefit analysis perspective the welfare value of the majority of the economic impacts that a transport investment generates (jobs, increased output, etc.) are already included in the cost benefit analysis (via the inclusion of travel time savings and other items of user benefit). The wider impact assessment is therefore only concerned with the impacts that are not included in the analysis. In some instances these are pure economic efficiency measures (which have a welfare value but no 'real' economic value) and in other instances they are GDP effects (such as increased output due to productivity increases).

The key messages from the work undertaken on wider impacts by the DfT are:

- Wider impacts are not always insignificantly small, therefore they may need to be included in appraisal otherwise decisions could be distorted
- Transport appraisal already captures most economic benefits and costs, including most of the impact on GDP, it is therefore unlikely that the wider impacts would be as big as the impact on time savings and reliability

[7] Wider impacts have previously been called Wider Economic Benefits (WEBs) and Wider Economic Impacts (WEIs) by the Department for Transport. In international literature they are also known as Indirect Effects.

- Wider impacts that are missing from appraisal consist of the main market imperfections: agglomeration externalities, imperfect competition and the economic benefits of increased employment and productivity in an imperfect labour market (due to the presence of an income tax)
- It is possible for a scheme to have negative wider impacts, but positive benefits are more likely.

The DfT suggests the following in its approach (DfT, 2005):

- The impact of the agglomeration externality will depend on the impact of the scheme on 'effective density' of employment in affected areas. The suggested method for calculating the wider benefit due to agglomeration is the elasticity of total productivity with respect to the density of employment in an area, multiplied by the change in effective density of employment in the area due to the project multiplied by GDP in the area. This impact is relevant to the purposes of our study.
- The impact of transport in improving competition is set cautiously at zero. This welfare impact relates to economic efficiency only.
- The impact from the presence of imperfect competition in transport using industries is recognised and therefore 10% should be added to the value of business time savings and changes to reliability of business travel. Again this welfare impact relates to economic efficiency only.
- The economic benefits of effects in the labour market (more people entering labour market, workers working longer hours and employment relocated from lower productivity area to higher productivity area) are an addition to national welfare and should be included in appraisal. These impacts are of interest to this study. However, it should be noted that the welfare benefit of these impacts differs from the full GDP impact[8]. Thus an analysis of the economy would value these changes differently from a cost benefit analysis as embodied in the DfT's guidance.

The spatial effects of transport investment on economic activity can be felt over a much larger area than that for the journey time savings and increased reliability of business travel. This is because competition effects may result in businesses in less accessible areas (which have experienced no change in accessibility) losing out to businesses in areas which now have greater accessibility.

Through the DfT's method of valuing GDP effects there is no overlap or double counting between user benefits and wider impacts. It is acknowledged that the welfare economic benefits and GDP effects are less robust than the conventional items included in an appraisal due to the newer methodology. The DfT therefore require these impacts to be identified separately so that the conventional economic and the wider impact effects can be separately identified.

3.3.3 Land and property prices

Whilst changes in land and property prices are not in themselves an objective of local and regional economic policy they are of interest as they act as a barometer for changes in the economy relating to productivity, output and employment. If a rail investment has an economic impact one would expect land and property prices to alter. It is therefore worthwhile in the first instance to examine the literature regarding these impacts.

As previously noted above, there are a lot more studies of land and property prices than of other economic impacts. In fact there have been sufficient studies for internationally recognised review (e.g. RICS, 2002)

[8] Increases in employment and changes in productivity due to commuting choice decisions of a workforce have a welfare impact due to the presence of a tax wedge (income tax in the labour market). The welfare value is therefore the proportion of wages paid in income tax, whilst the economic value is the gross value of the wages.

and meta-analysis papers (e.g. Debrezion et al., 2007) to be published. It is not our intention to repeat the content of these papers instead we turn to a number of relevant studies that highlight some specific points.

One the most methodologically sound ex post transport investment studies we have been able to identify is that by Gibbons and Machin (2005) [9] and relates to land and property prices in the vicinity of the Jubilee Line Extension. Our confidence in this study relates to the use of a large and reliable dataset that has remained consistent over the study period and relates to local impact due to its base in the property market.

The authors found that residential house prices in the vicinity of the JLE and the Docklands Light Railway increased by 9.3% compared to places unaffected by these infrastructure changes. This clearly demonstrates the economic value of this piece of infrastructure. In other work on the JLE it is estimated that the total value of land within 500 metres (for commercial) and 750 metres (for residential) of Canary Wharf station has increased by between £1.82 billion and £2.84 billion between 1992 and 2002; and within 500 metres of Southwark station, by between £0.82 billion and £1.68 billion. The best estimate of land 'uplift' attributable to the JLE in the Canary Wharf area is £2.0 billion (in the range between £0.3 billion and £2.7 billion), and in the Southwark area is £0.8 billion (in the range £0.0 billion to £1.45 billion). It is also estimated that the total value of property has increased by £3.9 billion at Canary Wharf and £2.0 billion at Southwark. It is believed that between £0.75 billion and £1.9 billion of this at Canary Wharf, and between £150 million and £650 million of the increase at Southwark, would not have occurred without the JLE. The 'Uplift' due to the JLE is estimated towards the top of the range quoted for Canary Wharf and towards the bottom of the range quoted for Southwark. (Lane et al, 2004)

With respect to more moderate urban rail investments than the JLE Gentleman (1983) found that the rail investments in Glasgow reversed the previous decline in house prices, whilst Mayor et al (2008) examining the impact of rail investments in Dublin found that DART (the heavy rail upgrade) raised house prices within 500 metres of stations by 7-8% and LUAS (the new light rail system) by 12-17%.

Inter-urban rail investments have also had positive effects on the economy as evidenced by land and property prices. For high speed rail, Cascetti et al (2010) found that high speed 1 raised house prices around stations (a finding confirmed by Pagliana et al, 2010). Preston and Wall (2008) also found a small impact around Ashford. Of course these findings are confounded with the fact that significant ancilliary investment has occurred in the vicinity of these stations so not all of the property price increase can be treated as arising from the rail investment.

In contrast to these studies identifying positive economic impacts are studies of the light and urban rail systems in Manchester (Forrest et al, 1996), Newcastle (Davoudi et al, 1993) Sunderland (Du and Mulley, 2007) and Sheffield (Dabinett et al, 1999) which found no impact on property prices. In an ex ante piece of work Arup (2009) report that the extension of the Wensleydale railway was not expected to cause significant changes in house values. Similarly for inter-urban rail Ahlfeldt (2009)[10] in another methodologically robust ex post study found no impact with respect to the new intercity station in Berlin.

[9] Gibbons and Machin (2005) use a 'differences in differences' empirical approach to evaluate the benefits of rail access. As the transport investment alters the distance to the nearest station for some households, but leaves others unaffected it is a quasi-experiment. The use of the differences in difference approach avoids the biases inherent in cross-sectional valuation work arising due to the problem of causality.

[10] Ahlfeldt (2009) uses the differences in differences method to estimate a hedonic property value function in a similar manner to Gibbons and Machin (2005).

What the latter examples identify is that rail investment whether urban or inter-urban is not guaranteed to have an impact on the local or regional economy. This supports Bannister and Berechman's (2001) argument that transport investment is not a necessary condition for economic development, but it acts in a supporting role when other conditions are at work such as the presence of positive economic externalities (such as agglomeration and labour market economies, good quality highly skilled labour force etc), investment factors (such as the availability of funds for the investment, network effects, timing of investment) and political factors (broader policy environment where decisions are made). Therefore it is particularly important to highlight that the impacts of investment are highly dependent on the characteristics of the region where the investment is potentially taking place. As discussed previously transport is only one of a number of factors that influence the economy and investment in rail systems alone may not stimulate the economy.

3.3.4 Employment/Household/Business/Agglomeration

Economic theory informs us that changes in economic output are most likely to occur as a result of investment which reduce companies' costs (by reducing the cost of travel in the course of work, or of freight transport). *Theoretical* research indicates that such increases in output may also result from agglomeration economies or from increases in labour supply, and these effects are most likely to occur from improvements in the cost or quality of commuting journeys into cities (Venables, 2007).

There is an argument that transport improvements to and within core city regions provide direct benefits of enhanced productivity of existing workers and increased employment, and agglomeration effects raising the productivity differential of the core city relative to the rest of the economy. This is because there is a positive relationship between city size and productivity (see for example Vickerman and Ulied, 2009). Lower transport costs can affect the way firms interact in the market. They can lead to localisation economies (where firms in the same industry benefit from the proximity to each other through specialised labour pools or R&D) and urbanisation economies (where firms gain a form of public goods benefit from the existence of an urban infrastructure).

However, transport improvements may be as likely to lead to increased regional disparities as they do to increasing cohesion, depending on the situation of the region. It is acknowledged that reductions in transport costs can lead to more agglomeration and to unequal impacts on regions connected by the same infrastructure. *Theoretical* work by Venables and Gasiorek (1999) confirms this but there is also evidence from highway schemes, mainly, that connecting a peripheral region to a core region may in fact exacerbate regional differences. The classic example is Appalachia in the eastern US where improved highway accessibility increased the rate of de-population as young people were able to move from the rural hinterland to the cities and still maintain contact with their families.

Internationally recognised *empirical analysis* on agglomeration economies indicate significant elasticities to proximity to economic mass, especially for services. Graham (2007) estimates a weighted average agglomeration elasticity of 0.119 for the economy as a whole, 0.186 for the service sector and 0.077 for the manufacturing sector. Further well regarded *empirical research* to estimate the distance decay effects of agglomeration has found that the effects of agglomeration diminish more rapidly with distance from source for service industries than for manufacturing (Graham et al., 2010)[11]. However the relative impact of agglomeration on productivity is larger for services than manufacturing.

[11] Graham et al. (2010) use firm level panel data to estimate the effect of access to economic mass on total factor productivity (TFP) for broad sectors of the economy. They use a control function approach to addresses potential sources of endogeneity associated

If the small, but important, intuitive step is made that an improvement in transport quality increases agglomeration (as Venables, 2007 has done) then *ex ante* transport appraisal work indicates that gains in productivity can be of the order of 10% to 20% to user benefits raising to up to 50% for Crossrail (DfT, 2005).

Unfortunately, these theoretical and ex ante predictions as yet cannot be confirmed through ex post work. This is because there is a dearth of ex post evidence of the impact of transport schemes on improving productivity through increased agglomeration. The only ex post study that has been undertaken worldwide is one that looked at two UK motorway schemes – there has been no study on rail investments. This study is methodologically robust and did not find any evidence that transport accessibility gains led to improvements in firm level productivity (Gibbons et al., 2010)[12]. This exploratory study casts some doubt on the assertions that transport can increase productivity via increasing the size of an agglomeration. Undoubtedly significant empirical evidence exists that proximity to economic mass influences productivity but it is unclear why no ex post evidence of transport investment influencing productivity has been found. Possibly it is because the data used in the study was 'noisy' and the variables of interest small in comparison to background effects or possibly it is because imperfect markets prevent the transport user benefits improving productivity. The latter argument is comparable to that used above to explain why some rail investments have no to minimal impact on land and property prices.

From an employment perspective, aside from employment in the rail industry, rail can support a large number of business related jobs. In the Highlands and Islands for example it was *estimated* that 1,500 FTE jobs are dependent on the functioning of the rail network (SDG, 2004). *Empirically* there exist significant correlations between employment density and accessibility by rail in urban areas (e.g. Gibbons and Machin, 2003; Colin Buchanan, 2009). This correlation arises due to two effects of which we are principally interested in the first. The effect we are interested in is whether employment is attracted to more accessible locations, whilst the second (and probably more dominant effect) is that rail investments are designed to link areas of high employment to residential areas. Gibbons and Machin (2003)[13] using a robust econometric method identify that the impact of new transport investment on attracting new employment to an area contributes about 5% of the observed elasticity between employment density and accessibility.

3.3.5 Regeneration/land use

Rail projects may also have an impact on relocating economic activity. Whilst improvements in commuting, business and freight transport may again be thought to dominate, improvements in transport for shopping trips, tourism and other leisure activities may also play a part. However, whilst such relocation may be helpful if it is desired to regenerate particular areas, it does not generally lead to additional output at a national level.

The studies of commuter rail systems have generally found some impact on land use. In West Yorkshire, there was some rise in population around new stations compared with similar areas elsewhere. Blainey and

with the production function and with the agglomeration-productivity relationship, and to allow for unobserved firm level heterogeneity. This method is robust to causality biases inherent in cross-sectional data.

[12] Gibbons et al. (2010) use panel data and differences in differences empirical methods to eliminate biases evident in cross sectional data. This allows them to robustly estimate the impacts of changes in accessibility on total factor productivity, labour productivity, wages and employment.

[13] Gibbons and Machin (2003) use differences in differences empirical methods to estimate the impact of accessibility on employment. This avoids biases in cross-sectional data, as would be evident in other work (e.g. Colin Buchanan, 2009).

Preston (2010) in a methodologically robust study[14] found that in the two decades following the opening of a new local station, it appears that the population grows up to 8% more in the area around new stations than in control areas. It was also found that a new station leads to 7-10% increase in house prices in the station's postcode sector.

It was suggested in Newcastle that the additional city centre-bound shopping trips generated due to rail investment may have strengthened the city centre relative to other retail locations (Davoudi et al., 1993). Any additional output generated by improved commuter rail services would tend to be in the city centre, but we have found no attempts to measure this impact of rail investments ex-post. NAO (2004) considered that light rail had helped regenerate rundown areas in Manchester, Birmingham and Croydon, but Dabinett et al (1999) found no such evidence for Sheffield; nor did Davoudi et al (1993) for Newcastle. Millward Brown (2006) surveyed firms in central Dublin following the opening of the light rail system but they considered any labour market or other benefits they had received to be very small.

In the period before the opening of the JLE, employment growth in the corridor lagged behind that in London as a whole. However, in the period after the opening of the JLE, there was a significant swing in this trend. It is *thought* that the JLE has relieved pressure from established employment locations and has been successful in redirecting employment to areas needing regeneration (Lane et al, 2004). Since the London JLE got the go-ahead, there has been more interest in residential development in the JLE corridor than in the rest of the Inner East London (IEL) area. This is partly due to the fact that a considerable proportion of land that could be developed in the IEL was located in the JLE corridor. Planning policies have encouraged higher densities, and the JLE has made these higher densities feasible. However there is little evidence that the JLE had made a significant impact on the rate of mixed-use or commercial development in the corridor, other than on the Isle of Dogs. It was thought that employment at Canary Wharf had doubled since the opening of the JLE (Lane et al, 2004).

Babalik (2000) looked at land use and development impacts due to rail investment in various places. It was reported that the Vancouver skyline and San Diego provide the clearest evidence of success due to stimulation of development in the city centre and declining areas, and the change in the pattern of urban development. The light rail investments of St. Louis, Manchester and Tyne and Wear were reported to show some success in the stimulation of city centre development; however Miami, Sacramento and Sheffield had at the point of writing shown less land use and development effects.

An international study undertaken by UITP (International Association of Public Transport) (Crampton, 2003) looked at the impacts of urban light rail in 34 cities. As with UK evidence the results of transport investment on the economy have been mixed. Six cities reported an increase in retail business generated adjacent to LRT lines, five cities reported the development of new retail areas and four cities reported increased employment. In the French city of Nantes between 1985 and 1995, 25% of new offices, 13% of commercial buildings and 25% of new residential dwellings were built within a 400m corridor either side of the light rail line. Results for Strasbourg 1998 showed that some offices moved out of the city centre to the outskirts of the urban area due to lack of expansion and difficulties in reaching the centre by car. By 1998, office prices in Strasbourg were 10-15% higher compared to other cities of a similar size. There is some evidence (Freiburg and Strasbourg) that the accessibility to a tram line may change the character of an industrial

[14] Blainey and Preston (2010) use a comparisons approach to compare 13 locations in which new stations opened (between 1982 and 1990) to 10 locations where no station exists or was opened for long run effects. These locations are comparable in all but their access to the rail network. For short run effects they compare 13 locations where stations opened (between 2002 and 2005) with 13 control sites. The strength of their analysis is in the number of control sites. Weaker studies will often only have 1 or 2 control sites.

area, as it becomes more attractive for the tertiary sector, leisure and cultural activities. When one activity starts to locate there, others follow in quick succession. However this was not found to be the case in the German town of Saarbrucken (Crampton, 2003).

Mixed ex post results for rail investment in the US has also been found though difficultly in separating out the impacts of rail schemes due to other factors in the economy adds to the difficulty in drawing firm conclusions. For example Nelson and Sanchez (1997) looked at the impact of the Metropolitan Atlanta Rapid Transit Authorities (MARTA) heavy transit network for Atlanta city, which was designed to accommodate the growth of the city which was forecast to expand by two million between 1990 and 2010. The work revealed changes in development patterns around new stations but the clearest results were from the suburban districts where sites were relatively undeveloped beforehand. It was difficult to separate out the effects of the transit related growth in places where other incentives to develop were present. The study found that in terms of disaggregating the impact of the transit alone, it could not draw any conclusions.

Another US example is the Bay Area Rapid Transit (BART) in the San Francisco Bay area. Cervero and Landis (1995) report that overall the land use and growth impacts around selected BART stations due to BART were relatively modest. Few significant land use changes occurred and with the exception of the downtown area, most new office growth was centred around freeway interchanges. The study stated that although it was unlikely that the downtown area could have handled the 150,000 new jobs in the area since the introduction of BART it was unclear how much of the job growth was created as a result of BART.

Evidence has been found of positive effects from new high speed links. Bonnafous (1987) found some evidence that Lyons expanded its role in the service sector as a result of the TGV Sud-est. Harman (2006) uses qualitative evidence that HSR aided regeneration in Lille and Lyons, but econometric evidence is forthcoming from other studies. Cascetta et al (2010) found that High Speed 1 was associated with an increase in population and employment in Camden, although this may have been partly as a result of associated developments rather than a direct causal relationship (again adding to the argument of the difficulty of isolating impacts). The only seriously *quantitative work on ex post* GDP impacts of high speed rail investment is that undertaken by Ahlfeldt and Fedderson (2010)[15]. They examined the impact at small settlements that formed intermediate stations on the new Cologne – Frankfurt high speed line, finding a 2.7% increase in GDP in the area of the stations relative to elsewhere. This work still has some methodological weaknesses (mainly due to calculating GDP in such small areas) but it represents one of the more methodologically robust ex post studies available.

The Channel Tunnel Rail Link (CTRL) is an interesting case to consider looking at a current example of high speed rail in the UK. The first section of the CTRL opened in Autumn 2003, from the Channel Tunnel to South London, resulting in an increase in passengers to 7.85 million in 2005 and improvements in sales and productivity. However these patronage levels are much lower than originally *estimated* (24 million for 2005), even though Eurostar services account for over 60% of the market shares between London and Paris and between London and Brussels. It was acknowledged by the Public Accounts Committee (2006) that the economic case for the CTRL still remains marginal, even with further sections. The benefits of regeneration were said to be essential but had to be separated out from other major infrastructure projects close to the CTRL and the 2012 Olympics (Bannister, 2007). In ex ante appraisals regeneration benefits

[15] Ahlfeldt and Feddersen (2010) use a number of empirical methods using panel data and comparisons with control locations. The work has some methodological weaknesses in that it is not absolutely certain that all forms of bias have been controlled for but it represents one of the more methodological robust ex post studies available.

were said to be extensive as 100,000 jobs would be created in the corridor and large numbers of new homes (50,000) would be built near the four intermediate stations – St Pancras, Stratford, Ebbsfleet and Ashford. Cascetta et al (2010) evaluated the regeneration impacts of the CTRL ex post and emphasised that it was clear that high speed services could serve as a factor in the development of city economies, supporting city development plans and the regeneration of run down areas. Their research found that there was a clear relationship between property prices and the distance to the nearest high speed station. HSR was said to improve a location's image by making it appear more modern and dynamic, and if it reduced commuting time and attracted more retail establishments to the area, this would increase the value of nearby properties. CTRL was seen as an example of this, and the authors found substantial and consistently significant effects of HSR accessibility on property prices and on residents' and employee jobs location. However, for offices, close proximity to a HSR station seemed to have a negative impact but location variables of St Pancras and inner London were an important factor. As mentioned previously not all of the ex post regeneration benefits can be attributed to just investment in HSR as substantial amounts of ancillary investment in the vicinity of the terminal stations has also occurred.

Ex ante assessments can often make strong claims regarding the benefits of the transport investment on regeneration and land uses. As ever with ex ante studies there is a degree of uncertainty as to whether these forecasts will ever be realised. For context we now turn to three of these studies. As is the case with most ex ante work they typically predict positive benefits as the ex ante modelling methods usually do not allow the negative impacts that transport can have on an economy (e.g. the two way road effect) or have any cognisance of local characteristics that may block the transmission of transport user benefits into the economy.

Sands (1993) looks at the potential for HSR in California and states that HSR would increase population and employment growth in regions it serves above the state wide average. It is believed that increases in employment and economic activity in the accommodation, retail and wholesale sectors would be dispersed across the whole system served by HSR, but with economic activity concentrated mainly in cities with stations. Land value premiums of 20% may occur around stations given that adequate transport infrastructure is provided and development is supported by public agencies.

In terms of the ex-ante research in the UK, Atkins (2008) feel that there is growing concern about the differentials in economic growth between the north and south, and transport investment may be able to help reduce this gap. With the potential HSR line, Scotland was thought to become a more attractive place for inward investors and would enhance the major city status of Glasgow and Edinburgh. It is believed that improving the north-south transport links of the UK is a vital factor in reducing the productivity gap, however it is not enough without other economic development measures. The HSR stations would need to be located in the city centres in order to maximise agglomeration benefits and support the higher value business development outside of London. Cities with more extensive financial services and research sectors were believed to benefit more rapidly from a HSR connection than those without.

3.4 Impacts by function/type of rail infrastructure

3.4.1 Local commuter services

As mentioned earlier the majority of the ex post evidence available on the economic impacts of rail services relates to new lines (or extensions of existing lines), with many of these being high speed or light rail passenger services.

We have already presented evidence from the studies with respect to the UK light rail investments in Manchester, Sheffield and Croydon, commuter services in West Yorkshire and urban rail in Newcastle, Glasgow and London (the Jubilee Line Extension). These studies identify that if the underlying economic conditions are appropriate commuter type services can help regenerate areas and can help sustain rural communities. There is little to add to this evidence on commuter type services aside from the ex post study by Millward Brown IMS (2006) who undertook the LUAS study on employers and retailers. This study which looked at the impact of two light rail lines – green and red lines which opened in Dublin in 2004 – confirms the findings of other ex post work. The report reveals a widely acknowledged positive impact on the ease of travel, better staff punctuality and improved satisfaction with access to and from the city centre. However the rail lines were not seen to have made significant relief to traffic congestion, had no impact on late deliveries due to congestion and the positive impact of recruiting and retaining staff was not obvious.

3.4.2 High Speed Rail (HSR) / Inter urban

This section looks at the research on HSR and the potential effects relating to this area. It is important to highlight that although not always explicitly stated, improvements to rail, in particular HSR, relate to time savings and it is the underlying theme behind most rail investment, therefore covered by the majority of literature in this report. We have already discussed the main findings of the quantitative ex post research identified in the literature (e.g. Ahlfeldt and Federson, 2010 and Cascetta et al., 2010) and the qualitative ex post research (e.g. Bonnafous, 1987; Harman, 2006). These studies identify that high speed rail can increase the economic performance of the cities it connects, though some of this results from displacement of economic activity from elsewhere. Nash and de Rus (2009) confirm this finding for the Madrid Seville high speed rail route. They found that the main benefits of HSR investment were travel time savings obtained when users shift from slower modes and gains from generated traffic and there was reported to be an increase in land value in Ciudad Real.

Vickerman and Ulied (2009) argue that although HSR can lead to improvements in the economic performance of regions, there are no guarantees that all the impacts in any one region are positive in the long run or regions not connected by HSR suffer any evident economic disadvantage. Studies on the impacts of the French TGV lines suggest that although it led to substantial growth in traffic, impacts on the local economies of Paris and provincial cities were much less certain. The Paris-Lyon study showed big impacts on the pattern of mobility, with changes in both directions. Many businesses in both locations changed their pattern of working leading to increased travel in both directions.

The importance of the labour market in wider benefits is also stressed by Vickerman and Ulied (2009). Improved transport can provide access to jobs which would have not been possible otherwise. If it allows people from employment deficient regions to access jobs in labour deficient regions, there would be gains to the workers, employers and the public sector which gains from tax revenue and lower social security payments. Also easier commuting may encourage existing workers to work longer hours, however in reality workers may use the gains for increased leisure rather than increased work. Workers will be able to move more easily from less productive to more productive jobs. HSR could have an important effect of potentially changing the size of the labour market for daily commuting and reinforcing the possibility of long distance weekly commuting where the constraints of housing or personal circumstances prevent job related migration. However, the potential for high speed rail to increase the size of the labour market is very dependent on the fare structure – high premium fares will discourage long distance commuting.

Graham and Melo (2010) consider ex ante the agglomeration effects of high speed rail and how they change connectivity between cities. Undertaking empirical research of data from the National Transport Model (NTM) for Britain, Graham and Melo (2010) obtain estimates for the distance decay gradients

showing that commuting flows are more responsive to changes in distances. It was found that an increase of one kilometre in commuting lengths produces a reduction in long distance home based flows of around 4%, and an increase of one kilometre in distances produces a reduction in long distance home based employer business and non home based employer business flows of around 0.4% and 0.35% respectively. In terms of agglomeration effects, it was thought that improvements in travel times would reduce the extent to which travellers perceive distance as an obstacle to travel. Detailed ex ante results show very small agglomeration benefits.

3.4.3 Rail Freight Improvements

Rail freight schemes need to be treated slightly differently from passenger schemes. Their economic benefits are likely to be dominated by:

- Reductions in operator costs;
- Congestion relief to highway users, hence the concept of "sensitive lorry miles" (values of time saved by other road users mean greater benefits for decongestion of roads); and
- Enabling increased production at sites that would otherwise be transport-constrained.

Rail freight has in recent decades become increasingly dependent on bulk heavy hauls such as coal, aggregates, liquid fuels and metals. However, in the UK a series of major freight intermodal terminals has been developed over recent decades, either on existing railway sites or in new locations and aimed at capturing other commodities conveyed in containerised form. Nowadays these facilities primarily act as inland ports for flows of containers from seaports (or Dollands Moor for imports via the Channel Tunnel) with relatively little intra-UK traffic. It should, however, be noted that other types of flow do exist than the container intermodal traffic considered in this section: these include single-customer flows such as Tesco stocks between Rugby and Grangemouth, and Royal Mail flows on a few axes.

The locations of a selection of the main intermodal terminals are shown below, together with an indication of traffic levels in recent years:

Table 3.1: Intermodal freight terminals in the UK

Name	Location	Date of opening[16]	Trains/week	
			2007	2011
Cardiff (Wentloog)	East of Cardiff on GWML	2001	5	7
Garston	South of Liverpool	-	11	1
Ditton	Runcorn	-	20	6
Landor/Lawley Street	Central Birmingham	1969	41	47
Birch Coppice	North-east of Birmingham	2002	41	20
Hams Hall	North-east of Birmingham	1996	26	16
Stourton	East of Leeds	-	32	27
Doncaster Railport	South of Doncaster	1996	20	14
Wakefield Europort	Near Castleford	1996	13	11

[16] Only given for terminals not on historic railway sites.

Name	Location	Date of opening[16]	Trains/week	
			2007	2011
Trafford Park	West Manchester	-	77	43

However, it is important to recognise that the current structure of the market for rail freight means that demand is very "lumpy" – in other words, it is dependent on a small number of large customers, either producers of bulk commodities carried in block freight trains or third-party shippers, and the extent to which facilities are used can change radically and rapidly with decisions made by these players, such as a steelworks closing or a third-party logistics specialist electing to choose rail for a trunk flow. This reflects the very limited progress made in the less-than-trainload sector. As a result, to a large extent changes in rail freight demand take the form of a train either running or not running – rather than a train conveying, say, 1,000 tonnes rather than 1,500 tonnes. This is also in contrast with passenger demand trends which are more "evolutionary" in their development, and underlines the difficulty in forecasting the trainload freight market with any degree of robustness.

Nonetheless, it can be observed in general terms that, other than coal haulage, rail freight in Britain has made little progress since privatisation in terms of modal shift – and the recent recession has badly hit many flows, particularly those connected to the construction sector (such as aggregates), but also intermodal flows of imported containers from sea ports, which are linked to overall consumer demand in the economy.

3.5 Implications for rail investment in Wales

It is difficult to draw firm conclusions from this evidence regarding the economic implications for rail investment in Wales (at the level of specific projects). Primarily this is due to the limited relevant ex-post data that is available internationally and the absence of ex-post data for rail schemes in Wales. It must be recognised that it is difficult to undertake ex post reviews of transport investment. Given the amount of time over which changes in transport investment may take to have an impact on economic activity, it becomes very hard to separate this from other potential changes affecting a local economy.

The situation is further complicated as the majority of any localised impact of transport investment is a result of the re-location of economic activity. Where economic activity relocates from and to is a function of the underlying economic characteristics of the locality (of the rail investment) and what that locality becomes 'connected' to. It is for this reason that the ex-post evidence reviewed above indicates mixed responses to rail investments. As previously mentioned, Banister and Berechman (2001) state that transport investment acts as a supporting role (and is not a necessary condition) for economic development when other conditions are present such as positive externalities, investment factors and political factors. If transport quality is acting as a constraint on economic activity then rail investment can be expected to have a positive effect. This can be seen for example in the increases in land prices evident near stations. However, where transport is not a constraint limited economic impacts may be felt. Several studies reviewed above have identified limited impacts on land prices of some urban rail and light rail schemes (e.g. Sunderland Metro and Manchester Metrolink). As land prices are a good barometer of economic conditions those schemes which have not affected land prices can be taken to have had at best only a limited impact on economic productivity. In some scenarios the situation can be even worse from a regional development perspective. This is because transport is a centralising force, and it may well be the case that economic activity centralises in the economic centre of a country to the detriment of the

periphery. This can happen where poor transport links act as a barrier protecting a regional economy from outside competition. The lowering of this 'protective' barrier through transport investment leads to the demise of the local businesses the investment was supposed to support. Similarly the lowering of the transport barrier may facilitate mobile members of the labour force to migrate out of the region and still maintain links with family and friends – thereby increasing the rate of de-population.

Whilst it is difficult to draw firm conclusions on the economic impact of future rail investments in Wales, a number of guiding principles are evident:

- Increased rail investment in new lines and service improvements will almost certainly centralise (or re-distribute) economic activity to the better connected areas. Ahlfeldt and Feddersen (2010) find a market access elasticity that implies a 0.25% growth in GDP for a 1% increase in market access. Bannerjee et al. (2009) find that increasing distance by 1% from the rail network decreases GDP/capita by between 0.12% and 0.18%.
- Where economic activity will centralise is dependent on the underlying economic conditions of the areas which have been connected.

Applying these principles and the evidence reviewed earlier to rail investments in Wales would suggest the following with respect to high speed rail, LRT, rural rail services, north-south links and electrification.

High speed rail: A national high speed rail network would strengthen the economies of the cities connected to that network, provided that these cities received a good level of service (see e.g. Harman, 2006). Part of this strengthening will result from economic activity, from areas not connected to the network, relocating to these cities. Also clear are the dangers of unconnected areas suffering employment and population loss to those areas connected, which in the case of Wales could mean that businesses may relocate to be along the proposed HS2 London-Birmingham-Leeds/Manchester axes.

There also appears to be evidence that, dependant upon the pricing policy adopted on the HSR operation, major changes in commuting patterns could occur. As already seen along the Great Western Main Line, this could mean making the journey from South Wales commutable to London were such a High Speed corridor to be provided.

From a Wales perspective, it is clear that to achieve the greatest economic benefits from a national High Speed Rail network, Wales should be either directly connected or provide feeder "classic compatible" train services onto the network. The latter policy currently features in the public plans for the HS2 route as far as Birmingham (phase 1), with onward running on "classic" tracks to Manchester. As the Welsh Government has no devolved responsibility or funding for the national rail network, it would be a DfT responsibility to develop and fund the forthcoming High Speed Rail network, hence the need for the case to be made to DfT for such a link to Wales.

Metro/LRT: A well designed urban metro/LRT scheme will increase accessibility and increase economic output of the areas served. They can also aid urban regeneration. The economic outcomes from such schemes is however dependent on local specific factors – areas served, underlying economic conditions, level of congestion, etc. As a consequence the ex post evidence on the success of metro/LRT schemes is mixed.

Rural rail services: Rail services can sustain rural communities by connecting them to larger urban areas. Rural communities with access to good local services that provide realistic commuting options to large employment centres can experience growth in population as a result of rail investment (Blainey and

Preston, 2010). In these situations a possible economic outcome is that economic activity centralises in the larger urban area, and the rural community acts as a dormitory settlement. This may not at face value seem desirable, but the positive outcome is that population decline can be halted and a small rural community sustained.

North-south links: Improvements in north-south train linkages in Wales would remove the need for air services if journey times can be brought under 3 hours. Who would benefit the most, in an economic sense, from such an improvement (North Wales or South Wales) is a separate question that would require a detailed study on the economic constraints and opportunities that North and South Wales suffer from and possess respectively.

Electrification: The observed 'sparks' effect on demand for newly electrified services has been attributed to confidence households and businesses place in new infrastructure that has a high degree of permanence. Whilst no ex-post economic data on electrified services exists the 'sparks' demand effect is taken to imply an increase in economic confidence and therefore activity. The presence of the sparks effect remains controversial, with similar effects noted from complete route upgrades such as Chiltern Lines into London Marylebone (which saw improvements throughout but without the physical provision of electric trains and associated infrastructure).

Urban connections- Cardiff - Swansea: Empirical evidence does not give a clear signal as to the impact of an improved Cardiff-Swansea link. On one hand it would create significant integration between the two cities' economies which can raise productivity levels in both ("agglomeration benefits") – though ex post evidence on agglomeration benefits is lacking. On the other hand there may be a redistribution from the smaller and more peripheral economy to the larger one. Recent evidence from the reopening of the Ebbw Vale line, which enhanced links between the Valleys and Cardiff, allegedly had a negative impact upon Newport. It would be worth undertaking comparative analysis between the Cardiff-Swansea pairing and that of the most similar Manchester-Liverpool interaction, as well as the more complementary links between Leeds and Manchester (and possiblly Edinburgh and Glasgow).

Finally, it is worth emphasising that a new or improved rail service will only deliver a positive economic impact if journey times are competitive with alternative modes of travel (namely road and air) and, from a passenger rail perspective, the scheduling of services facilitates both commuting and business travel (i.e. day return trips with sufficient time for business activity at the destination). In all cases, easy accessibility to rail services from local and more distant communities and markets is essential.

3.6 Conclusions from this section and issues for further research

Rail investment which improves services may have a substantial impact on demand, partly as a result of direct switching from other modes and partly from changes in travel patterns (the latter often accounting for a quarter of the impact on demand for commuter services and up to half of that for inter-urban links). For new commuter rail systems typically less than a quarter of the demand comes from car. For high speed rail the diversion from road seems to be much less than that, as road is less significant at the outset for such medium-distance journeys into the biggest urban centres (typically London); however, rail may well take most of the more significant air market.

Evidence of wider impacts of rail investments on land use, employment and output is very mixed. For commuter services, a number of studies of light rail systems have found no impact, although other studies do claim to have found effects in some regeneration areas. The conclusions on the impact on house and other property prices are similarly mixed; studies of major schemes in some of the largest cities, including

London, Dublin and Glasgow, found an effect, but studies in Manchester, Newcastle, Sunderland and Sheffield did not.

There is more solid evidence for new high speed rail links, with regeneration found in London, Lyons and Lille, house price increases in London and Ashford and evidence of increased economic activity at intermediate stations along the Cologne – Frankfurt high speed line. We have noted, however, the two-way road effect of transport investment and its particular relation to high speed rail. HSR has the potential to centralise economic activity and offer agglomeration benefits. At the same we have found evidence that the connected cities can be opened up to labour and business competition from a wider area.

In terms of how transport investment impacts affect different sectors of the economy, the main findings are that the impacts are larger for the service sectors than for manufacturing, impacts measured as elasticities are small, the impacts show very steep rates of distance decay – very closely clustered around points of improvement such as stations and the impacts are specific and should not be transferred between different regions.

Overall then there is some evidence of wider economic impact from both commuter and inter urban rail investments, but these are difficult to measure and, as one might expect, seem generally to be greatest for major schemes affecting big cities.

It is hard to draw conclusions from these ex-post data for rail projects in Wales as so much is dependent on the underlying economic conditions in the localities where the investment occurs. In the main though, we would expect rail investment that provides services useful to commuters and businesses to generate economic growth in the vicinity of the rail line. Much of this growth will be due to re-distribution, but rail investment (as with other transport investment) can be important in terms of sustaining rural communities and binding a nation together – once again subject to the condition that the rail service is useful to households and to businesses.

Appendix A includes both a primary (used in the above) and a secondary (reviewed and discarded for this study) bibliography.

4. Economic and social datasets

In this section we present results for selected case study areas designed to establish whether changes to rail services have had an impact on key economic indicators, socio-demographic and socio-economic data. We note that the selected lines were chosen in consultation with WAG to reflect the North – South and urban – rural nature of Wales and because, with the exception of Treherbert they had benefited from rail investment in the last 5 years (see earlier sections of this report for a description of these improvements). It is important to acknowledge that we cannot isolate rail or general transport impacts upon the economy from wider investments and trends. Thus the endogeneity of impacts upon socio-economic statistics is a key issue. In sections 5 and 6 we consider the growth in rail demand and passenger profiles in the same case study areas in order to examine any correlation between socio-economic change and rail investments.

In our analysis of rail demand data (section 5), we analysed the North Wales corridor as a whole. For the socio-economic analysis we will be looking at population, house prices, employment etc. specifically for the North Wales stations which have enjoyed recent major improvement in rail connectivity towards Wrexham/Shrewsbury and the Marches/Cardiff. The relevance of these wider places is that it is on these lines that the service improvements have manifested themselves: they are not part of the study corridor, and clearly it is economic benefits to the North Wales Coast rather than any enjoyed at the other ends of the journeys which are material.

Figure 4.1: Base line: Treherbert line

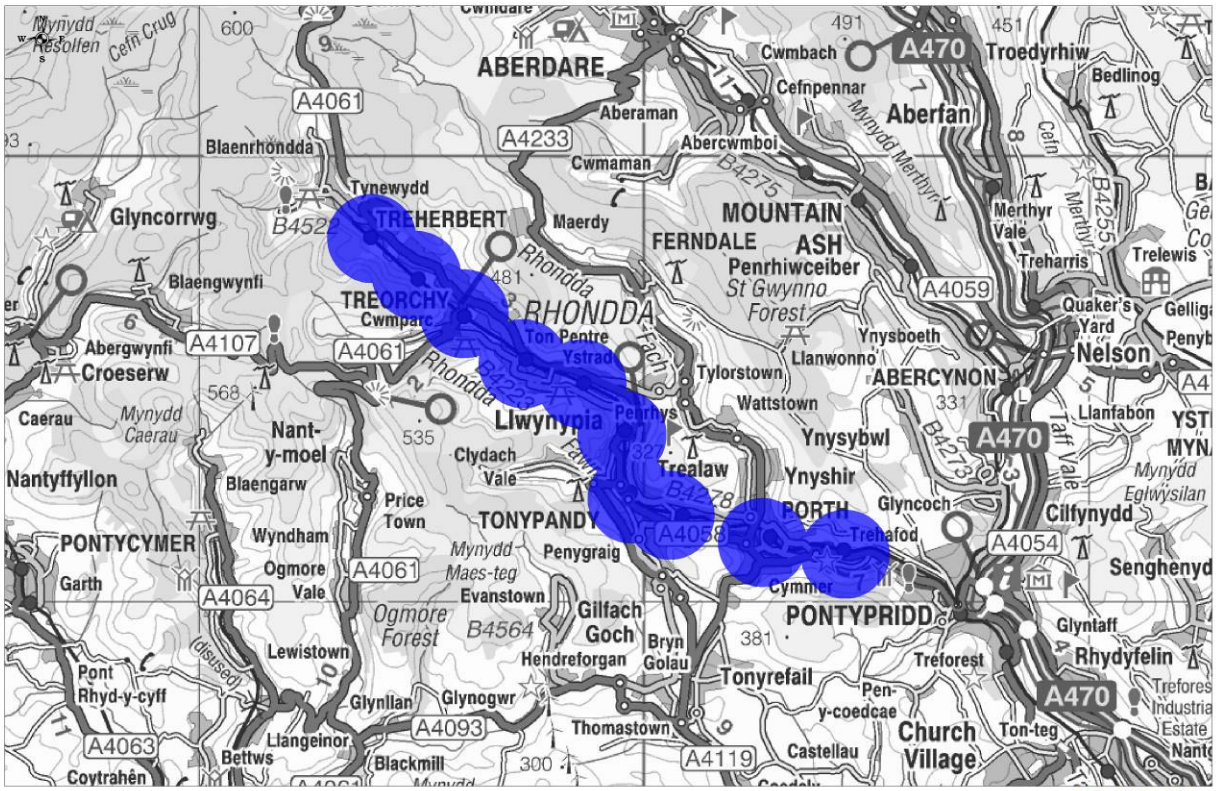

Figure 4.2: Case study line 1: Aberdare line

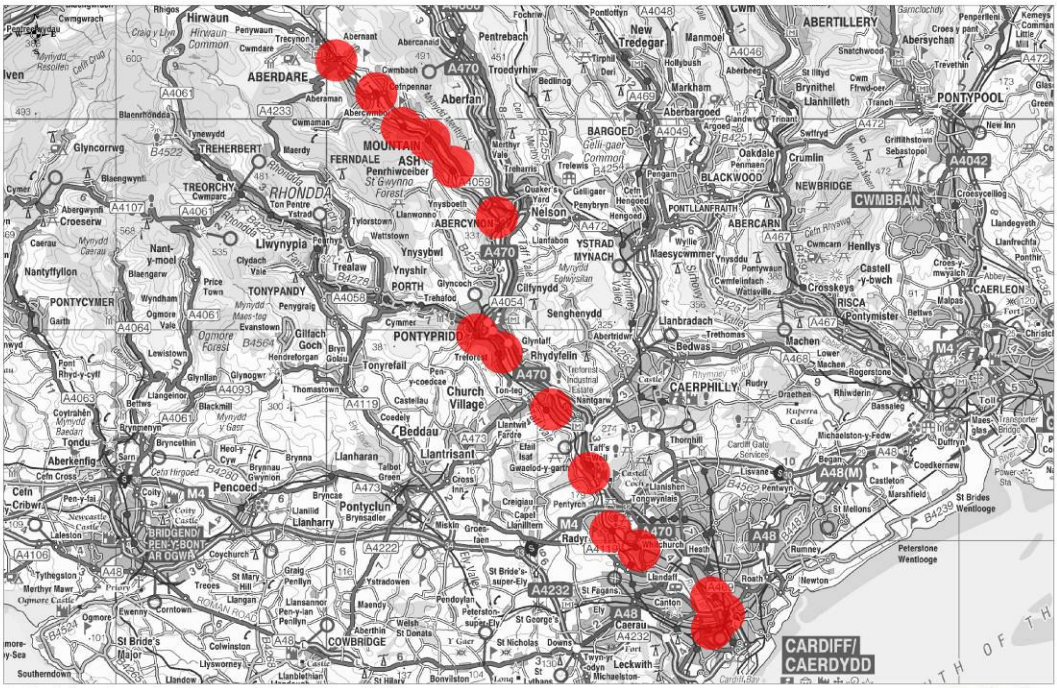

Figure 4.3: Case study line 2: Carmarthen line

Figure 4.4: Case study line 3: North Wales Coast line

Table 4.1:Stations included in case study analysis

Aberdare line	Carmarthen line	North Wales Coast line[17]	Treherbert line
Aberdare	Carmarthen	Holyhead	Treherbert
Cwmbach	Ferryside	Valley	Ynyswen
Fernhill	Kidwelly	Rhosneigr	Treorchy
Mountain Ash	Pembrey & Burry Port	Ty Cross	Ton Pentre
Penrhiwceiber	Llanelli	Bodorgan	Ystrad Rhondda
Abercynon North	Gowerton	Llanfairpwll	Llwynypia
Pontypridd	Swansea	Bangor (Gwynedd)	Tonypandy
Treforest	Llansamlet	Llanfairfechan	Dinas Rhondda
Treforest Estate	Skewen	Penmaenmawr	Porth
Taffs Well	Neath	Conwy	Trehafod
Radyr	Britton Ferry	Deganwy	
Llandaf	Baglan	Llandudno	
Cathays	Port Talbot Parkway	Llandudno Junction	
Cardiff Queen Street	Pyle	Colwyn Bay	
Cardiff Central	Bridgend	Abergele & Pensarn	
	Cardiff Central	Rhyl	
		Prestatyn	
		Flint	

Data for two time periods was utilised in this assessment with the aim of identifying significant changes in economic indicators; 2003 to 2005 and 2006 to 2008. This study compares the rates of change of these two time periods.[18]

4.1 Data sets

Socio-demographic and socio-economic data was gathered for catchment areas for each of the study lines. These catchment areas were defined using the stations listed above and applying a 1 km buffer to each station, with data areas cutting or within this buffer included in the analysis. Within each catchment area the data used for analysis was at the finest spatial scale available. This varied for each data set as shown below, together with the factor generated from the analysis and the source of the data.

This information was aggregated and used to generate an average for each catchment line for the four study years (2003, 2005, 2006 and 2008). Using these averages, growth rates for the pre- and post-timetable change periods could be calculated by measuring the rate of change over each study period. This enabled the comparison of the different growth rates between each period. This difference could then be compared between the case study and Treherbert base line, aiming to identify disparities and therefore links to an impact on economic activity. Table 5.2 provides an overview of the key data sets examined in this assessment.

[17] Chester is not included in this analysis even though we are aware it will attract as an attractor station for the North Wales Coast Line. This could be included in further analysis however a number of the datasets applied would not be compatible as there is a difference in collection and dissemination between some England and Wales datasets.

[18] It should be noted that a major timetable change was introduced for Arriva Trains Wales across the whole network in December 2005.

4.2 Sensitivity testing

In order to examine the robustness of the results from using the above methodology a sensitivity test was applied to the findings. In order to do this 2008 data was excluded from the second time period to try to eliminate the impact of the recent economic downturn which could distort the data.

Table 4.2: Socio-economic indicators used in the analysis

Socio-economic indicator	Factor	Data source	Spatial level	Notes
Population	Percentage change in population	Office of National Statistics (ONS) mid year estimates (June 30th in each year) (2008)	Lower Super Output Area (LSOAs)	Population data was also subjected to the sensitivity test
Employment	Percentage change in employment levels	Annual business Inquiry (2008)	Lower Super Output Area (LSOAs)	Population data was also subjected to the sensitivity test
Deprivation	Percentage change in IMD rank	National Statistics (ONS) mid year estimates (2008)	Lower Super Output Area (LSOAs)	Indices of Multiple Deprivation (IMD) data is only available for two individual years (2005 and 2008) rather than as a time series. The approach used to obtain the change in deprivation rank was averaging the LSOA ranks in each catchment area then averaging these numbers to generate an overall IMD 'score'. This was done both for 2005 and 2008 so a percentage change could be calculated. This information was then used to calculate the percent change. The lower the IMD rank, the more deprived that area is (the most deprived LSOA has a rank of 1). An increase in the percentage change is therefore equal to a rise in the IMD ranking and an increase in deprivation.
House Price	Percentage change in average house price	Land Registry sold prices19 (2010)	Postcode districts	The month of July for each year was used as a representative time period to gather house price data, as this was an active period during the year. This enabled in the majority of cases for the average house price to be calculated based on a significant number of sales. However, some areas experienced a low number of sales for a part period. This data therefore needs to be treated with a degree of caution.
Gross floor areas	Percentage change in Gross Floor Area (GFA) for commercial and industrial use (retail, office, factory and warehouse).	ONS 'Neighbourhood Statistics' (2008)	Middle Super Output Areas (MSOAs)	

[19] www.home.co.uk

Socio-economic indicator	Factor	Data source	Spatial level	Notes
Car ownership	Percentage change in the number of households with no car	TEMPRO (Department for Transport software that provides data for transport planning purposes)	TEMPRO zone level	

In the sections below we present changes in socio-economic conditions for the catchment areas of the case studies using 2003-2005 and 2006-2008 data. For each socio-economic indicator, data for the case studies is compared with the baseline, Wales and Great Britain figures.

4.3 Population

Following the rail improvements each case study line has experienced a modest increase in the rate of population growth, with 2003-05 growth between 0.6% and 2%, and post-2005 growth at levels of 0.7% to 2.4%.

The difference between the base and the case study lines during these study periods is significant. Pre-2005 the base line experiences negative population growth of 0.3%. This negative rate of growth is enhanced post improvements increasing the difference between the base line and the case study lines. National population growth during these periods followed a similar pattern to the case study lines. The rate of growth for Wales and Great Britain also increased after 2005.

There is a clear difference between the rate of change in population growth for base and the case study lines post-2005, suggesting a positive link between this and the rail improvements. However, national data trends follow a similar pattern the case study lines. Therefore it is possible that the increased rate of growth may be associated with a national trend – population trends rather than rail improvements.

It should also be noted that these averages may mask large variations in population changes between different stations along the same corridor.

Table 4.3: Average changes in population for case study and base lines, 2003-08

Line	2003-2005	2006-2008
Treherbert line (base)	-0.3%	-1.5%
Aberdare line	2.0%	2.2%
Difference relative to base	*2.3%*	*3.7%*
Carmarthen line	1.5%	2.4%
Difference relative to base	*1.7%*	*3.9%*
North Wales Coast line	0.6%	0.7%
Difference relative to base	*0.8%*	*2.2%*

Table 4.4: Average changes in population at national levels, 2003-08

Line	2003-05	2006-08
Great Britain	1.1%	1.3%
Wales	0.7%	1.0%

4.3.1 Sensitivity test

The removal of 2008 data results in a slight increase in the level of growth for the case study lines, although the base line remains the same, increasing the difference between the two. This affirms the trends identified above and provides evidence that the recent economic downturn has not masked any trend in population growth.

Table 4.5: Average changes in population for case study and base lines, 2003-07

	2003-2005	2006-2007
Treherbert line (base)	-0.3%	-1.5%
Aberdare line	2.0%	2.3%
Difference relative to base	*2.3%*	*3.7%*
Carmarthen line	1.5%	2.5%
Difference relative to base	*1.7%*	*3.9%*
North Wales Coast line	0.6%	0.8%
Difference relative to base	*0.8%*	*2.2%*

Table 4.6: Average changes in population at national levels, 2003-07

Line	2003-05	2006-07
Great Britain	1.1%	0.7%
Wales	0.7%	0.5%

4.4 Employment

Employment rates for the case study lines following improvements maintained the previous trend of positive growth, although the rate of change *declined* significantly. Employment growth of 5.9% to 6.4% declined to 0.7% to 2%.

The base line employment growth rate experienced a similar trend following this period; however, there is a marked difference in the scale of this decline between the case studies and the base line. During the pre-improvement period the base line experienced a comparable level of positive employment growth in comparison to the case studies (6.0%). However, post-2005 this rate declined significantly to -2.2%. This decrease in rate is far more pronounced than any decrease witnessed by case study lines. Nationally, employment growth in Wales demonstrated a similar trend to the base line, moving from positive growth of 6.4% (2003-2005) to negative growth post-2005 (-0.4%). Employment growth in Great Britain remained positive (1.2%) following the rail improvement period, declining only slightly from 3.1% over the period 2003-2005.

Again, there is a clear difference between the rates of change for this socio-economic indicator between the base and the case study lines post-2005, suggesting a positive link between employment growth and the rail improvements. This evidence is supported by national data because the rate of change in employment during these periods is broadly consistent with base line figures.

It should be noted that, similarly to the above population data, these averages may mask the fact that there are large variations in employment changes between different stations along the same corridor. For instance, within the Carmarthen catchment area there was an increase in employment of 80% between 2003 and 2005 around Ferryside station, whereas employment fell by 42.7% around Britton Ferry station

over the same time period. This reflects the frequent situation where a small station's catchment may only encompass one or two large employers.

Table 4.7: Average changes in employment for case study and base lines, 2003-08

Line	2003-2005	2006-2008
Treherbert line (base)	6.0%	-2.2%
Aberdare line	6.4%	0.7%
Difference relative to base	0.4%	2.9%
Carmarthen line	6.2%	0.7%
Difference relative to base	0.2%	2.9%
North Wales Coast line	5.9%	2.0%
Difference relative to base	-0.1%	4.2%

Table 4.8: Average changes in employment at national levels, 2003-08

	2003-05	2006-08
Great Britain	3.1%	1.2%
Wales	6.4%	-0.4%

4.4.1 Sensitivity test

Imposing the sensitivity test on employment growth data results in a decrease in the level of employment growth recorded for the case study lines. In respect to the base line, the sensitivity test also resulted in a decline in the post-2005 employment growth rate.

The trends in employment growth for the case study lines and the base line broadly remain the same. This provides evidence that the recent economic downturn has not masked any trend in employment growth, and provides support for the conclusions drawn above.

Table 4.9: Average changes in employment for case study and base lines, 2003-07

	2003-2005	2006-2007
Treherbert line (base)	6.0%	-1.5%
Aberdare line	6.4%	0.3%
Difference relative to base	*0.4%*	*1.8%*
Carmarthen line	6.2%	0.9%
Difference relative to base	*0.2%*	*2.3%*
North Wales Coast line	5.9%	1.7%
Difference relative to base	*-0.1%*	*3.2%*

Table 4.10: Average changes in employment at national levels, 2003-07

	2003-05	2006-07
Great Britain	3.1%	1.9%
Wales	6.4%	1.3%

4.5 Deprivation

Changes in the level of deprivation following the improvements for the case study lines are varied. Following the improvements the Aberdare and Carmarthen line catchment areas became less deprived, whereas the North Wales Coast line became more deprived following this period.

Conversely the base line catchment area became *less* deprived post 2005, and crucially at a rate significantly higher than the Aberdare and Carmarthen lines.

This mixed evidence makes it difficult to draw any conclusions on the impact of improvements on deprivation levels. Other relevant factors that influence changes in deprivation would need to be taken into account in order to reach a more robust conclusion. We would once again emphasise that, unlike other socio-economic measures used in this study, the IMD figures are a *rank* – that is, they are a relative measure of the subject area as against all other communities in the country; therefore it is possible that significant changes in entirely unrelated areas may change the subject area's ranking and so give potentially spurious results here.

Table 4.11: Change in IMD rankings by line

Line	% change in IMD rank, 2005-08[20]
Treherbert line (base)	+9%
Aberdare line	+4%
Carmarthen line	+5%
North Wales Coast line	-6%

4.6 House prices

Average house price growth for the case study lines decreased significantly from between 31.7% and 57.7% pre-2005 to between 2.7% and 11.3% post-2005.

The base line experienced a similar trend with average house price growth also falling from 73.4% to 3.7%. Although the trends are similar, in comparison to the case study lines the scale of the decline for the baseline is greater. This evidence therefore suggests that there is a link between improvements and a slowing in the decline of average house price growth. Nevertheless, it is difficult to draw a firm conclusion solely from this evidence. Other relevant factors that influence changes in average house price growth would need to be taken into account in order to reach a more robust conclusion.

Table 4.12: Average changes in house prices for case study and base lines, 2003-08

	2003-2005	2006-2008
Treherbert line (base)	73.4%	3.7%
Aberdare line	31.7%	4.4%
Difference relative to base	*-41.7%*	*0.7%*
Carmarthen line	57.7%	2.7%
Difference relative to base	*-15.7%*	*-1.0%*

[20] A positive change is equal to an area becoming relatively less deprived.

	2003-2005	2006-2008
North Wales Coast line	41.9%	11.3%
Difference relative to base	*-31.6%*	*7.6%*

4.7 Gross floor areas

The rate of change in Gross Floor Areas (GFA)[21] post 2005 for the case study lines declined going from positive to negative growth.

GFA growth for the base line post 2005 followed an opposite trend to the case studies, moving from negative to postive growth following this period. These trends suggest that the rail improvements may have had a negative impact on GFA within the case study catchment areas. This trend may be explained by the potential for improvements in transport increasing the centralisation of economic activity. For example improved transport links to Cardiff may result in an increase in people using Cardiff business rather than local business, thus encouraging business movement to Cardiff, with employment trends following suit. However, it is also worth noting that this indicator has not been subjected to a sensitivity test meaning that the trends above could be associated with the recession since 2007. Once again, however, it should also be noted that the causation may not operate this way: it is possible that the improved rail service in an area *which was declining anyway* has enabled those living there to gain access to opportunity in the main centre, without needing to move away.

Table 4.13: Average changes in Gross Floor Areas, 2003-08

	2003-2005	2006-2008
Treherbert line (base)	-5.9%	0.2%
Aberdare line	1.3%	-0.9%
Difference relative to base	*7.2%*	*-1.1%*
Carmarthen line	8.9%	-0.2%
Difference relative to base	*14.8%*	*-0.4%*
North Wales Coast line	4.8%	-0.1%
Difference relative to base	*10.7%*	*-0.3%*

Table 4.14: Average changes in Gross Floor Areas at national levels, 2003-08

Line	2003-05	2006-08
England and Wales (GB not available)	0.9%	-0.1%
Wales	4.4%	-0.7%

4.8 Car ownership

The average change in the number of households with no car remained negative with little change post 2005 for the case study lines – that is, rates of car ownership increased. The base line experienced a similar pattern, remaining at a level of -1.1%. These trends indicate that the improvements had little or no impact on this indicator. However, we consider that TEMPRO car ownership data need to be treated with a degree of caution, as they are not based on actual new car registrations but on estimated trends for the areas concerned.

[21] GFA includes all commercial and industrial space: office; retail; warehouse; and factory

Table 4.15: Average changes in the number of households with no car, 2003-08

	2003-2005	2006-2008
Treherbert line (base)	-1.1%	-1.1%
Aberdare line	-0.8%	-0.9%
Difference relative to base	*0.3%*	*0.2%*
Carmarthen line	-0.8%	-0.8%
Difference relative to base	*0.2%*	*0.3%*
North Wales Line	-0.6%	-0.8%
Difference relative to base	*0.5%*	*0.3%*

Table 4.16: Average changes in the number of households with no car at national levels, 2003-08

Line	2003-05	2006-08
Great Britain		
Wales	-0.8%	-0.8%

4.9 Conclusions on Possible impacts

Following the rail improvements statistical evidence illustrates some clear differences between the base and case study lines in the majority of cases, and highlights potential impacts on socio-economic indicators. These are summarised below:

Population - a positive impact on growth. However, this trend may be associated with a national population growth patterns.
Employment – a slowing in the decline of growth. Case study catchment areas saw a reduced decline in employment growth compared to the base line, which moved to an absolute decline in the number of jobs.
Deprivation – no discernable impact.
House prices – a slowing in the decline of growth. Case study catchment areas saw reduced decline in house prices growth compared to the base line.
Gross Floor Area – a negative impact on growth.
Car ownership – no discernable impact.

Therefore, this research has identified some evidence that improvements may have had a positive impact on certain socio-economic indicators.

4.10 Recommendations for further study

Although it is possible to establish trends from these socio-economic datasets, it is difficult to draw robust conclusions solely based on this analysis. A comprehensive evaluation of other relevant factors is required in order to substantiate the theories established above. In order to do this it is recommended that:

- A longer or larger data set is obtained – this may enable regression analysis to be undertaken and tests of statistical significance to be produced (see below).
- Analysis of results by station rather than line.
- Rail demand by station to be drawn out so that a more direct comparison with employment and population growth by station can be made.
- Passenger behaviour and business location surveys are undertaken to explore reasons behind encountered trends.

- A case study is undertaken in relation to the Valley Lines to test the hypothesis that land values/house prices respond to new station provision.

In addition, it would be worth considering widening the evidence base to beyond Wales for examples of rail investments, with such examples as the Robin Hood line in Nottinghamshire/Derbyshire, and the reopening of Airdrie-Bathgate as potential examples.

Finally, following on from the above mention of regression analysis, such analysis could be used to identify the significant impacts of rail investment for key case studies. As ever with such an analysis, there would be a need for a large enough time series or spatial dataset to enable enough variability to be present to provide confidence in the results alongside detailed work to establish net economic and social impact.

5. Demand – MOIRA analysis

In order to ascertain the extent to which investment in improving passenger rail services has been associated with increases in demand, we analysed passenger journey data contained in MOIRA, for the railway years ending 31 March 2000 to 31 March 2010 inclusive.[22] This was done at an all-Wales level (compared against an all-UK dataset), on the most heavily used routes, and also on four case study corridors – three of which had experienced service improvements and one not. MOIRA data was derived in the form of passenger-journey figures; this will tend to show slightly different outcomes than if the data were revenue or passenger-kilometres: the latter would bias towards longer journeys, whereas passenger journeys emphasise the importance of large numbers of shorter journeys being made frequently – reflecting the day-to-day core work of the railway such as conveying commuters. Due to the commercial sensitivity of this data we have only reported headline findings in this section. However, we are confident that our conclusions can be supported from the full data set.

5.1 Wales – the overall context

Total demand across Wales has experienced a continued increase in demand since 2000, with the rate of growth increasing since 2005/2006. There does not, at least as yet (i.e. up until 31 March 2010) appear to be clear evidence of the recession having a marked impact on the growth in demand. It should be recalled that the overall growth will have been bolstered in part by the opening of new stations and services, such as the Vale of Glamorgan (2005) and the Ebbw Vale (2008) lines.

Indexed performance for total passenger journeys in Wales compared with the UK between 2000 and 2010 shows Welsh demand outstripping the UK in every market by ticket type. Generally service improvements have been associated with significant growth in passenger numbers. Further, more detailed work is required if we are to be able to identify the extent to which this is newly generated traffic (perhaps associated with economic recovery or with decentralisation of residential location relative to the main employment centres) or modal shift. Section 4 draws conclusions from a wider socio-economic data set enabling us to draw some tentative conclusions in this direction.

We now consider in more detail the four specific corridors chosen for closer study.[23] We acknowledge that the use of Treherbert as the control corridor is open to challenge, although selected areas were chosen in full consultation with Welsh Government officials. It may be worth revisiting these and using an alternative control area should further similar research be deemed beneficial.

5.2 Carmarthen corridor[24]

This corridor essentially covers the South Wales Mainline west of Cardiff. The service group analysed was AW4320, which covers the most relevant through services, and therefore encompasses through workings to Pembroke / Fishguard / Milford Haven including those commencing/terminating at Carmarthen – but excluding Cardiff – Bridgend – Maesteg and Heart of Wales Line services. We have however primarily considered the section east of Whitland, where the three West Wales branches converge.

22 MOIRA is a nationwide rail demand and revenue modelling tool. The journey and revenue data contained is based on full records of actual ticket sales as recorded by the railway's LENNON system.

23 The first three corridors are fairly straightforward in layout and additional maps are not given here. However the locations of the stations on each corridor are shown in the mapping in chapter 4.

24 See map in Figure 4.3.

5.2.1 Service offering

Prior to December 2005 the timings of services running between Whitland, Swansea and Cardiff Central on a weekday were relatively consistent. Throughout the day there were a total of 16 trains that provided the service, Whitland to Swansea between 02:00 and 22:00, 9 of which continued to Cardiff. Between the hours of 08:00 and 20:00 there was one train an hour to Swansea, departing at approximately 10 minutes past the hour (13 in total), with 6 of these trains continuing on to Cardiff; there was no structured pattern to this extended service to Cardiff.

In contrast the origins and final destinations of services that ran between these stations varied considerably, with services originating at Fishguard, Milford Haven, Pembroke Dock and Haverfordwest, and services terminating at a range of stations including Cardiff, Swansea, Exeter St Davids, Manchester Piccadilly, Penzance and Bristol Temple Meads.

Since the December 2005 timetable change, trains along the Whitland to Swansea/Cardiff route have increased in number, with 18-19 trains departing between 02:00 and 23:00, 17 arriving at Swansea (the exception being the direction Fishguard – Cardiff boat train) and 9 providing a service on to Cardiff. Between the hours of 08:00 and 21:00 there is a service running between Whitland and Swansea approximately 8 minutes past every hour (it is not a precise clockface timetable[25]), with an additional service every two hours, also continuing to Cardiff, departing roughly 45 minutes past the hour. In the alternate hour, a Cardiff service commences at Carmarthen, generally running through to Manchester. Finally, two daily Fishguard boat trains are additional, one travelling to/from Swansea and the other to/from Cardiff and using the Swansea District route to avoid Swansea station.

The majority of the trains originate either at Pembroke Dock or Milford Haven; services generally either run through to Manchester Piccadilly or terminate at Swansea, with individual services terminating at Crewe or at Cardiff Central; the timetable intervals of services east of Swansea are regular, but the pattern of the through workings continuing beyond Cardiff is less so with through services alternating with terminating ones. Nonetheless, the pattern is significantly less irregular than before 2005.

In comparison to the pre-December 2005 timetable, the frequency of service has remained relatively similar although there are an additional two trains per day which terminate at Swansea. There has been a significant change in the pattern of train services that run through Whitland, with regular services to either Manchester Piccadilly or Swansea replacing a service that included 6 separate destinations.

Beyond the timetable itself, many services are now operated by fairly new “Coradia” class 175 DMU stock, primary replacing class 158s. Arguably the class 175 offers an improved ambience as against the 158, and certainly in comparison to the more basic class 150 “Sprinter” unit. However, overall train capacity is in general not significantly greater than previously, and the older stock still plays a significant role.

5.2.2 Demand trends

A trend of steady growth has been observed until the year to 31 March 2007, during which a significantly more rapid growth trend emerges. This would suggest that the simplification of the timetable and the slight increase in services may have led to growth – or made the railway better able to cope with underlying demand growth. The data suggests a growth in short-distance commuting and personal business/leisure

25 And there is no 13:08 departure.

travel, and implies that Swansea's importance as a regional attractor is significantly strengthening, especially in recent years.

It is, however, worth noting that the December 2005 timetable change brought an additional commuting service from Carmarthen to Swansea in the morning peak, and a corresponding extra train returning in the evening peak – it is highly likely that this enhancement has enabled those in Carmarthen, Pembrey & Burry Port and Llanelli to access jobs in Cardiff significantly more easily by rail than previously. The new services are in each case fairly close to previously existing trains – but for commuting flows 15-20 minutes in a train's timing can make a significant difference to whether rail is chosen for the journey.

5.3 Aberdare Corridor[26]

The Aberdare corridor encompasses the route eastwards from Cardiff Queen Street via Cathays to Pontypridd and the Aberdare branch itself. It excludes the Pontypridd – Treherbert section. The reason for this distinction is to separate those sections of the route which have benefited from service improvements (the Aberdare and central section) from those which have not yet (the Treherbert branch).

5.3.1 Service offering

Prior to December 2005, the frequency, timings and destinations of services running between Aberdare and Cardiff Central on a weekday were not consistent. The service varied between one and two trains per hour. Between 06:00 and 10:00 services did not observe standard clockface times, and this was also apparent between 17:00 and 22:00. In the inter-peak period there was a semi-standardised timetable, with trains departing Aberdare at 20 or 50 minutes past the hour; during some hours trains left at both times. Under this timetable trains departing from Aberdare, and calling at Cardiff Central, had a variety of destinations including Barry Island, Penarth, Cardiff Central, Maesteg and Radyr.

Since the December 2005 timetable changes along the Aberdare line, the service has become more frequent, with two trains departing every hour between 08:00 and 19:00. The timetable has also become standardised with these services departing Aberdare at 25 and 55 minutes past the hour (now xx:21 and xx:51). The destination for all services leaving Aberdare between 08:00 and 18:00 is Barry Island; after this time the destination of services varied between Cardiff Central and Barry Island (now Cardiff Central and Penarth).

For the section between Abercynon – Pontypridd – Cardiff, the service offering is supplemented by twice-hourly Merthyr Tydfil services; in this case, however, the move from hourly services only came with the May 2009 timetable change. As a result, the section inwards from Pontypridd has moved from four to six trains an hour. It can therefore be seen that there have been significant changes in the timetable since the last major change in December 2005, and a further improvement affecting the central section in spring 2009.

In terms of rolling stock, services continue to be provided by a mix of class 150 "Sprinter" and class 143 "Pacer" units, all fairly old (1980s construction) – there have however been some capacity augmentations with double units used on busier services.

26 See map in Figure 4.2.

5.3.2 Demand trends

This line has experienced steady and very strong growth, with a one-off peak in the 2004-05 year (the reason for which is at this stage not entirely clear). However, from 2006-07 onwards, the rate of growth has steepened, only easing off during the last year of recession (though still increasing). Total demand is up around 81% on 2000 levels.

5.4 Treherbert Corridor (control line for this study)[27]

This corridor encompasses those stations on the Rhondda line beyond Pontypridd; that is, from Trehafod onwards. Stations on the Pontypridd – Cardiff section of the same service group have been excluded, because these have benefited from the service improvements introduced on the Aberdare line[28]. The enhancements on the Aberdare route have not yet been effected on the Treherbert branch itself, and in this sense, the Treherbert branch can be considered to be a "control": a route which has seen little change in its service over the study period.

5.4.1 Service offering

The Treherbert line has experienced less change than most other lines in the Valleys network. Prior to the 2005 timetable change, there was a 2 tph service from Treherbert to Cardiff Central for most, though not all, of the day, with trains generally departing Treherbert at xx:31 and xx:59. In the morning and evening peaks, additional services ran, though they were irregularly timed and ran through to various destinations.

After the timetable change in December 2005, the position was rationalised, with a more regular 30-minute interval in place between 06:00 and 20:00, with trains departing Treherbert at xx:17 and xx:47. Daytime services all terminate at Cardiff Central, with evening ones extended to a variety of destinations. This remains the position at present (autumn 2010).

The Rhondda line has therefore experienced less significant service improvements than the Merthyr/Aberdare lines during the study period. However, it should not be concluded that the Treherbert line has experienced no changes at all in its service: in addition to the minor changes to timetabling, there have been capacity improvements in terms of selective train lengthening to tackle crowding.

As with the Aberdare line, services are largely provided with "Pacer" or "Sprinter" stock, with 4-car units used at peak times (though a move to peak 6-car sets is intended for the future).

5.4.2 Demand trends

In common with other Valleys lines, the Treherbert line has experienced strong growth – and again that growth has been strongest in commuting and full-fare travel, suggesting increased demand for rail-borne commuting and other peak-time journeys. Overall growth has been 49% – markedly less than on the Aberdare line, though clearly more than respectable in absolute terms.

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27 See map in Figure 4.1.

28 Though of course we have included all journeys between Treherbert branch stations and any other destination, not just journeys within the branch itself.

5.5 North Wales Coast Corridor

This corridor is larger and somewhat more complex than the others. Its study arises out of the desire by stakeholders to examine the recent trends on this important east-west route which also feeds into Wales's north-south links. It comprises journeys which:

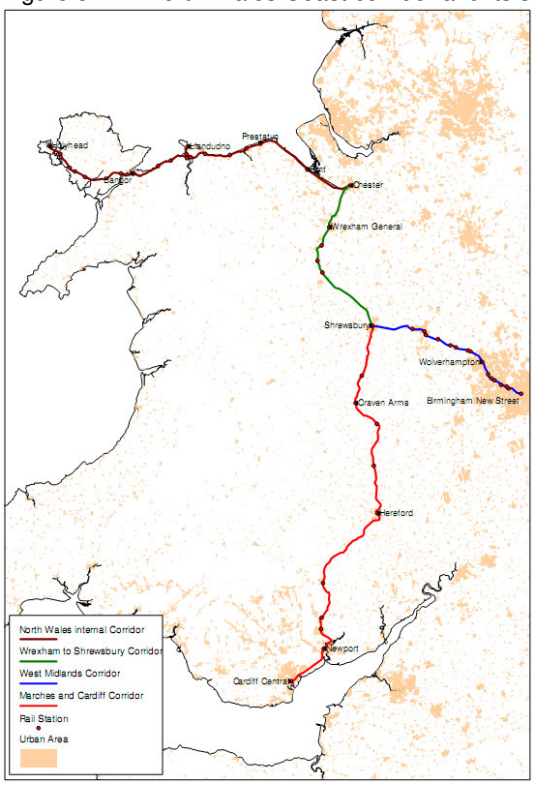
- Originate or terminate at stations on the North Wales Coast mainline between Chester and Holyhead (including Llandudno branch but not the Conwy Valley branch to Blaenau Ffestiniog), AND
- Have as their destination or origin either another station within the North Wales Coast line, or a station south of Chester served primarily by ATW services, including those on the route to Shrewsbury and then beyond either towards Wolverhampton and Birmingham International or south along the Marches line to Hereford, Newport and Cardiff, AND
- Wholly or mainly use ATW services.

This therefore expressly *excludes* journeys likely to be of less relevance to this study, such as those to/from Crewe and stations to London (using Virgin West Coast or Wrexham & Shropshire), and those to Manchester or Liverpool. The corridor includes several service groups; the principal ones are, however, the following ATW services:

- Holyhead – Chester – Shrewsbury – Cardiff;
- Holyhead – Chester – Shrewsbury – Birmingham International; and
- Llandudno – Llandudno Junction – Chester – Manchester Piccadilly (but not east of Chester).

For the purposes of our analysis, we have considered the corridor as a whole, and not it split into sub-markets as we are requested to respect data confidentiality issues. The corridor and its sub-markets can be seen below:

Figure 5.1: North Wales Coast corridor and its sub-markets



5.5.1 Service offering

The service offering on the North Wales line has been subject to significant change, which took effect principally from the December 2005 timetable change.

Before this date, there was no real pattern to the services; generally speaking, there were trains roughly hourly from Holyhead to Chester, mostly continuing to Crewe, with many extended to Birmingham New Street and/or London Euston. In addition, many services ran only as far west as Bangor, be it further trains from the Crewe direction, those from Birmingham via Shrewsbury, or services from Manchester Piccadilly. Gaps were filled with local services, some running only between Llandudno Junction and Bangor. Relatively few trains from the North Wales Coast reversed at Chester to continue to Shrewsbury and the West Midlands – and there was a single Holyhead – Cardiff return working; in all other cases, through passengers would need to change trains, generally in Chester. The total number of eastbound departures from Holyhead was 20 per weekday. Manchester services generally ran to/from Llandudno, though with some exceptions.

The present position is quite different and characterised by a far greater degree of regularity both in the service pattern and the departure times – though a clockface system has not been achieved. The number of weekday departures from Holyhead has now risen to 23, with the only trains stopping short of Holyhead (Bangor or Chester) being certain VWC services. Holyhead – Cardiff services run approximately every two hours, alternating with those to Birmingham. In both cases, trains now reverse at Chester to provide direct links to Wrexham and Shrewsbury – so avoiding the need for through passengers to interchange at Chester. Generally the Birmingham services provide the stopping services along the Coast. Llandudno is served by hourly Manchester trains (in addition to connections eastward out of/into Conwy Valley trains at Llandudno Junction). In addition to VWC's London services from Chester, Bangor or Holyhead, the picture is completed by the single locomotive-hauled Holyhead – Cardiff – Holyhead daily working (operating via Crewe). Alongside the simplification of the timetable pattern and the increase in frequency in many cases, the main feature is the significant increase in the number of services which, via reversal at Chester, provide direct links from the North Wales Coast to Shrewsbury and the West Midlands – but above all southwards along the Marches Line to Cardiff, which now has 9 direct trains from the North Wales Coast (including Chester), as opposed to only three in summer 2005. As a result, the number of journeys which can now be made without interchange has increased very substantially.

Rolling stock has changed from a mix of 2-car class 158s on north-south services and 4-car loco-hauled sets on the North Wales Coast itself, the former having provided the few through services, to new 3-car class 175 "Coradia" units on almost all services, other than the daily premium Holyhead – Cardiff service, which is provided by a high-quality loco-hauled set.

5.5.2 Demand trends

Overall the picture was roughly a steady one – indeed with some evidence of gradual decline – from the beginning of the study period in the 1999-2000 year until the 2004-05 year. However, after that, and particularly from 2005-06, demand has started to grow steadily and increasingly strongly, such that overall demand in terms of passenger-journeys has grown by around 34% between 2004-05 and 2009-10, with no evidence as yet of the recession having led to an easing of this trend.

5.6 Rail demand growth – conclusions

It is impossible to use historic demand data to carry out a wholly scientific study of the effect of improving rail services on passenger ridership levels. This is because (a) few if any lines serving major centres have had absolutely no changes in timetable or train provision; (b) a simple analysis of demand trends as shown by ticket sales does not account for changes in the environment in which the railway concerned operates: shifts in employment, economic activity, population distribution, car ownership and other trends outside the railway will have direct effects on passenger demand. Therefore our analysis in this section is inevitably prone to "noise".

Nonetheless, some conclusions can be drawn from this high-level analysis. We are aware that all of the Valleys network has seen high levels of growth; it is known that the Valleys have been in some respects an exceptional case, with social/economic change and significant improvements in rail's offer leading to order-of-magnitude shifts in journey-to-work patterns, with commuting into Cardiff far more widespread[29]. However, the comparison of the Treherbert branch section with the Aberdare branch plus central Taff Vale section of the line is informative. As we have seen, all lines in this area (including the Merthyr Tydfil branch) now enjoy half-hourly services on each route all day – meaning that as far as Pontypridd there are 6 trains per hour, amounting in practice to a "turn up and go" level of service towards Cardiff. This section has therefore benefited from the 2005 move to half-hourly trains through to Aberdare, and the same happening to Merthyr Tydfil in 2009. Previously both branches had only hourly services, and the central section therefore only four trains per hour (five between 2005 and 2009).

As discussed, most Valleys services have also moved from a single 2-car "Pacer" unit to two units – this, however, applies across all lines (at least at peak times), so should not confuse the position between the lines under study.

There does appear to be a cogent case that at least a significant part of the additional growth seen on corridors which have had service enhancements is actually attributable to those improvements, with the additional services having an "unlocking" effect allowing rail better to reach its potential. This also suggests that relatively low-cost interventions can provide the keys to such effects, and hence benefits outweighing their likely costs. It is equally apparent that this effect is not restricted to any one category of rail service – our study shows clear evidence of service improvements yielding major demand uplifts from:

- Enhanced frequencies on short-distance commuter routes (Valleys lines);
- Small numbers of additional trains making new commuting flows practical (Carmarthen corridor);
- "Stitching together" existing separate services to provide regular through trains and avoid the need for interchange, developing new markets for rail both on short-to-medium journeys and long-distance flows (North Wales Coast to Wrexham, Shrewsbury, the Marches and Cardiff).

It is not clear how much of the new-to-rail demand is additional journeys and how much is modal shift from road (air being of limited relevance in Wales, except for the Anglesey – Cardiff service discussed above). However, the order-of-magnitude increases in rail usage, against national trends of overall travel remaining broadly static, do suggest that much has been modal shift. This is a cautious suggestion given that the number of journeys have remained static but passenger kilometres have continued to increase – therefore improvements to transport may have had both a decentralising effect and a broadening of labour market catchment areas. We would be able to better consider this when travel to work patterns are available from the 2011 Census.

29 This is, for example, acknowledged in Network Rail's Wales RUS.

The extent to which further improvements could repeat this effect is not clear, but there is no real evidence that demand for rail in Wales has reached a "plateau" level beyond which further service improvements would cease bringing significant demand boosts. This is likely to reflect rail's relatively low modal share on most corridors in Wales: it only takes a small proportionate shift away from road to bring an order-of-magnitude increase in rail demand. Clearly this is both an opportunity and a challenge for the railway: it would not take a significant modal shift in rail's favour for existing capacity to be exhausted and major invested to be required to avoid stifling a move to rail and constraining overall rail growth. In some cases there is already evidence of this, with peak-time crowding reported not only on short-distance commuting flows.

5.7 Recommendations for further study

While strong, the evidence set out in this section as to the demand uplift effect of rail service improvements is still to an extent circumstantial. We would recommend that a fuller study be carried out to analyse its causes further. This would provide firmer evidence as to:

- The comparison of each line's performance: whether the improvement in the service is linked to a clearly increased propensity of individuals to make rail journeys, as opposed to not travelling or to choosing other modes;
- Whether the growth seen on the study corridors has exceeded PDFH predictions, and how this growth can be explained by reference to social, economic and demographic changes in the areas served, and/or to changes in rail's service offering.

In addition, it is to be recommended that (given sufficient time and money) any further analysis should include identifying and examining control corridors for each route being looked at, with the control being in a structurally similar area and with a similar journey time to the key attractor involved.

6. Passenger Profiles – National Rail Travel Survey

We carried out a high-level analysis of data for Wales contained in the National Rail Travel Survey (NRTS) dataset. This dataset provides valuable information about rail travel in Wales, including journey purpose, modes of access to stations, and frequency of trips, plus data as to *who* is travelling by rail in Wales in terms of age, sex, socio-economic background and car ownership. While only available as a "snapshot" (as at 2004/05) rather than a time series, nonetheless NRTS data can be instructive and can form the basis of a more detailed market analysis, such as by comparing the demographic/economic profile of those carried by rail with the profile of all those living in the railway's catchment.

We have analysed NRTS data for each of the four corridors forming our case studies. In each case, we have taken all journeys starting or terminating at a station on the relevant corridor; the data has been weighted by the frequency with which the survey respondents travelled by rail, so that daily travellers are afforded more weight than occasional ones. Conveniently, the time-point of the NRTS surveys falls almost exactly midway through our study period. For ease of comparison between corridors, in this section we have grouped the findings by variable rather than by corridor.

A degree of caution is advised with the NRTS samples used: while the data sets are fairly large, they do not include as many samples (i.e. survey responses) as is common in, say, South-East England. Nonetheless we consider that they are generally of sufficient size for the results to be meaningful, and that the profile they suggest of the Welsh railway's passengers is credible. We would also refer the reader to section 4 where there more details on important demographics around the case study corridors that will influence the traveller profiles.

We have set out this section by summarising the characteristics the NRTS data reveals for each corridor, and then drawing together some overall conclusions. Charts showing the individual results for each line and criterion are in Appendix C.

6.1 Journey purpose

On the ***Carmarthen corridor***, commuting classes of journey make up a large proportion of travel (64%) – we have seen in the previous section that this is likely in large part to relate to travel into Swansea, though lesser centres such as Carmarthen also have some commuting, and smaller towns will also attract some educational flows (such as secondary schools and colleges). A further 10% is business travel (a reasonable proportion for a regional railway), reflecting the interurban role the mainline plays, linking business/industrial centres such as Cardiff, Swansea, Carmarthen, Haverfordwest and possibly Milford Haven. Almost all of the remaining travel (around 26%) comprises leisure and personal travel, largely in the off-peak.

The ***Aberdare line*** (including the Cardiff – Pontypridd section) is overwhelmingly a commuter railway: over 84% of journeys are to work or education. The high figure for education probably largely reflects the effect of Cathays, the station for Cardiff University. As would be expected of a suburban line, business travel is minor (though not negligible at 5% – Cathays will attract journeys to the WAG offices); the remaining 11% is personal business and leisure travel. This breakdown reflects the social and economic structure of the districts the railway serves – in particular the need of Valleys residents to travel to Cardiff for work opportunities, the local employment bases having in large part disappeared over the last 25 years. In other words, this sample strongly supports the contention that rail is playing a very important role in providing access to opportunity – and so promoting social inclusion.

The profile of the ***Treherbert corridor*** is, as might be expected, similar in some respects to the Aberdare line: exactly the same proportion is employment commuters, though with fewer educational trips. Business travel is actually slightly higher than on the Aberdare line, though the 2% difference should be treated with caution as sample sizes are small – there are few major economic centres on the branch, and it is possible that some of the cases here may represent those who have more than one workplace. The pattern of schools and colleges is different in this area. The remaining 21% is, as would be expected, leisure and personal business: as on the Aberdare route, shopping trips are fairly significant, as is general leisure travel. Once again, however, the large numbers of trips made for access to jobs (commuting) and essential local services (shopping and personal business) are strongly suggestive of a railway expanding the opportunities of a fairly economically deprived area, and so promoting social mobility and inclusion.

The obvious contrast between the two Valleys corridors and Carmarthen route reflects the nature of the railways concerned: the Valleys services are branchlines linking obvious generators of trips (residential communities with few jobs and limited local services and leisure facilities) with one major attractor, Cardiff. In contrast, the Carmarthen line links several major centres, providing interurban links as well as classic generator – attractor flows, and this is reflected in its much more diverse mix of trip purposes.

It is not possible, in the absence of a comparative time series, to comment on whether the improvements to services described in the previous section have had an effect on the composition of rail demand by journey purposes. However, in particular the Valleys examples provide evidence that the railway is promoting economic opportunity and social inclusion, and the South Wales mainline, even west of Swansea, is combining doing this with providing important links between regional economic centres.

NRTS suggests that the ***North Wales Coast corridor***'s passenger journeys are dominated by short-distance flows along the Coast line itself. These therefore also dominate the NRTS results in the full study sample, and they show a great preponderance of daily flows – above all that over half of the journeys are educational flows (we are aware of strong individual flows into main centres, such as Fflint to Chester). Trips to work make up more than another quarter – so together these two varieties of commuting make up an overwhelming 79% of the passengers sampled. There is a limited amount of business-related travel (of 6%), with the balance made up of travel for leisure and personal business.

Educational flows tend, without specific policy changes such as moves to/from bus or changes in educational patterns as a whole, to track general population patterns, so it is likely that the growth seen in commuting on North Wales Coast corridor has come from elsewhere. However, it should be emphasised that the NRTS dataset dates from 2004/05 – so largely predates the massive growth seen in the Wrexham – Shrewsbury – Marches – Cardiff sub-markets. Given that this growth has largely been in longer-distance travel, it is likely that the breakdown given by the NRTS data is no longer entirely accurate. Nonetheless, it will be recalled that even now, the shorter-distance "internal" flows still make up 74% of the overall market, so subject to this caveat the analysis is still of some value.

It is useful to break the North Wales Coast corridor down into its constituent sub-markets, and we have done so on the same basis as with the journey data:

- On journeys between the North Wales Coast and the **Wrexham – Shrewsbury corridor**, we see a large number of journeys to and from work – even though they are still outweighed by educational commuting, particularly into Wrexham. Again, this predates the service changes and the major growth – but the sizable proportion of the then small overall market who were commuters could be taken to suggest that growth in this sector by modal shift towards rail was possible, in the sense that there was a commuting market. Again it can be seen that there is some business travel – though as

with the overall market it is likely that demand will have been stifled by the need to interchange at Shrewsbury for the vast majority of journeys before 2005.

- Care is needed with the **West-Midlands** sub-sample: the data sample size is particularly small here, but the breakdown is included for completeness. It shows a very strong preponderance of leisure travel (65%), which is not in itself incredible for a longer-distance flow of this type – though it seems unlikely that such a large proportion as the 35% suggested is commuting to work or education. Equally, one would expect some business travel – bearing in mind that this corridor did enjoy some direct services from North Wales even before the December 2005 enhancements. We therefore believe that the small sample size (which affects all NRTS data for this sub-market) makes the results for the North Wales – West Midlands journeys unreliable, and we have therefore not given them separately in the remainder of this analysis.
- On the **North – South** route (Marches & Cardiff journeys), even prior to the improvements, travel was dominated by business trips, with leisure making up almost all of the rest, and little commuting taking place over such long distances. The position may well have been that, while few trips were made, there was demand from the North to the capital. It is possible that some of this demand was made up of those attending the Welsh Government institutions in Cardiff as well as private-sector business travel – and it is likely that this preponderance of business use has been one driver behind not only the provision of new direct services but also the addition of the high-quality Holyhead – Cardiff loco-hauled service with particularly business-friendly facilities and a faster journey time.
- Because it is the biggest sub-market, the "**internal**" sub-market reflects, as one would expect, the overall picture, with daily education and work predominating. Business trips are slightly less important overall, with, as ever, the balance made up of leisure and personal business trips. The main point is essentially confirmation that the overall picture shown for this corridor as a whole is largely a reflection of this sub-market, given its dominance in 2004/05.

6.2 Station access modes

For this data, we considered the modes of access used by travellers on each of the study corridors (also counting the modes of egress for the returning parts of return trips).

The ***Carmarthen line*** shows a fairly typical breakdown for a mainline with a mix of stations serving settlements of various sizes, and with a variety of access arrangements. Walk-up and car access (the latter including both park-and-ride and kiss-and-ride) each make up 39%, and of the remainder, most are bus users (reflecting the transport nodes in Swansea and Carmarthen), with some using taxis and only around 1% cycling – broadly reflective of the national situation outside London. [It should be noted that the reference to metros or light rail is evidently spurious and likely to reflect incorrectly completed forms, most probably respondents making long-distance journeys to/from cities with such facilities (e.g. Birmingham or London), confusing access with egress and so responding for the "wrong" end of their rail journey.]

The position on the Valleys lines is quite different:

On the ***Aberdare route***, a large majority of passengers walk to the station – and fewer than a quarter travel in cars; this reflects the stations having very localised catchments (the proportion using bus is also small), being close together (so minimising walk access times) – and above all is a mark of the low car ownership of the Valleys. As is commonly the case, the more frequent rail travellers are the less likely to use a car. Being essentially a commuter and community railway, taxi access is minimal (it is associated with business travel). Again, around the national average cycle to the station.

The fact that car ownership (discussed further below) is low is to an extent in rail's favour – but not wholly, in that if wealth levels rise, car ownership is likely to increase, which at least in the short term is associated with falls in demand for rail; rail travel only rises again once incomes increase to levels where individuals can afford to own a car but not necessarily use it for all journeys.

The ***Treherbert*** branch can be seen as an even more extreme example of what has been observed along the Aberdare corridor: here, walk access is even more dominant, and car access of both types is only 16%. The difference is likely to reflect the fact that the Aberdare corridor includes the central Taff Vale section between Cathays and Pontypridd, where there are pockets of relative wealth, but also where several stations lend themselves to park-and-ride use for the city centre of Cardiff – particularly Trefforest, Llandaf and Taffs Well – with large car parks and a turn-up-and-go frequency of train service. The Treherbert branch in contrast draws most of its patronage from a very localised catchment: only 23% of passengers use *any* motorised mode of transport for station access.

The overall station access position on the ***North Wales corridor*** is fairly typical for a mixed-market railway of this nature where shorter journeys predominate – it is comparable to the Carmarthen corridor, though with minority modes squeezed further both by walk-up access and car use. Notably, however, cycle access was far from negligible, even in 2004/05.

Most of the sub-markets of this corridor have a roughly similar profile, so are not shown separately in this report, with one exception: the long-distance **North-South flows** between the region and the Marches/Cardiff. Here, the profile fits closely with the journey purpose findings for this sub-market: it is the profile of business travel: over three quarters travel to the station by car – rising to a massive 94% when taxis are counted. Given the sparseness of the rail network in Wales, park-and-ride and kiss-and-ride are essential parts of many longer-distance journeys, with rail used for the "trunk haul" into the main centre (generally Cardiff in this case); the journey length and the avoidance of congested urban traffic at the Cardiff end outweigh the need to interchange.

6.3 Car ownership

NRTS elicits data on the number of cars in the household of the rail traveller responding.

The figures for the ***Carmarthen corridor*** are fairly typical – there are relatively few households with no car, reflecting in part the low population density of some of the rural areas through which the railway passes. The data also, however, shows that the vast majority of rail travellers come from a car-owning household, underlining the weakening in recent years of the traditionally assumed linkage between *household* car ownership and rail demand. Clearly, however, where there is only one car in a multi-person household, and two adults work, one is in any event likely to need to use public transport. However, it is notable that 38% of rail travellers come from households with at least two cars – it is very likely that adult respondents in this category have made a choice to use rail, rather than needing to do so. Again, therefore, this shows how car ownership is no longer directly related to a fall in rail usage – particularly amongst those prosperous enough to own a car but be able to choose not to use it.[30]

As might be expected, the proportion of no-car households is higher in the Valleys, where there are areas of significant economic deprivation – though still fewer than a quarter of ***Aberdare line*** travellers have no

30 Needless to say, it should not however be assumed that those with no car are necessarily in this position for financial reasons: they may have chosen not to drive for entirely different motives.

access to a car. Even here, a third of rail travellers are from multi-car households: the typical rail traveller is no longer someone who is "dependent" on public transport; it may in particular reflect the wider "railhead" character of some Aberdare-line stations, serving more rural catchments where car access is high despite modest levels of prosperity.

The ***Treherbert branch*** profile is suggestive of a less prosperous catchment – which is consistent with this area not including the Pontypridd – Cathays section with its park-and-ride markets and more prosperous housing than in the Valleys proper: here we see a higher proportion of carless households, and of those which do own cars, they are far more likely than elsewhere to have only one: only one in six has more than one car. This underlines the evidence that the Treherbert branch fulfils a vital social function in linking communities to the outside world.

As with access modes, ***North Wales*** is again shown to be similar in general profile to South-West Wales – few rail travellers have no access at all to a car, and 40% actually have two or more cars in their household. Again, the evidence is that car ownership is no bar to rail use. That said, it will be recalled that at the time of the survey many travellers were educational commuters – either school or college – and these respondents are likely not to have personal access to a car. Once again, within the North Wales corridor, the sub-market showing the greatest divergence from this overall picture, and so considered separately, is the long-distance **North-South** market. Here, as expected from the access mode data, very few of these largely business travellers come from no-car households – and the vast majority (75%) from multi-car homes.

6.4 Income groups

Again, this data is collected at household rather than individual level, in £ per annum.

The income profile on the ***Carmarthen corridor*** reflects, as with car ownership, the mixed catchment of the South Wales Mainline, with a preponderance of middle-income levels. The lowest income range is likely in large part to reflect travellers in full-time education.

The ***Aberdare corridor*** has a significantly large low- (or more probably no-) income market – again reflecting educational flows such as to Cardiff University (full-time students). However, there are also higher numbers of earners with low incomes than on the Carmarthen line, reflecting the depressed nature of much of the Aberdare route's local catchment, and correspondingly lower numbers in the higher income groups. Note, for example, that one household in seven has an income above £7,000 (so probably not in full-time education) but below £12,500 – suggesting significant deprivation.

Once again, the deprived nature of the areas served by the ***Treherbert branch*** can be seen: only 20% of rail-using households have an income above £35,000 per annum. Also, despite the lower educational flows, there are still 13% with an income under £7,000 – these may be benefit recipients. The largest group is made up of those with an income of between £17,500 and £35,000; while we have no data to confirm this, it is likely that the bulk will be clustered towards the lower end. As with Aberdare, therefore, there appear to be significant numbers of households on particularly low incomes.

The results for the ***North Wales Coast corridor*** suggest a very wide mix of travellers (including substantial numbers of no-income households representing students) – but also significant numbers of fairly high-income households. The breakdown varies somewhat by sub-market, and is therefore considered

individually[31]. Essentially, however, while incomes are mixed, the breakdowns confirm that the no-income households are associated with the educational trips, though the "internal" trips are also made by those in higher income groups (possibly educational trips by younger students living with working parents). Conversely, there are few no-income householders travelling on the Marches/Cardiff corridor, again reflecting the preponderance of business travel.

6.5 Travellers' ages

These are grouped in ranges. It is likely that child travellers will be underrepresented, as they are for obvious reasons less likely to complete the survey forms – and under-16s are not counted at all.

The age profile for the ***Carmarthen corridor*** confirms that significant numbers of young people are travelling by rail, over a third being under 25 – note also that the propensity to travel by rail does not appear to drop noticeably once travellers reach the age when they qualify for a driving licence. Other than the oldest groups, whose need to travel is in general less, the least likely to travel by rail are 35-44 year-olds – it could be argued that this generation has been brought up to aspire to car ownership and can generally afford it; nonetheless, there is no real "dip" in this range, and the immediately older group appear in fact to be the most likely to choose rail[32]. Nor is there much evidence nowadays of the trend during the 1970s and '80s for only the very young and the elderly to use rail: the demand profile looks, all in all, fairly well-balanced.

As expected, young adults form a very large group on the ***Aberdare corridor***, actually forming the majority of all travellers: this is wholly consistent with the large educational flows. Of the remainder, the profile is not dissimilar to that observed on the Carmarthen line. It could, however, be considered positive for rail that 83% of passengers on this line are under the age of 45, in that they are most likely to be working people who are "in the habit" of using rail and may be expected to keep doing so.

The profile on the ***Treherbert corridor*** is closer to that of the Carmarthen line, with, as would be expected, fewer of the A-level/undergraduate age range. Once again, however, the age range is well balanced, albeit with a larger than normal group of the elderly (70-plus).

The ***North Wales Coast corridor*** provides confirmation of the make-up of the educational trips so important on this route, particularly on the "internal" trips – while some travellers are younger school pupils, many are attending six-form and similar education. Otherwise, the profile is similar to other corridors studied, though with slightly more over-60s than elsewhere – it may be that away from the Cardiff conurbation there is less bus competition offering free travel for over-60s.

As with other elements of the traveller profile for journeys in the North Wales Coast corridor, the principal sub-market which is noticeably different is that southwards over the Marches line towards Cardiff: here, the vast majority of travellers are of working age, with very few below 25, but also larger numbers of mature travellers, who may either be senior professionals or the retired travelling for leisure purposes. Again, this fits closely with the profile of the line as revealed by other indicators discussed above – though one would comment that, now that direct South – North journeys are possible on this corridor, older leisure travellers may well nowadays make up an even higher proportion: such passengers are generally regarded as being

31 As in all cases, the results charts for the sub-markets are in the Appendix. We have, however, again excluded the West Midlands sub-market for which the NRTS dataset is too small to be satisfactory

32 This is not necessarily the case, as clearly this will depend on the demographic breakdown of the area.

amongst the most likely to be deterred from rail travel by the need to interchange. That said, business travellers are also typically averse to interchange – the fact that these two groups even in 2004/05 constituted the majority of travellers in this sub-market arguably goes some way to explaining the scale of the demand growth that the provision of direct journey opportunities has led to.

6.6 Conclusion: The lines in profile

On the strength of our high-level analysis of the NRTS data, we would characterise our four case study corridors as follows:

- ***Carmarthen line***: a very mixed and balanced mainline with a variety of attractor and generator stations, leading to rail travel carried out for a mix of purposes which is broadly what would be expected of this type of route. This balance can be seen in the age and income profiles (as in car ownership, a proxy for wealth). While most passengers walk to the station, buses are used in larger towns, and park-and-ride (as well as kiss-and-ride) is significant.

- ***Aberdare line***: two main types of travel are evident – heavy educational flows to schools, colleges and the University; plus commuting (including some park-and-ride) into Cardiff itself. Other journeys are made for leisure and personal business in significant numbers. There is a park-and-ride market, though most passengers walk to the station. The line serves pockets of real deprivation, but also employment attractors – the latter however largely away from the Aberdare valley branch section.

- ***Treherbert line***: this branch serves a vital social function, linking residents of a deprived area with few local opportunities or facilities with those of the outside world – and it does this for all ages. Many travellers, having no car and with buses being impractically slow over longer distances, are dependent on the train, especially to take them to work – but equally many appear to use it by choice. The vast majority walk to their local station.

- ***North Wales Coast line***: the majority of travel is daily commuting, much of which is for educational rather than professional purposes, along the Coast itself (including to Chester). This travel is carried out by passengers from a very wide spread of socio-economic backgrounds, and car ownership is in line with wider averages. The North – South Wales market, at this stage in its infancy, is different, dominated by business travel, though with leisure flows evident. We consider that it is this corridor where the NRTS results should be treated with the greatest caution, because of the radical changes in rail's offer and passengers' travel patterns since 2004/05 – indeed, there would be an arguable case for undertaking new research specifically on the North Wales Coast corridor and its various sub-markets in order to ascertain precisely which groups are making up the large numbers of new rail travellers.

Common features between all four corridors (and of wider relevance) are:

- Car ownership's effect on reducing rail travel is much weaker than historically – especially in more prosperous areas.

- While park-and-ride is important for some travellers and stations, the majority of rail passengers walk to their local station, especially for regular commuting/education journeys. The exception here is travel on business, where car access (whether the traveller's own, a lift or a taxi) is dominant. On the one hand, the car's status as a minority access mode in most cases means that the need to provide expensive parking is limited, but on the other hand it suggests that rail may struggle to

broaden the catchments of existing stations in some areas. However, in larger towns and cities, bus integration appears to pay dividends, and any growth in cycling would have the ability to expand those catchments at very low cost.

- Rail travel is no longer – to the extent it ever was – the reserve of those too young, too poor or too old to have a car – but it still provides a lifeline for those with no other transport options.

- Despite the existence of far faster air travel, rail is often chosen for business trips of anything up to 4 hours' duration: there is evidence of this even before flows like Bangor – Cardiff were greatly improved from 2005 onwards.

6.7 Recommendations

It would be highly desirable to compare the data from NRTS with the socio-economic and demographic profile of *all* the population within station catchments – that is, including those not using rail. Station catchments could be deduced using NRTS itself, and the wider data is publicly available from several databases. This would allow a study to ascertain which travellers are benefiting from the rail service – and which are being missed, such as through car-dependency or through social exclusion.

While our analysis of the NRTS data regarding the socio-economic and demographic characteristics of rail travellers gives an informative 'snapshot' of who is benefiting from rail services, the implications of this for *future* rail demand – and for the extent of the social and economic benefit expected to be derived from rail services – largely depend on matters beyond the scope of this study. Equally, the purpose of this study has not been to forecast rail passenger demand but to analyse the benefits of rail investments. To consider the likely future trends in the demographics of rail's current and potential markets, and so who would be most likely to benefit from future service enhancements, requires a study of these wider social and economic currents looking into the future rather than analysing historic, albeit recent, data. Such a further study would no doubt be informed by matters as diverse as educational policy, improvements in health-care provision (life expectancy), and trends in the geographic and sectoral make-up of Wales's employment base.

Finally, as noted above, while only 5-6 years old, on routes where demand has risen significantly since the December 2005 timetable changes, the NRTS data can be regarded as a little out of date. The MOIRA analysis indicates that in general the increases in demand have been unevenly spread, with the journeys where rail's offer has improved most showing strongest growth. This being the case, it is highly likely that the profile of rail travellers will have changed – particularly the make-up of the North Wales Coast rail market – so there would be a strong case for gathering new data from rail users on the study corridors. This would enable the impact of rail improvements on the *type* of people travelling to be studied, complementing our analysis in the previous chapter of the numbers of rail travellers.

7. Conclusions

Overall this research assignment set out to:

1. Provide an overview of recent investment in rail in Wales and at a strategic level in the wider UK, in the context of general rail industry developments.
2. Provide an analysis of recent trends in rail usage, including a profile breaking down such use.
3. Review case studies from previous literature on the economic impacts of rail investments in Wales, the UK and wider OECD countries.
4. Draw suitable conclusions from the evidence regarding the effects and effectiveness of different types of rail infrastructure investments, identifying where further research may be required.

This document delivers on points one and two above (albeit this has been restricted due to confidentiality issues), and to an extent on the third, subject to the restrictions imposed by the limited availability of appropriate evidence from previous studies. Both the client and the research team have shown a great deal of flexibility around the methodology mainly due to the lack of ex-post economic impact work on rail generally – and even less material directly relevant to the economic, social and topographical structure of Wales. Our conclusions, i.e. point four, are presented below. However, what is clear is that more research (original surveys etc) would be required to produce the ex-post material (and indeed ex-ante material about specific investments) that would allow us to be more assertive in these conclusions.

7.1 General principles

Whilst it is difficult to draw firm conclusions on the economic impact of future rail investments in Wales a number of guiding principles are evident:

- Growth in rail demand in Wales has outstripped growth across the UK 2000-2010 – testimony to the popularity of the mode in Wales and the success, in passenger terms, of rail since the 2005 timetable changes.
- Increased rail investment in new lines and service improvements will probably centralise (re-distribute) economic activity to the better-connected areas. Where that economic activity will centralise is dependent on the underlying economic conditions of the areas which have been connected. These impacts may be enhanced when rail is part of a wider regeneration investment.
- Rail services can sustain communities by connecting them to larger urban areas. Rural and peripheral communities with access to good local services that provide realistic commuting options to large employment centres can experience growth in population as a result of rail investment – or it can prevent depopulation from areas which have seen significant declines in local economic activities, by allowing them to survive as commuting centres – as seen in the Valleys. The community as a dormitory settlement may not at face value seem desirable, but the positive outcome is that population decline can be halted and a community sustained.

7.2 Demand

Our review of MOIRA ticketing data has provided a useful insight into the effect of service improvements in Wales. Growth in demand following investments has been positive and very strong, even where the scale of the investments has been modest, and the details included in this report suggest positive impacts with an especially positive growth in demand from the North-South service improvements.

7.3 High speed rail

From the literature and case study reviews we suggest as follows. A national high speed rail (HSR) network will strengthen the economies of the cities connected to that network, provided that these cities receive a good level of service. Part of this strengthening will result from economic activity, from areas not connected to the network, relocating to these cities. Issues for Wales are likely, therefore, to concentrate upon Cardiff's role as the dominant attractor relative to other settlements and inter alia:

- Improvements between Cardiff and Swansea including electrification (see below);
- General improvements linking any HSR hub with the remainder of the rail network in Wales and associated investments in this wider network;
- Links to development, land use and regeneration policy and investment – with such alignment designed to maximise impact and value for money.

Elsewhere there is some evidence for new high speed rail links providing economic benefits, with regeneration found in London, Lyons and Lille, house price increases in London and Ashford and evidence of increased economic activity at intermediate stations along the Cologne – Frankfurt high speed line. Most recently the provision of domestic high speed services from Ashford, Canterbury and other Kent towns is believed to have begun to exert a positive influence on the economy of the area.

The literature review notes the potential for HSR to have a negative impact on connected areas as the improved accessibility may open them up to competition from "more able" firms in the wider connected area. We also need to acknowledge the potential growth from HSR to be based upon relocation from other areas (Wales and wider) thus possibly reducing any net positive impacts at the all Wales level.

From a Welsh perspective, it is clear that to achieve the greatest economic benefits from a national high speed rail network Wales should be either directly connected or be provided with "classic-compatible" feeder services onto the network. The latter policy currently features in the public plans for the HS2 route as far as Birmingham (phase 1), with onward running on "classic" tracks to Manchester. For Wales fully to tap into the network as currently planned, it could be argued that evidence should be examined as to the scope for:

- Running HS2-compatible trains to the North Wales Coast line;
- Providing fast links to the planned Old Oak Common HS2 station.

As the Welsh Government has at present no devolved responsibility nor funding for the national rail network, it would be a DfT responsibility to develop and fund the forthcoming High Speed Rail network, hence the need for the case to be made to DfT for such a link to Wales. The current HS2 plans could make North Wales towns more attractive given that the proposed HS2 route is expected to run close to the existing West Coast Main Line, and hence the scope for major journey time reductions from these locations to London (and potentially Birmingham) – bringing these English cities significantly closer to the North Wales Coast than Cardiff.

Without a direct high-speed route it would be important for South Wales in particular to have good links via the Great Western Main Line to Old Oak Common (interchange with HS2 and Crossrail). In addition, in the context of any future high-speed line running westwards from London, careful consideration needs to be given to the implications of the current DfT plans to electrify only to Cardiff rather than on to Swansea, as this would be most likely to preclude running classic-compatible high-speed trains through to Swansea.

7.4 Urban, Metro, LRT

The studies of urban commuter rail systems have generally found mixed evidence of economic impact. There is some evidence for positive impact on property and house prices notably from Dublin but less from investments in the UK. A key point for us from this literature was the assertion that investment in this type of rail solution is best integrated with wider regeneration investments.

7.5 Regional rail services

Rail services that connect peripheral communities to larger urban areas on "commutable" train services can have a stabilising effect on rural populations. This is a key issue in a Welsh context, and our case study work *suggests* a positive relation between population growth/stabilisation and rail investment. Our analysis, using NRTS data, of the characteristics of present-day rail travellers, supports the contention that rail travellers using such services come from a very wide variety of social, demographic and demographic backgrounds – implying a wide "reach" for rail in market terms, and in particular underlining rail's role in allowing those in peripheral communities to gain access to employment and educational opportunities in main centres. This supports the argument that good regional rail services can play a role in avoiding the depopulation of such areas.

7.6 North-south links

Experience elsewhere has shown that improvements in long-distance rail linkages largely remove the need for air services if journey times can be brought under 3 hours, with air becoming almost irrelevant where the rail journey time is below 2 hours. Journey times of around 3 hours between North and South Wales (such as Bangor/Holyhead – Cardiff, the only intra-Wales flow in which air is significant) may well be a realistic medium-term aspiration, and the performance of rail on this corridor as against national trends suggests that rail has the capacity to achieve growth through modal shift rather than merely increasing mobility. The issue of who would benefit the most, in an economic sense, from such an improvement (North Wales or South Wales) is a separate question that would require a detailed study on the economic constraints and opportunities that North and South Wales suffer from and possess respectively.

However, our case study work *cautiously* suggests benefits for the North Wales economy from the investment in the North-South links since 2005. In addition, the NRTS evidence of prosperous travellers from multi-car households using rail for journeys towards Cardiff has provided some evidence to support the contention that rail is on this corridor achieving modal shift from the car as well as from air. A relatively large proportion of these journeys are business trips.

Finally, it is worth emphasising that a new or improved rail service will deliver the most positive economic impact not only if, as discussed above, journey times are competitive with alternative modes of travel, but also from the scheduling of services to facilitate either commuting or business travel (i.e. day return trips with sufficient time for business activity at the destination) – or both.

7.7 Local investment

Our research has allowed us to ***suggest*** that relatively modest investments in rail improvements, compared with costly high-speed rail infrastructure or similar, can have beneficial impacts on the local economy – and more widely as seen in the North-South Wales direct services.

Our case study reviews found:

Population - a positive impact on growth, apparently beyond that associated with national population growth patterns.
Employment – case-study catchment areas saw a reduced decline in employment compared to the control and base-line areas.
Deprivation – no discernable impact.
House prices – a slowing in the decline: case-study catchment areas saw reduced decline in house prices compared to the base line.
Gross Floor Area – a negative impact on growth
Car ownership – no discernable impact.

It is important to acknowledge that we cannot isolate rail or general transport impacts upon the economy from wider investments and trends. Thus potential deadweight and the endogeneity of impacts upon socio-economic statistics are a key issue.

Evidence of wider impacts of rail investments on land use, employment and output is mixed however. For commuter services, a number of studies of light rail systems have found no impact, although other studies do claim to have found effects in some regeneration areas. The conclusions on the impact on house and other property prices are similarly mixed; studies of major schemes in some of the largest cities, including London, Dublin and Glasgow, found an effect, but studies in Manchester, Newcastle, Sunderland and Sheffield did not.

The scope of this study has not enabled us to examine in detail which sections of society enjoy any benefit which improved rail connectivity brings, and therefore to say whether such schemes have the potential to increase social inclusion by, for example, disproportionately benefiting the least well-off. However, analysis of the profile of travellers on, in particular, the Aberdare and Treherbert corridors provides some evidence to suggest that rail is performing an important task in providing links to jobs, education and other opportunities for those living in communities known to be deprived. It also shows that many of those using rail for these purposes do not have access to a car so would probably often be unable reach those opportunities without the train (distances being generally too great for practical bus commuting). We have, however, not attempted to quantify these social inclusion effects on the limited data available. Conversely, the profile of the North-South Wales services suggests a higher proportion of more prosperous travellers (those making business journeys in particular) using rail and therefore standing to benefit – at least in the case of longer-distance journeys. However, it is likely that this different profile simply reflects the different catchment areas served and above all the different types of travel undertaken by all modes along these corridors, rather than implying that there are less prosperous sections of society that are being excluded from the benefits of rail connectivity.

It is hard to draw absolute conclusions from this ex-post data for rail projects in Wales, as so much is dependent on the underlying economic, social and demographic conditions in the localities where the investment occurs. In the main though, we would expect rail investment that provides services useful to commuters and businesses to generate economic growth in the vicinity of the rail line – though access to local services and to education (including higher education) is also a very important function fulfilled by rail and should not be ignored, as without this wider connectivity communities may not be economically sustainable entities. Some of this growth may be due to re-distribution, but rail investment (as with other transport investment) can be important in terms of sustaining peripheral communities and binding a nation together – once again subject to the condition that the rail service is useful to households and/or to businesses.

7.8 Wales investment

It is clear that Welsh stakeholders will want to be involved in the debate over high-speed rail and other major potential improvements in the UK's rail network. What the evidence confirms beyond doubt is a clear and growing demand for rail travel in Wales at all levels. Significant projects like HSR appear unproven in terms of their economic benefits being consistent and comprehensive in all the areas studied – again emphasising the importance of endogenous factors.

It seems clear however that major urban areas not considered or developed for HSR will be at a disadvantage in terms of their attractiveness to investors. Much more detailed work on this is required if we are to draw firm conclusions in a Welsh context, with potential solutions/options already set out section 7.3 above.

The general buoyancy of rail in Wales and the results from our case studies suggest that smaller-scale investments may offer a strong foundation from which to enhance the growth of the Welsh economy. Further research with reference to case studies would appear to be required to address the key question over whether better links between Swansea and Cardiff can create significant integration between the two cities' economies, which can raise productivity levels in both ("agglomeration benefits"), rather than the alternative prediction of a redistribution from the smaller and more peripheral economy to the larger one. Similar scenarios exist to that of Swansea-Cardiff, with Manchester-Liverpool most closely reflecting a stronger-weaker city pairing, to be contrasted to the more equal and complementary city pairings of Manchester-Leeds and possibly Edinburgh-Glasgow.

7.9 Rail freight

As we have noted, the position regarding rail freight is very different from passenger travel, in terms of the variables affecting it as well as the effects it has on the wider economy. There is very little data publicly available to enable a robust analysis of historic trends, let alone a linking of rail freight infrastructure provision and enhancements with wider economic performance.

What is clear is that in general rail freight in Britain remains very closely linked to the bulk heavy-haul model, and has struggled to expand beyond this "comfort zone" since privatisation. Wagonload freight has shown little progress, and intermodal traffic is strongly linked to imports through sea ports – themselves in large part a function of consumer demand in the economy; as such they have taken a substantial hit during the current recession.

The main wider economic benefits of a modal switch to rail freight, i.e. beyond benefits accruing to the shipper, are likely to include those of highway decongestion, reduced damage to highway infrastructure, plus reductions in other negative externalities associated with heavy road vehicles, such as contributions to pollution/greenhouse gas emissions, noise, accidents and highway severance effects. A wider view may also consider the conservation of oil and other scarce energy resources to be an inherent benefit.

Looking to the future, in the short-to-medium term there appears to be sufficient capacity within current infrastructure to enable rail freight to expand – the limiting factors are likely rather to be the relative costs and convenience of rail against road. Moves towards the "seven-day-a-week railway" and increases in energy costs may in this context favour rail, as to a lesser extent may the availability of public subsidy – more under revenue-linked schemes to rebalance costs between modes (such as the Sensitive Lorry Miles scheme) than capital schemes such as Freight Facilities Grants.

7.10 Further research

Our report highlights numerous areas where further investigation might be considered beneficial to economic policy-makers in Wales and the UK. These include inter alia:

- Consideration as to whether better links between Swansea and Cardiff can create significant integration between the two cities' economies which can raise productivity levels in both with comparative analysis between the paired cities of Edinburgh: Glasgow, Leeds: Manchester and Manchester: Liverpool.

- Refinement and enhancement of the socio-economic datasets used for example:
  - A longer or larger data set is obtained – this may enable regression analysis to be undertaken and tests of statistical significance to be produced (see below).
  - Analysis of results by station rather than line.
  - Rail demand by station to be drawn out so that a more direct comparison with employment and population growth by station can be made.
  - Passenger behaviour and business location surveys are undertaken to explore reasons behind encountered trends.
  - A case study is undertaken in relation to the Valley Lines to test the hypothesis that land values/house prices respond to new station provision.
  - Use of an alternative control line/corridor.
  - Widen the evidence base to beyond Wales with such examples as the Robin Hood line in Nottinghamshire/Derbyshire, and the reopening of Airdrie-Bathgate as potential examples.
  - Further work to better integrate these measures with NRTS, MOIRA, PDFH and other transport/rail data.
  - Regression analysis to identify the significant impacts of rail investment for key case studies alongside detailed work to establish net economic and social impact.

- A fuller study (such as back-casting) to analyse increases in rail demand relating to rail service improvements. This would provide firmer evidence as to:
  - The comparison of each line's performance: whether the improvement in the service is linked to a clearly increased propensity of individuals to make rail journeys, as opposed to not travelling or to choosing other modes.
  - Whether the growth seen on the study corridors has exceeded PDFH predictions, and how this growth can be explained by reference to social, economic and demographic changes in the areas served, and/or to changes in rail's service offering.

- An examination of the case for HS2-compatible trains to link London and Birmingham to North Wales coast towns.

- A comparison of the data from NRTS with the socio-economic and demographic profile of *all* the population within station catchments – that is, including those not using rail, would be desirable. This would allow a study to ascertain which travellers are benefiting from the rail service – and which are being missed, such as through car-dependency or through social exclusion.

- The NRTS data can be regarded as a little out of date and may not fully reveal changes in the profiles of rail travellers - particularly the make-up of the North Wales Coast rail market – so there would be a strong case for gathering new data from rail users on the study corridors. This would enable the impact of rail improvements on the *type* of people travelling to be studied, complementing our analysis in the previous chapter of the numbers of rail travellers.

Appendices

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Appendix B. Wales Rail Planning Assessment options

Table B.1: South Wales Main Line (Carmarthen to Severn Tunnel)

Objectives and what could be done	Expected benefits / Reason for investment
Short term options	
Maintain and improve rail connectivity on the South Wales Mainline: • Maintain half-hourly Cardiff-London services • Consider improvements to peak London-Swansea services through timetabling review • Attempt to resolve differential in car park prices between 'InterCity' and other stations	• Congestion on M4 • Crowding on peak services into Swansea • Further the development of Swansea Bay spatial plan area • Railheading currently to smaller stations avoiding smaller stations in West Wales • Cost for parking at mainline stations; free parking at Valley line Stations
Medium to Long term Options	
Maintain and improve rail connectivity on the South Wales Main Line: • Reduce journey times to and from London, Cardiff and Swansea • Consider whether application of IEP would provide further benefits to the South Wales Mainline	• Low mode share • Opportunities to speed up journey times and improve performance by removing capacity constraints
Provide improved rail infrastructure and services to make rail more attractive for commuting and to serve new developments in South Wales: • Continue development of interchanges and improved passenger facilities • Possible new stations on SWML relief line • Passenger services on Beddau- Llantrisant Line	• Demand exceeding capacity on services and station car parks • Network Rail work to bring SWML relief line up to passenger standard provides opportunity to provide additional services
• Further Ebbw Vale services to increase frequency to Rogerstone and extend the service to Newport	• Capacity and frequency increases since 2005 have led to recent growth • Meet demand from centres not well serviced by rail • Spatial Plan indicates possible economic developments in Llantrisant area • Provide capacity for future demands: urban Development Plans set out substantial growth in Llanwern area and Cardiff.

Table B.2: South East Wales (Cardiff Valley lines and the former county of Gwent)

Objectives and what could be done	Expected benefits / Reason for investment
Short term options	
• Increase capacity between Cardiff Queen Street North, Cardiff Central and Cogan Junction to provide additional journey frequencies • Additional frequencies on Valley Lines and Vale of Glamorgan/Barry/Penarth • Improve all day rail service capacity on the Maesteg, Rhymney and Caerphilly-Bargoed Lines • Improve rail service frequency on the Maesteg, Bargoed-Rhymney and Vale of Glamorgan lines to two trains per hour	• Accommodate increasing demand and potential peak hour overcrowding • Accommodate patronage associated with housing growth in the Valleys and employment growth in the coastal areas as identified in the South East Wales Spatial Plan. • Support the Heads of Valleys Regeneration programme • Demand exceeds capacity by 15% in weekday peaks and leisure peaks
• Develop a strategy taking into account of the relationship between demand, pricing and usage of car parks at Valley Lines stations, with a view to car park expansion where appropriate	• Capacity and frequency increases since December 2005 led to growth • Accommodate predicted growth

Objectives and what could be done	Expected benefits / Reason for investment
Improve frequency of stops and train service patterns and frequency of stops at specific locations in South East Wales: • Enhance peak service frequency at Abergavenny, Pontypool and Cwmbran, where possible within existing timetable • Enhance service frequency at Chepstow	• Improve existing overcrowding • Facilitate growth that has come from previous rail improvements • Accommodate the further substantial growth which is anticipated • Allow demand to be met from centres not well served by rail
Consider enhancing Bristol-Cardiff Capacity	• South East Wales Spatial Plan indicates housing growth along the Abergavenny-Chepstow corridor, with limited road capacity • Improved access required to hospital at Cwmbran • Latent demand identified for travel to Chepstow
Medium to Long Term Options	
Improve access to rail network and connectivity to Cardiff Airport through: • Commuter services from Cardiff to Abergavenny with associated new stations serving Pontypool and Cwmbran • Facilitate multi-modal access to and from the railway including station facilities, car parking (for example at Caerphilly, Ystrad Mynach, Treforest and Barry and integration of bus services • Ensure developments have access to the railway • Improve physical access at stations • Improve Vale of Glamorgan services with additional stations	• Substantial further growth anticipated • Demand exceeding supply at station car parks • Anticipated future growth in demand from major new developments (e.g. major employer at St Athan) • Assumes capacity improvements Cogan Junction completed
Improve rail links to key centres in the Midlands and Southern England, to improve accessibility and support the economy: • Consider upgrading quality of current Birmingham to Cardiff service, including on board facilities and luggage capacity. • Provide additional capacity to meet demand on Bristol and Birmingham services as appropriate • Investigate the potential for an increase in service frequency between Bristol Temple Meads, Newport and Cardiff via the Severn Tunnel from one to two trains per hour	• Demand exceeds capacity • Opportunities to improve facilities to meet market • Low modal share for longer distance journeys • The South West RPA forecasts growth in peak demand on the Bristol to South Wales Route with demand expected to exceed capacity across the morning peak.

Table B.3: South West Wales (Swansea to Fishguard, Milford Haven and Pembroke Dock)

Objectives and what could be done	Expected benefits / Reason for investment
Short term options	
Improve rail connectivity and performance • Improve timing of connections at Swansea • Accelerate journey times	• Improved connections for West Wales and England • Rail mode share currently low • Smaller stations avoided for rail heading
Medium Term Options	
• Potential increase in service frequency at Gowerton from three to four trains per hour	

Table B.4: North-South links (Cardiff to Hereford, Shrewsbury and Crewe (Marches Line), and Cardiff to Wrexham and Holyhead)

Objectives and what could be done	Expected benefits / Reason for investment
Short term options	
Improve journey times on Marches Line corridor to improve connectivity between South Wales and North Wales and the North West of England: • Increase line speed from 70mph to up to 100mph at selected locations • Continue programme of North Wales development of public transport interchanges and improved passenger facilities • Better environment for business travel	• Low mode share • Long journey times between North Wales, the North West of England and South Wales • Market potential for both leisure and business/journey to work travel • Strong demand from North Wales business community for business class
Medium Term Options	
Improve access to the rail network on the Marches Line and the balance of local and long distance services: • Improve journey times further and serve distinct passenger markets • Improve physical access at stations • Continue programme of North Wales development of public transport interchanges and improved passenger facilities.	• Opportunities to improve existing facilities and provide rail access to new major developments • Some stations remote from town centres

Table B.5: Central Wales (Aberystwyth and Pwllheli to Shrewsbury and Birmingham New Street (Cambrian Line); and Swansea to Shrewsbury (Heart of Wales Line)

Objectives and what could be done	Expected benefits / Reason for investment
Short term options	
Enhancements to Cambrian Line to improve connectivity to Shrewsbury and beyond; including Birmingham: • Improve train frequency to key settlements (e.g. Aberystwyth) • Define modest programme of interventions including review of station facilities, station car parking and integration with rural bus services • Provide rolling stock more suited to the carriage of bicycles and luggage	• Demand exceeds capacity at peak holiday periods • Low frequency of service is a deterrent to use • Performance risk perceived as higher with infrequent services • Nature of many journeys indicates that rolling stock facilities are poorly suited to passengers' needs
Medium term Options	
Enhancements to the Cambrian Line to improve connectivity to Shrewsbury and beyond, including Birmingham: • May require re-examination of timetable on Cambrian Line. • Possibility of terminating services at Shrewsbury with a reliable onward connection to Birmingham	• Current poor performance and infrastructure constraints which limit timetable flexibility
• Accessibility improvements on Cambrian Coast platforms.	• Suppressed demand for rail travel.
Frequency and quality enhancements on the Heart of Wales Line to improve accessibility and promote social inclusion and tourism: • Improve frequency from four to five trains per day • Align service to key market needs (for example increase capacity at peak holiday periods) • Promote services experiencing low patronage and	• No suitable alternative bus services • Demand exceeds capacity at peak holiday times

Objectives and what could be done	Expected benefits / Reason for investment
linkage to destination/Marketing	

Table B.6: North Wales (Holyhead and Llandudno to Manchester and Crewe; Blaenau Ffestiniog to Llandudno Junction (Conwy Valley line); Wrexham to Bidston)

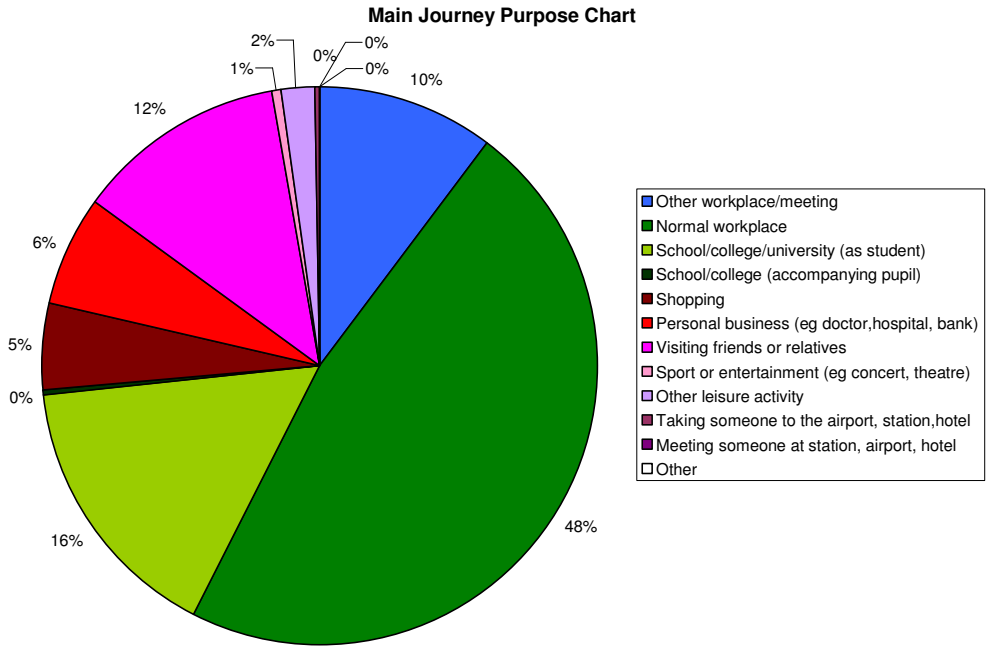
Objectives and what could be done	Expected benefits / Reason for investment
Short Term Options	
Improve connectivity to major employment centres in North East Wales and North West Cheshire: • Improve journey times and connectivity between North Wales Coast and North West England (e.g. Manchester and Manchester Airport) • Improve capacity on the Wrexham-Bidston line by lengthening trains • Review connections at Chester in view of hourly Chester-London Euston services to be provided in the 2008 timetable	• Low mode share for rail • Frequency increases elsewhere in Wales from December 2005 have led to increased passenger volumes
Enhancements to Conwy Valley Line to improve public transport in this environmentally sensitive areas: • Established affordable options that will enable freight trains to use the route. This may facilitate modest benefits to passenger services • Passing provision to create frequency and capacity benefits for freight and possible passenger services	• Opportunities to provide capacity to meet freight demand from current slate mining activities • High tourist season demand (including linkage to Ffestiniog Railway)
Medium Term Options	
Improve connectivity to major employment centres in North East Wales and North West Cheshire: • Improve connectivity to and from the Wirral, Liverpool and Deeside • Construct new station at Deeside Park • Review of peak train capacity	• Build on strong rail market between North Wales and North West England • Perceived demand for rail access to Deeside business park • Capacity constraints on some peak services
Improve access to the North Wales coast: • Improved timetabling of Virgin's North Wales Main Line services and connectivity of ATW services • Promotion of services experiencing low patronage • Facilitate multi-modal access to the railway, including enhanced station facilities, car parking and integration of bus services	• Low mode share for rail • Urban Development Plans indicate major new developments which would benefi t from better access to rail services
Improvements to the Conwy Valley Line to enhance accessibility and increase rail usage: • Improve physical access at stations. • Facilitate multi-modal access to and from the railway including integration of bus services • Improve connectivity at Llandudno Junction • Infrastructure to give better protection from flooding	• Low mode share for rail • Poor performance

Appendix C. NPS data analysis

C.1. Journey purpose

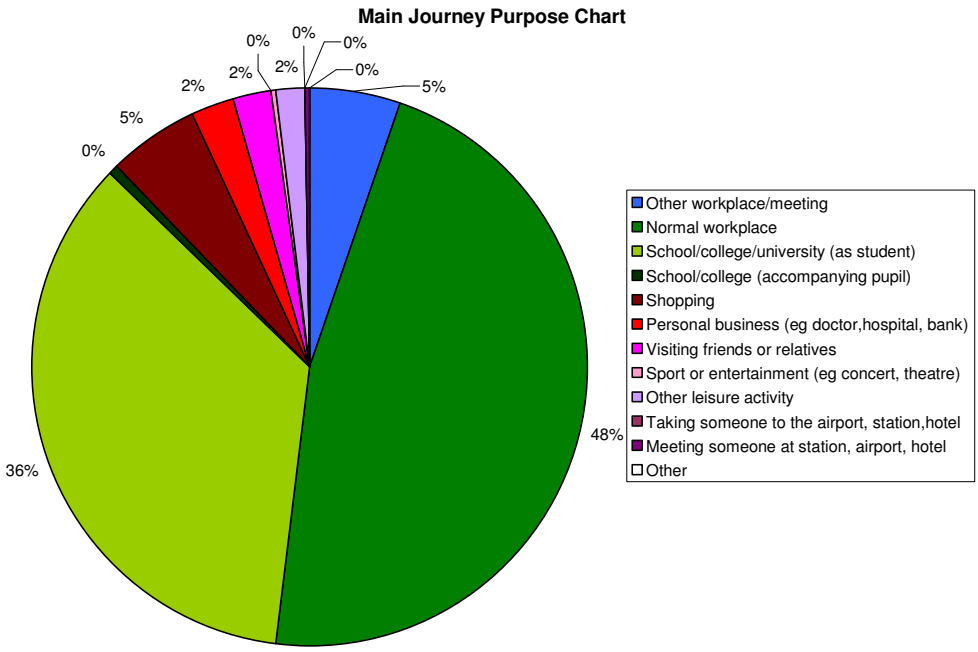
In all of the following charts, blue shades represent business journey purposes, green commuting journeys (which includes education), and red/purple the leisure/personal business sector.

Figure C.1: Carmarthen corridor: breakdown by journey purpose



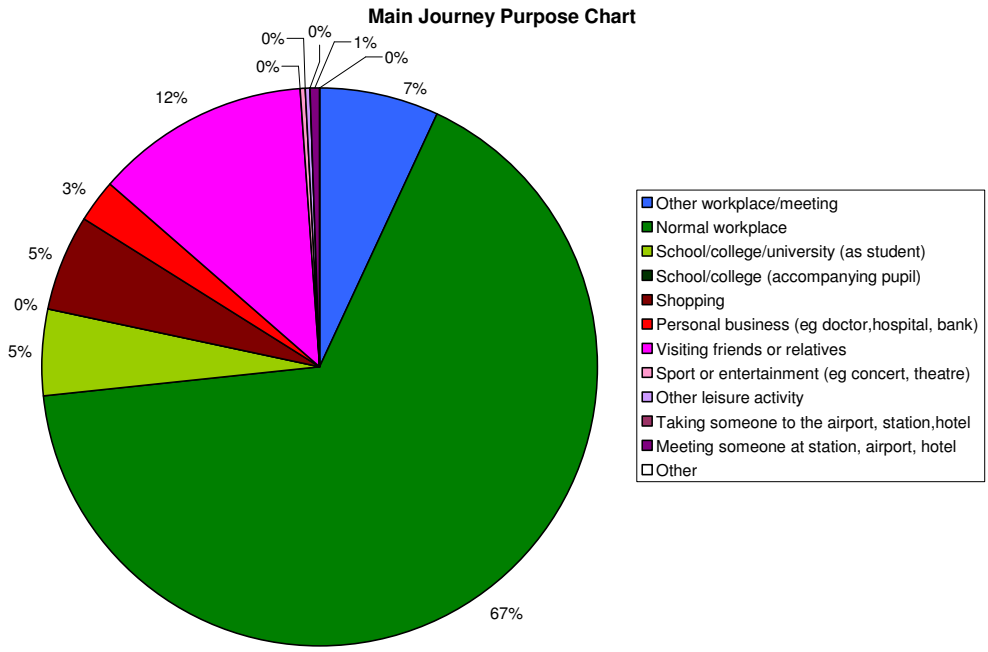
Source: National Rail Travel Survey (2004/05)

Figure C.2: Aberdare corridor: breakdown by journey purpose



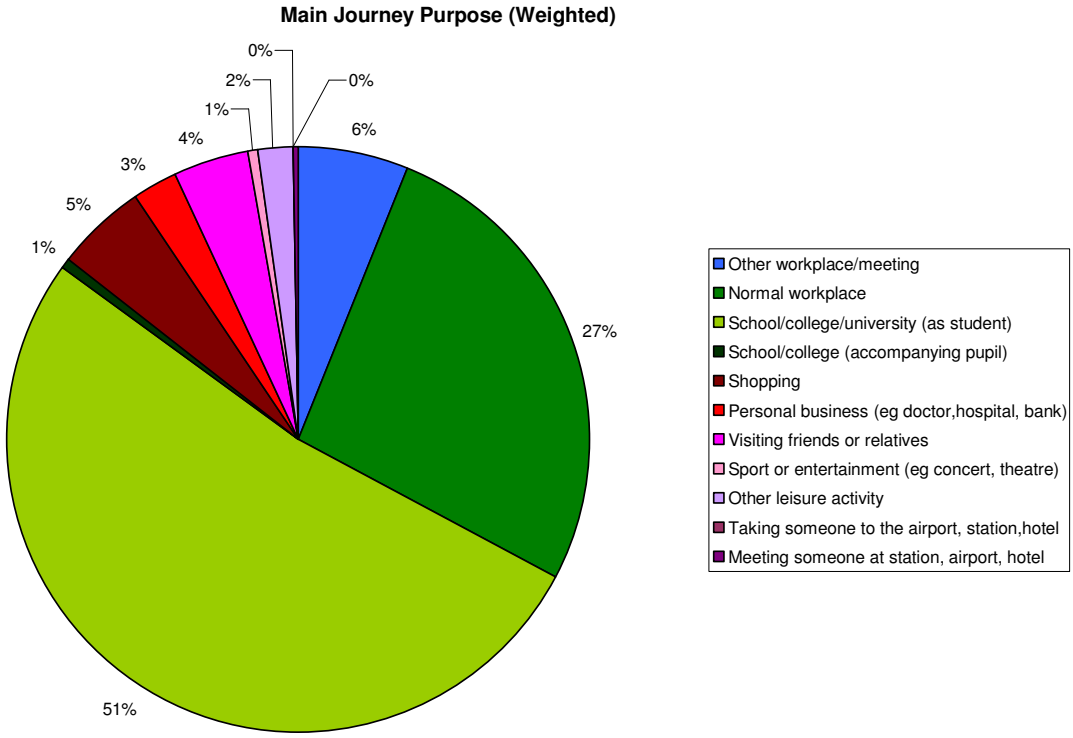
Source: National Rail Travel Survey (2004/05)

Figure C.3: Treherbert corridor: breakdown by journey purpose



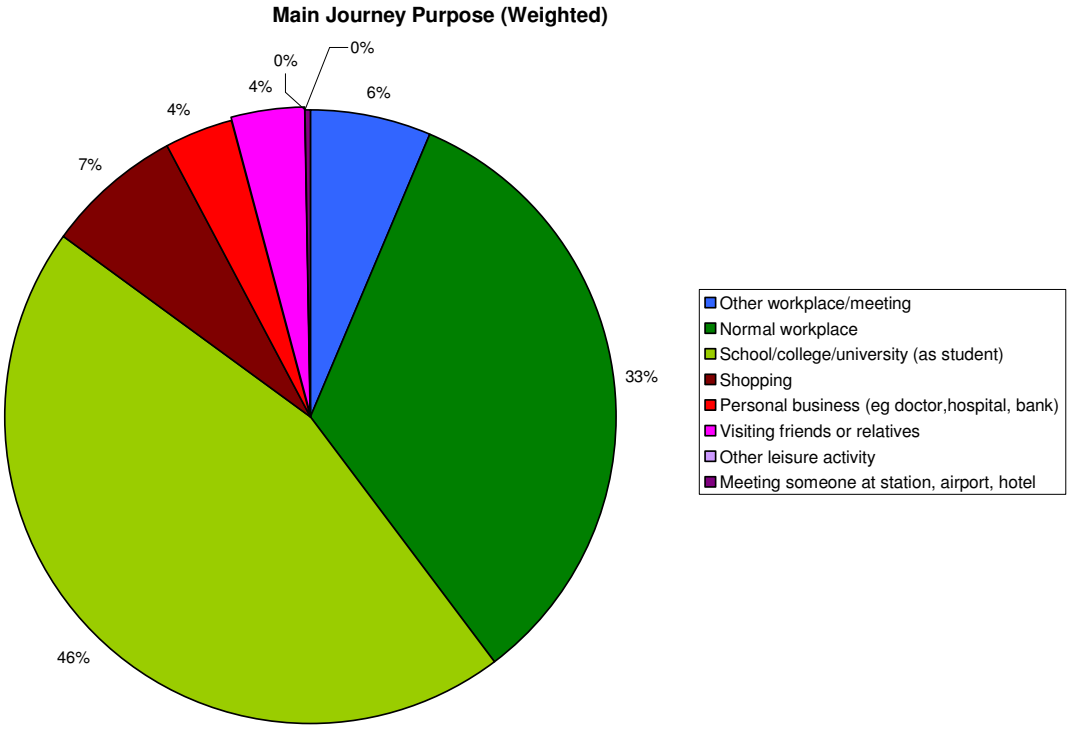
Source: National Rail Travel Survey (2004/05)

Figure C.4: North Wales corridor: breakdown by journey purpose – all journeys



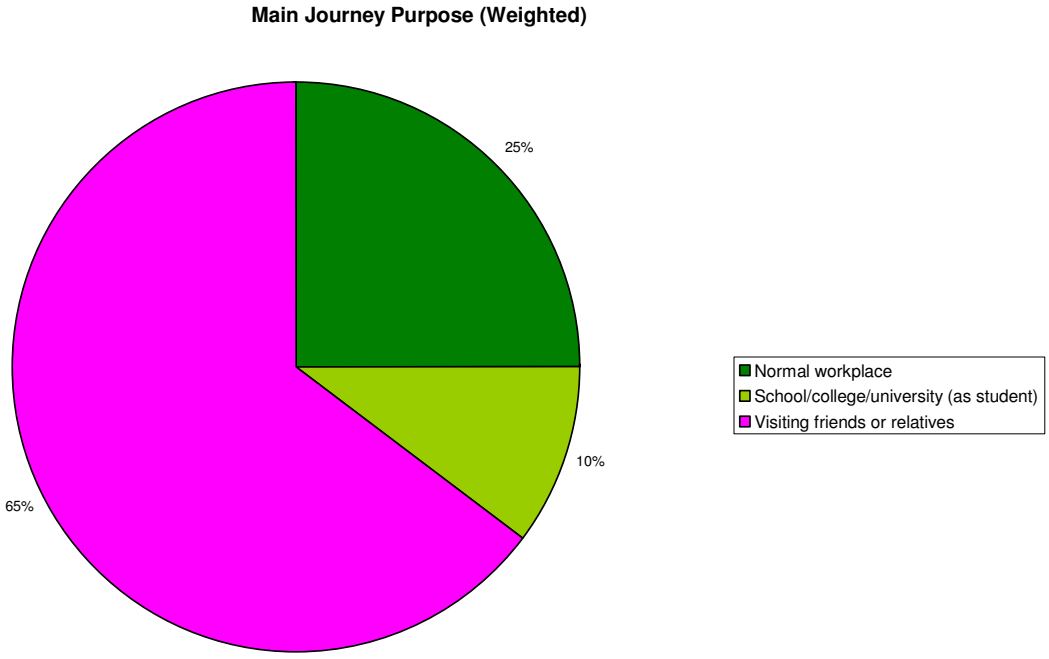
Source: National Rail Travel Survey (2004/05)

Figure C.5: North Wales corridor: breakdown by journey purpose – Shrewsbury journeys



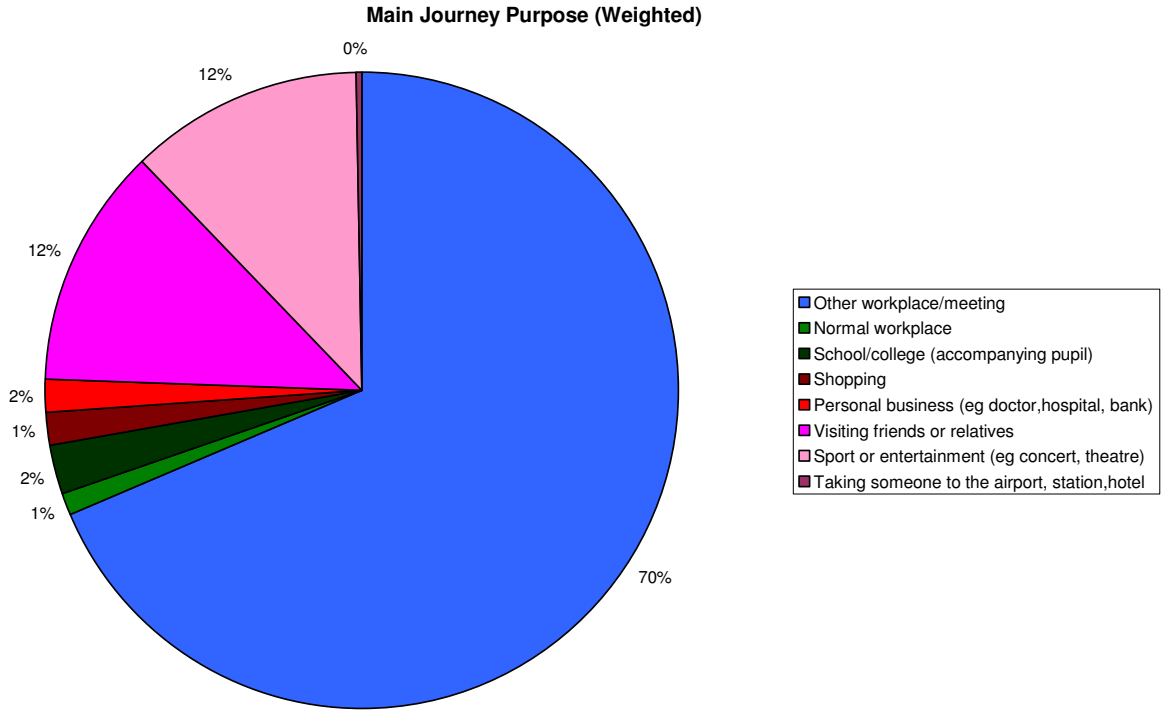
Source: National Rail Travel Survey (2004/05)

Figure C.6: North Wales corridor: breakdown by journey purpose – West Midlands journeys



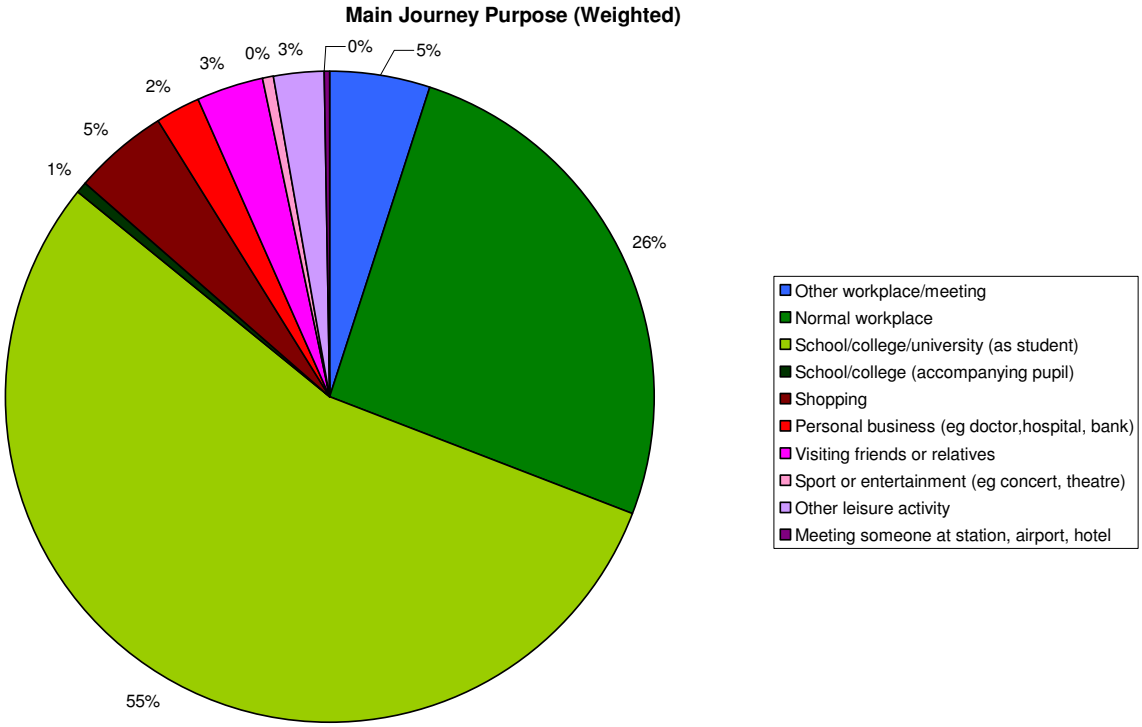
Source: National Rail Travel Survey (2004/05)

Figure C.7: North Wales corridor: breakdown by journey purpose – Marches and Cardiff journeys



Source: National Rail Travel Survey (2004/05)

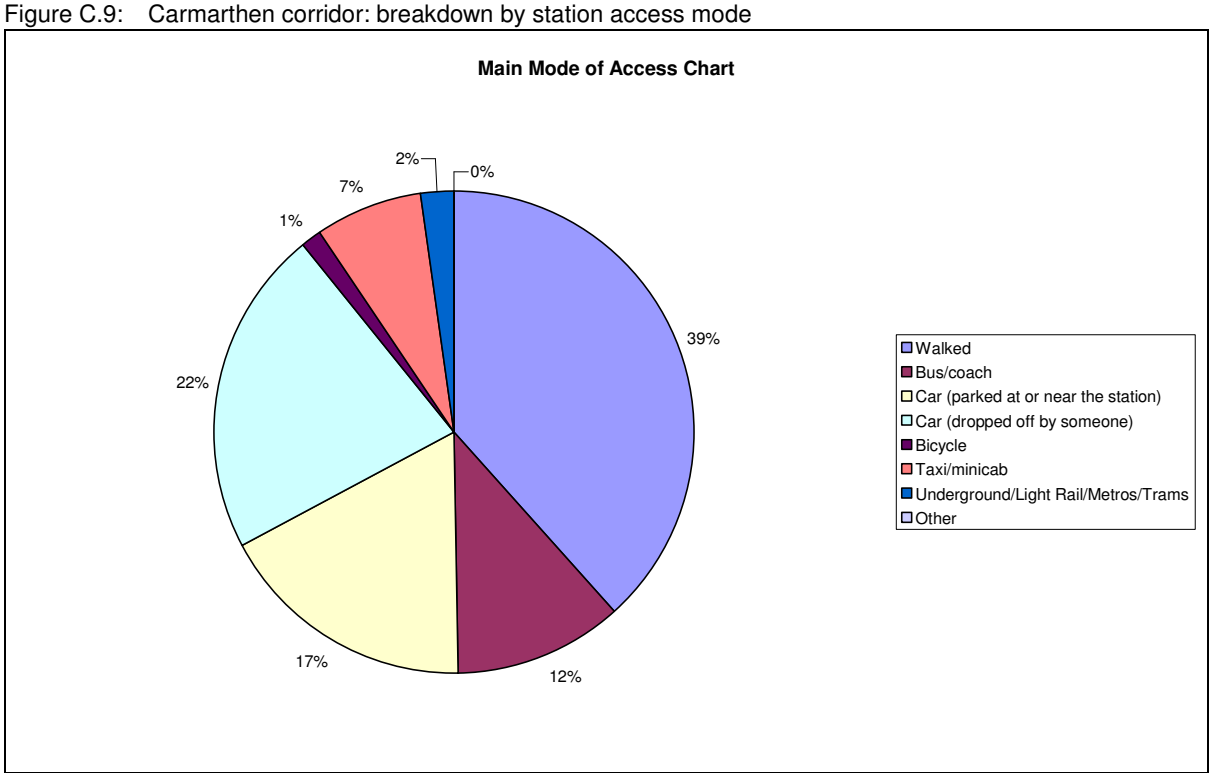
Figure C.8: North Wales corridor: breakdown by journey purpose – North Wales Coast internal journeys



Source: National Rail Travel Survey (2004/05)

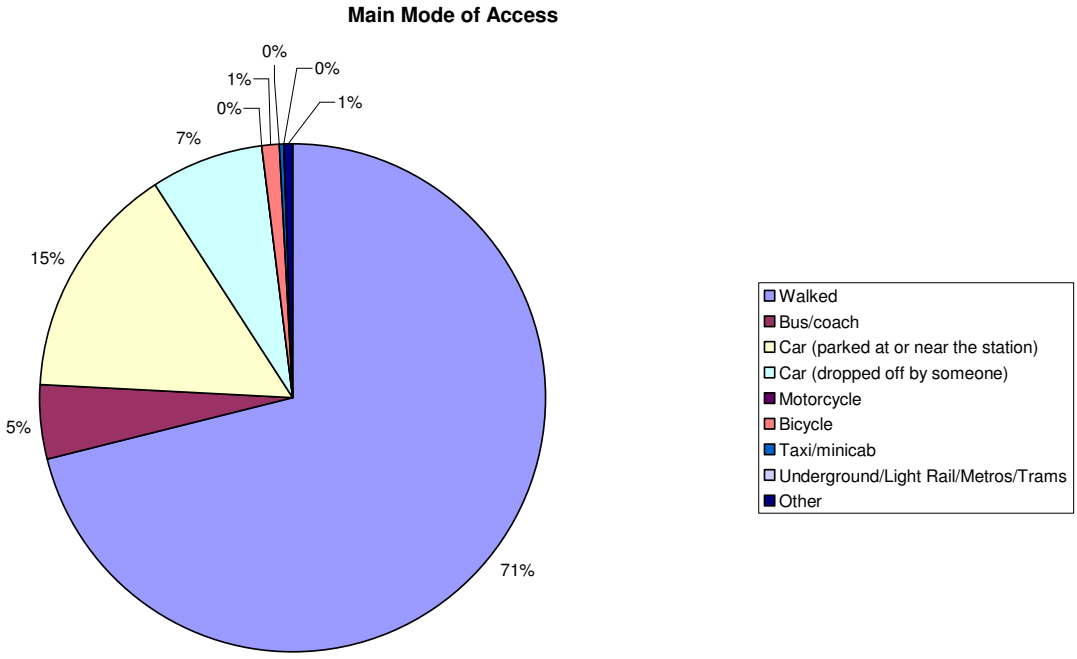
C.2. Station access modes

Figure C.9: Carmarthen corridor: breakdown by station access mode



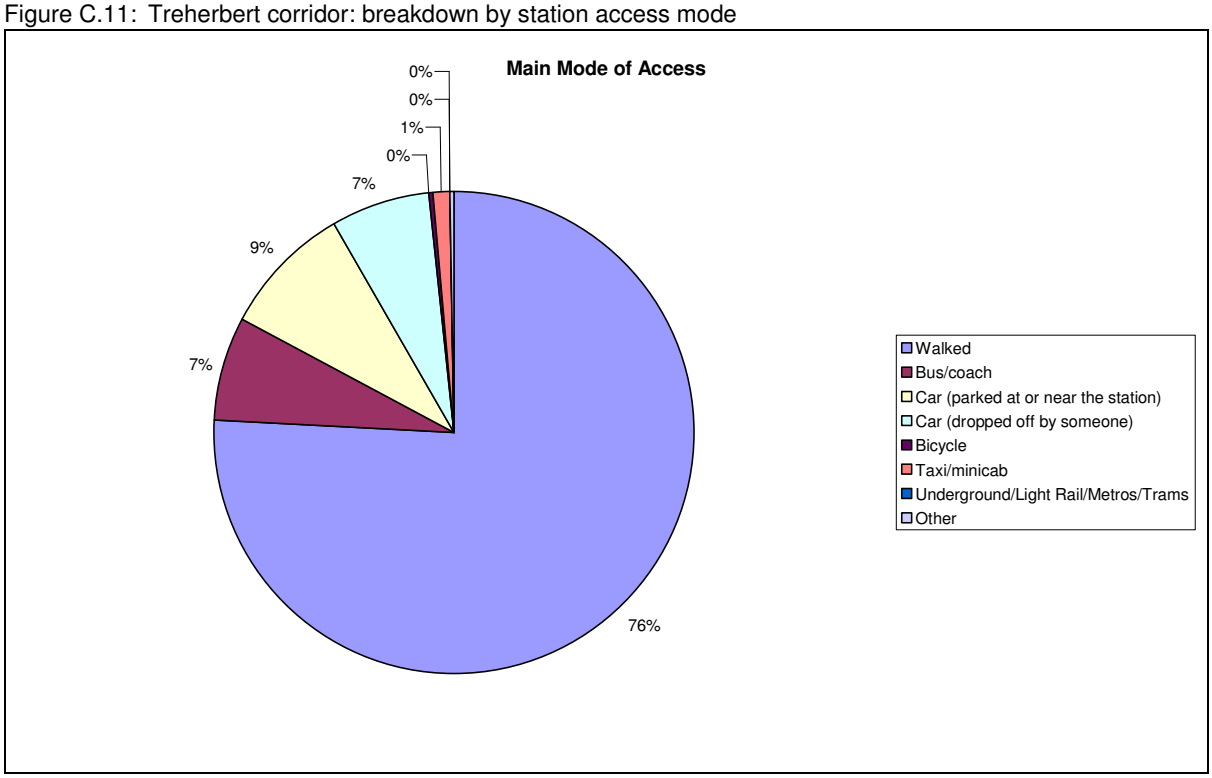
Source: National Rail Travel Survey (2004/05)

Figure C.10: Aberdare corridor: breakdown by station access mode



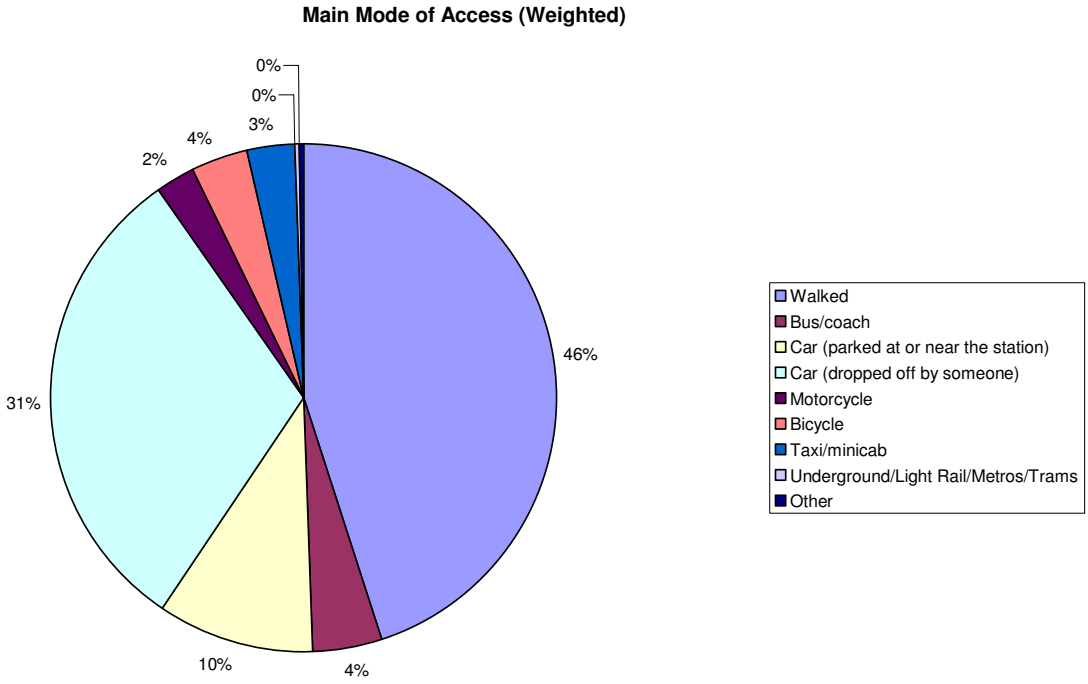
Source: National Rail Travel Survey (2004/05)

Figure C.11: Treherbert corridor: breakdown by station access mode



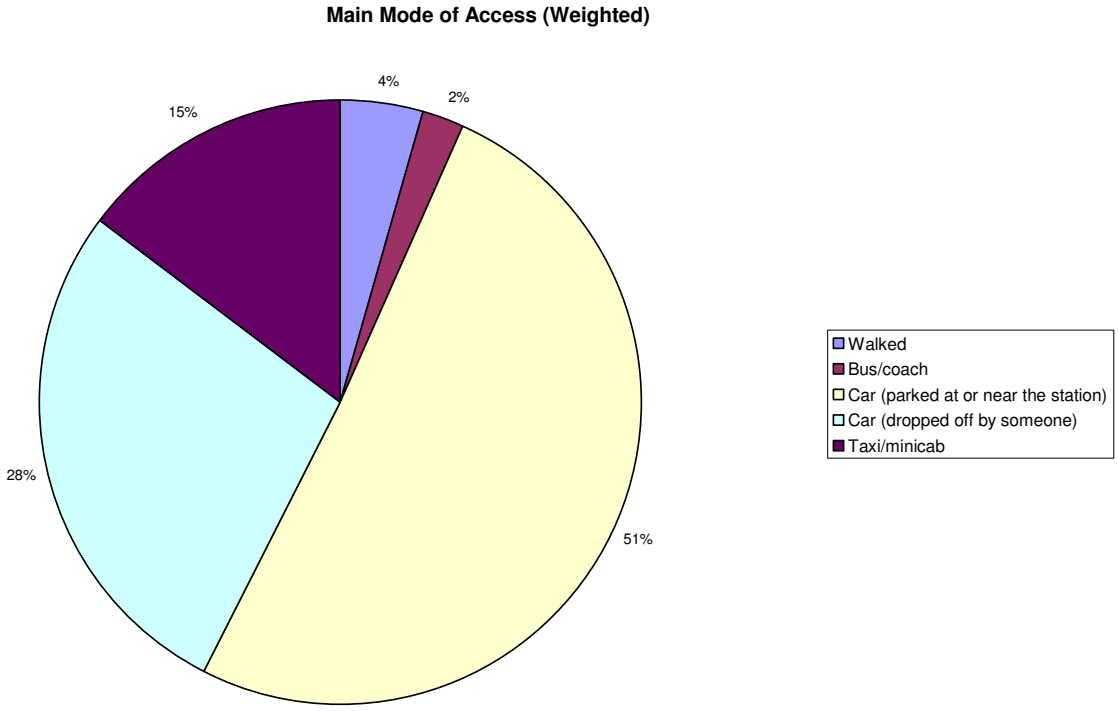
Source: National Rail Travel Survey (2004/05)

Figure C.12: North Wales Coast corridor: breakdown by station access mode (all journeys)



Source: National Rail Travel Survey (2004/05)

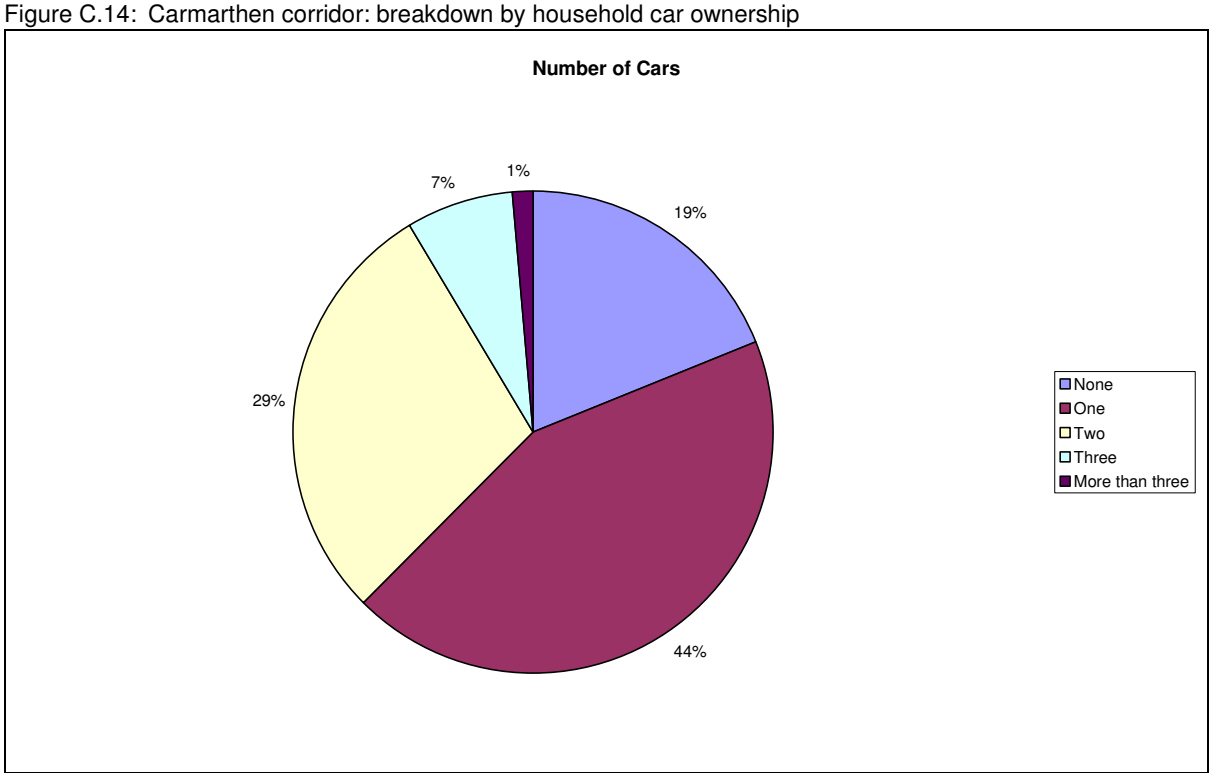
Figure C.13: North Wales Coast corridor: breakdown by station access mode – Marches / Cardiff journeys



Source: National Rail Travel Survey (2004/05)

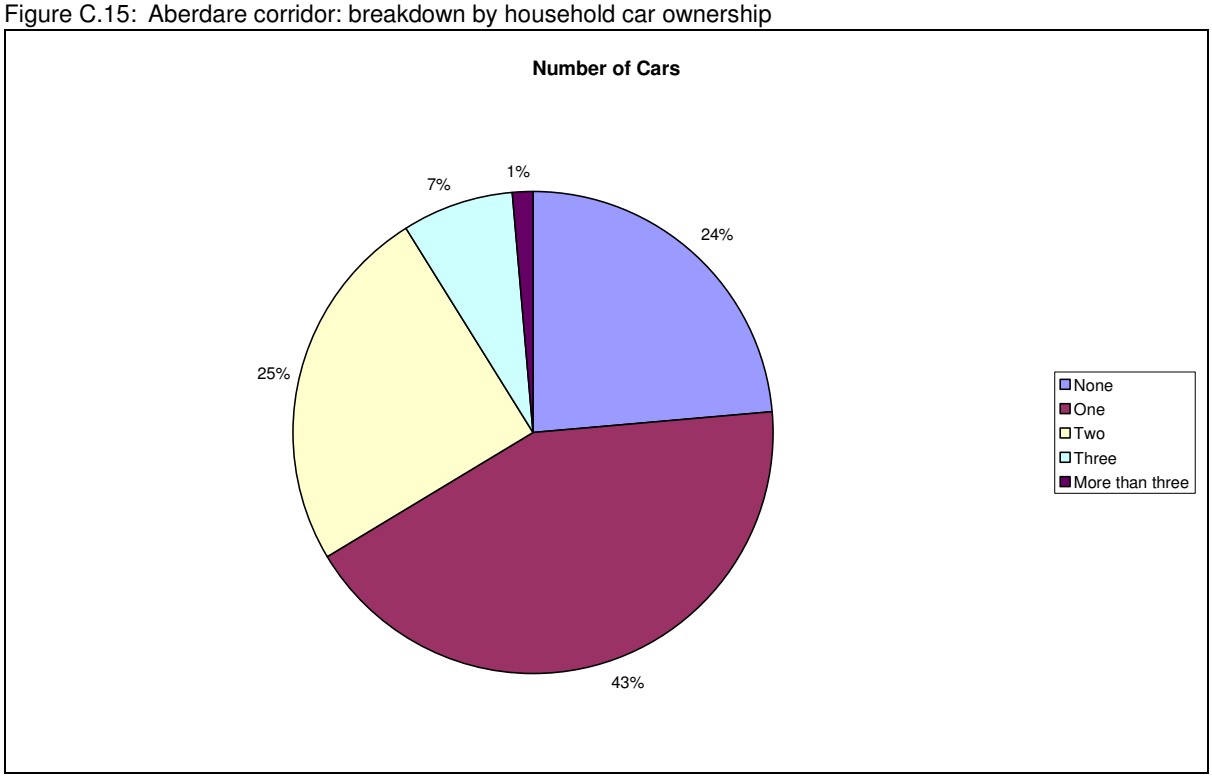
C.3. Car ownership

Figure C.14: Carmarthen corridor: breakdown by household car ownership



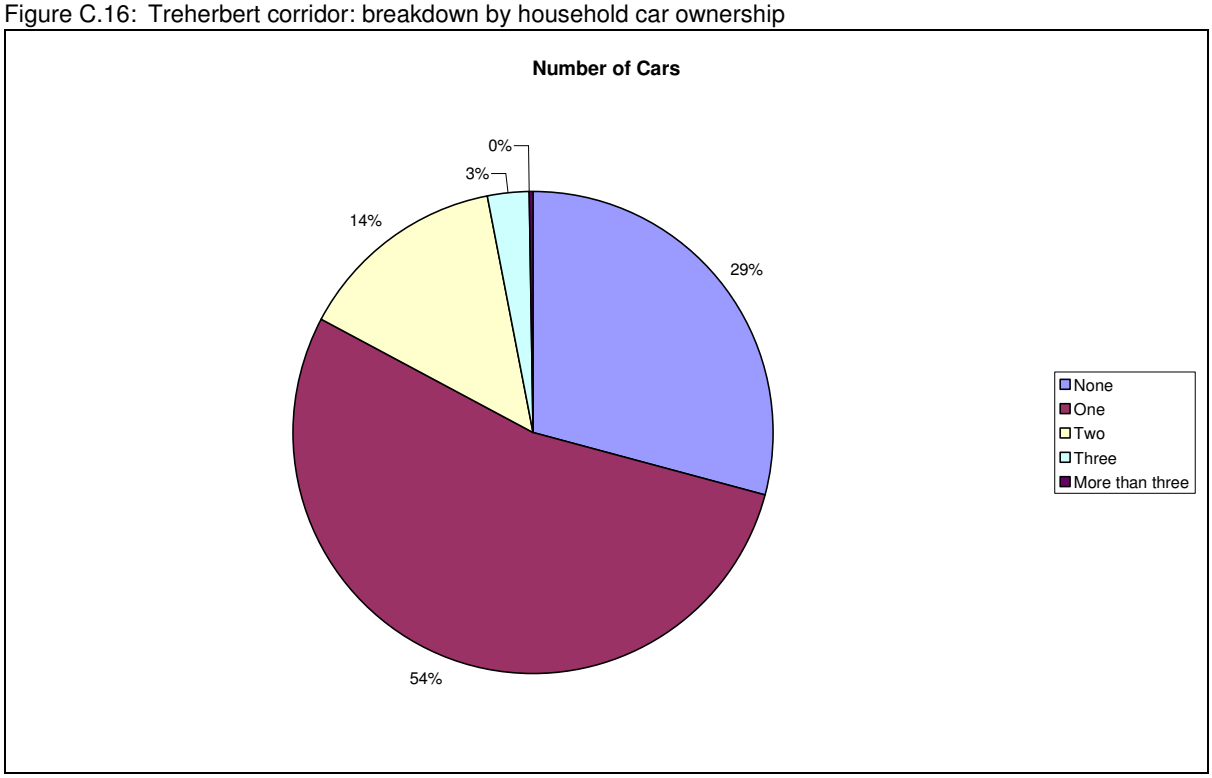
Source: National Rail Travel Survey (2004/05)

Figure C.15: Aberdare corridor: breakdown by household car ownership



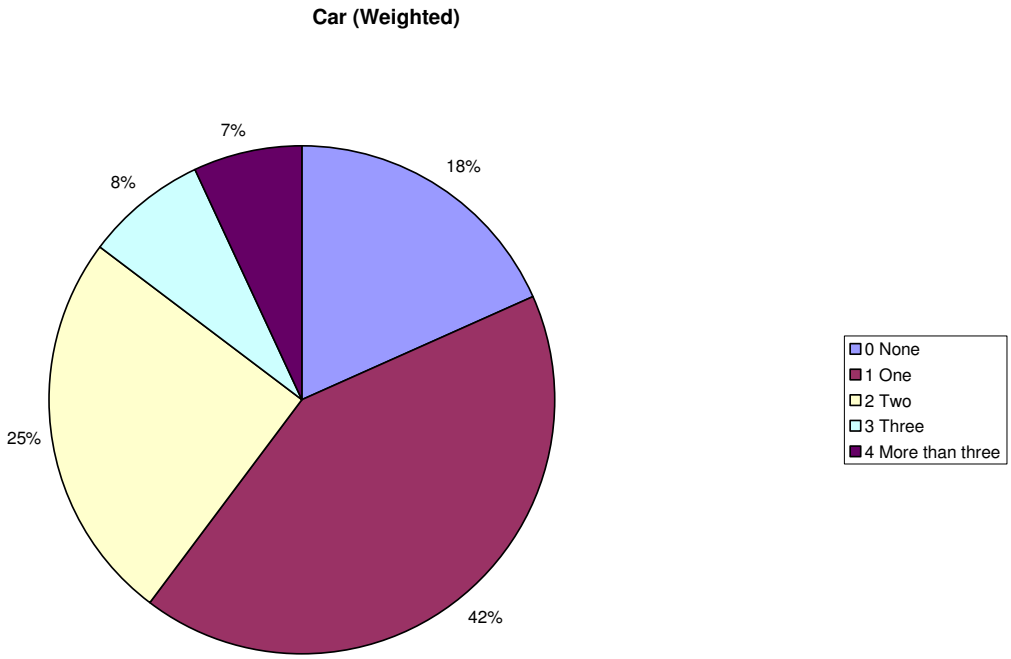
Source: National Rail Travel Survey (2004/05)

Figure C.16: Treherbert corridor: breakdown by household car ownership



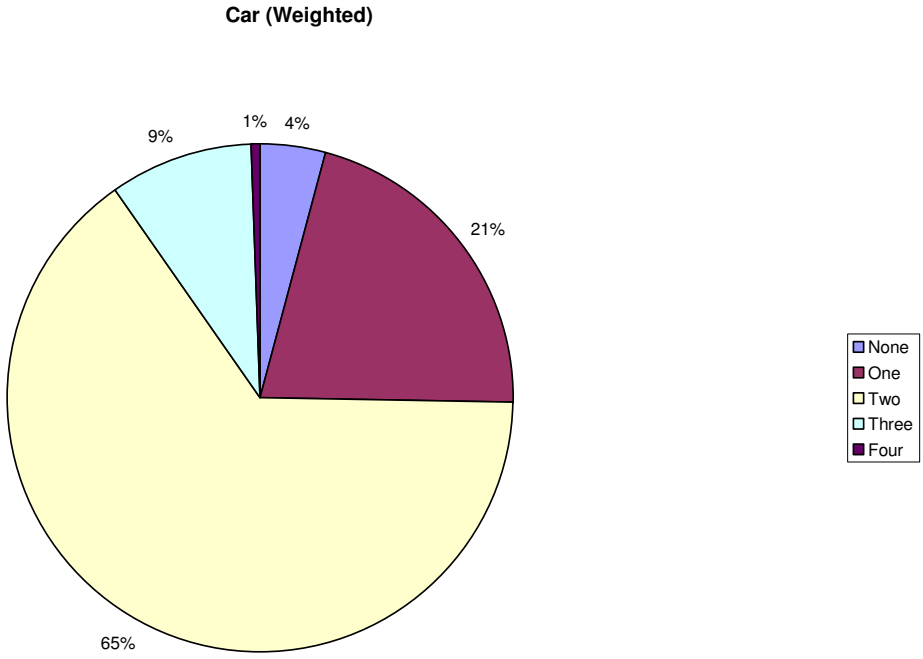
Source: National Rail Travel Survey (2004/05)

Figure C.17: North Wales Coast corridor: breakdown by household car ownership – all journeys



Source: National Rail Travel Survey (2004/05)

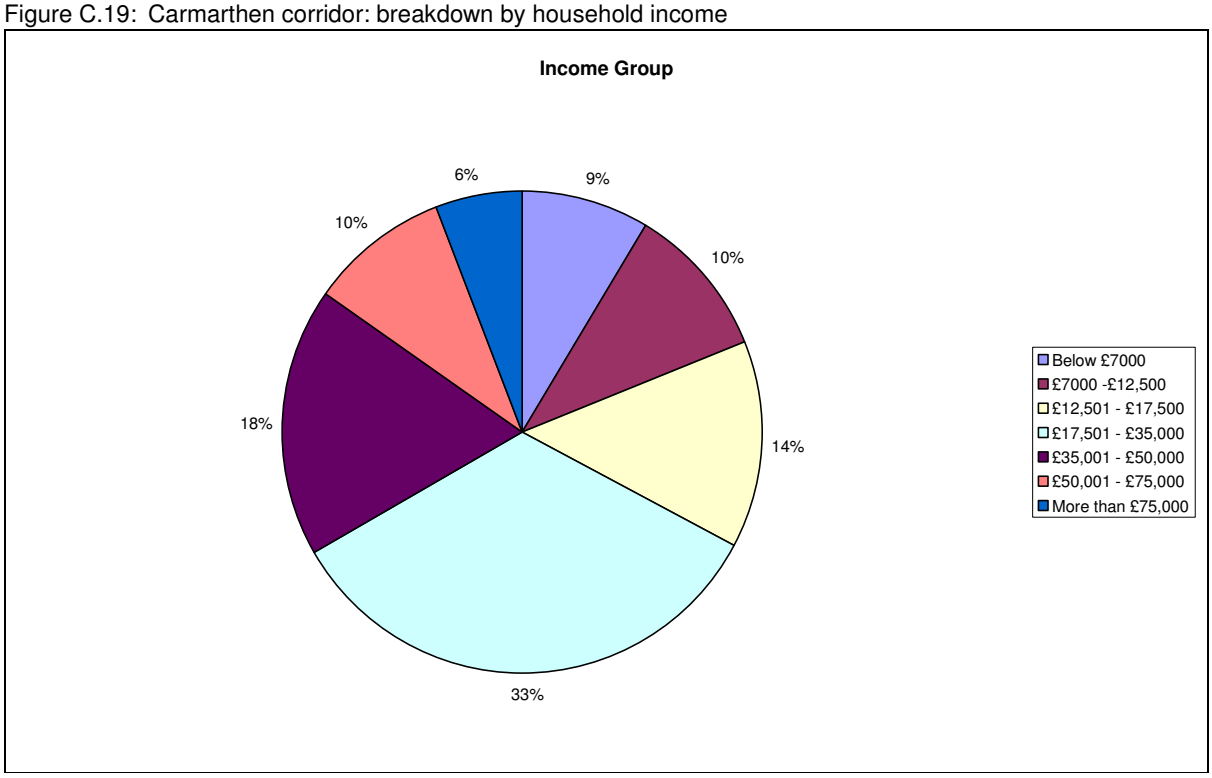
Figure C.18: North Wales corridor: breakdown by household car ownership – Marches / Cardiff journeys



Source: National Rail Travel Survey (2004/05)

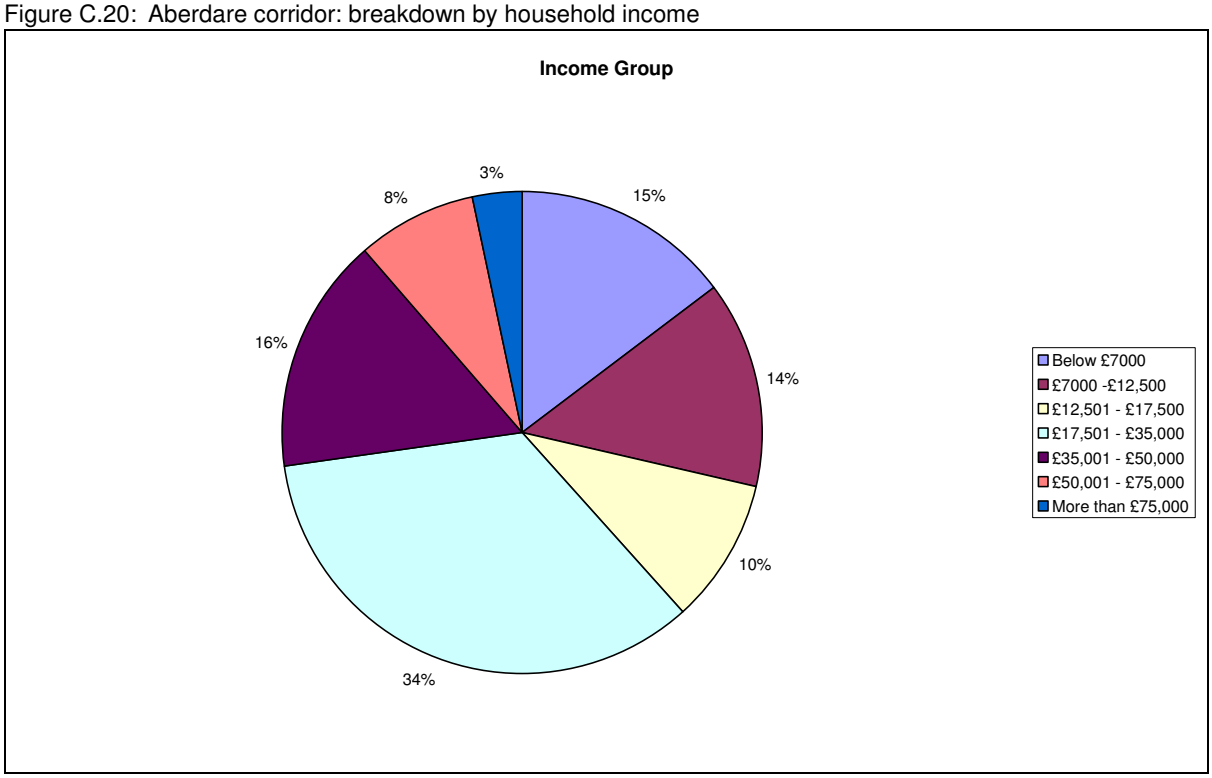
C.4. Income groups

Figure C.19: Carmarthen corridor: breakdown by household income



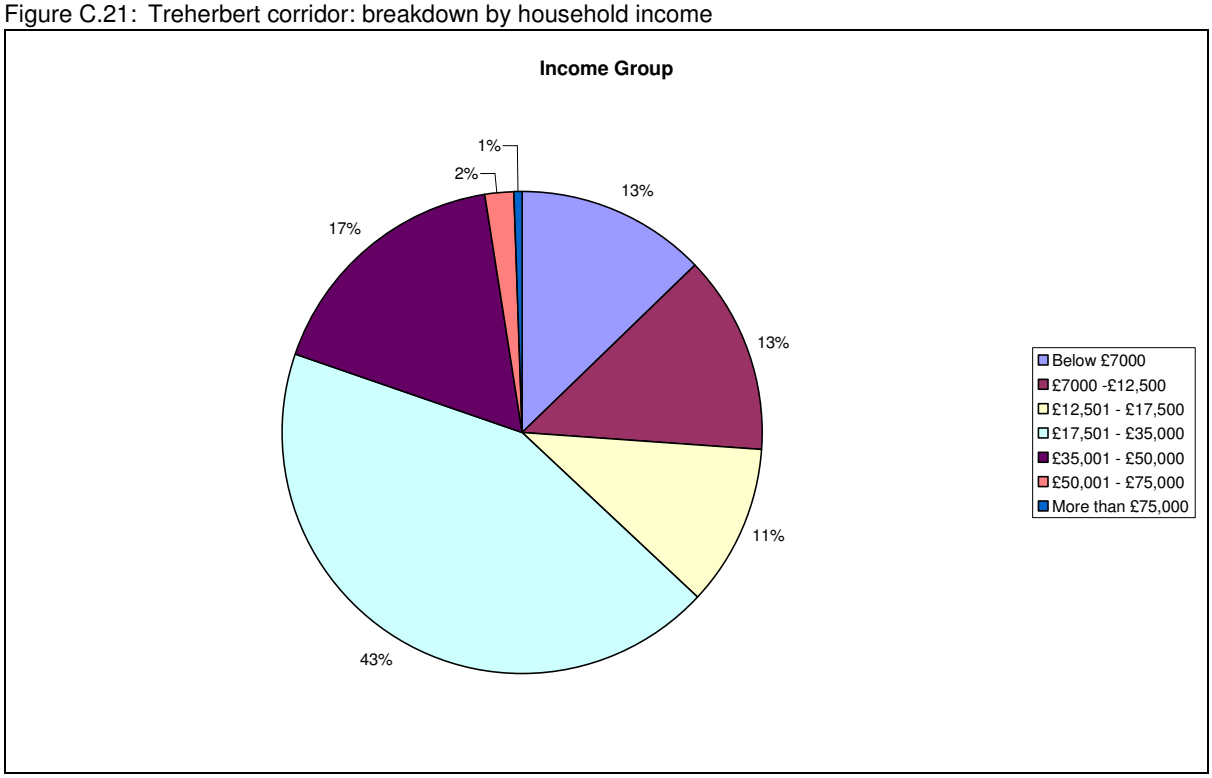
Source: National Rail Travel Survey (2004/05)

Figure C.20: Aberdare corridor: breakdown by household income



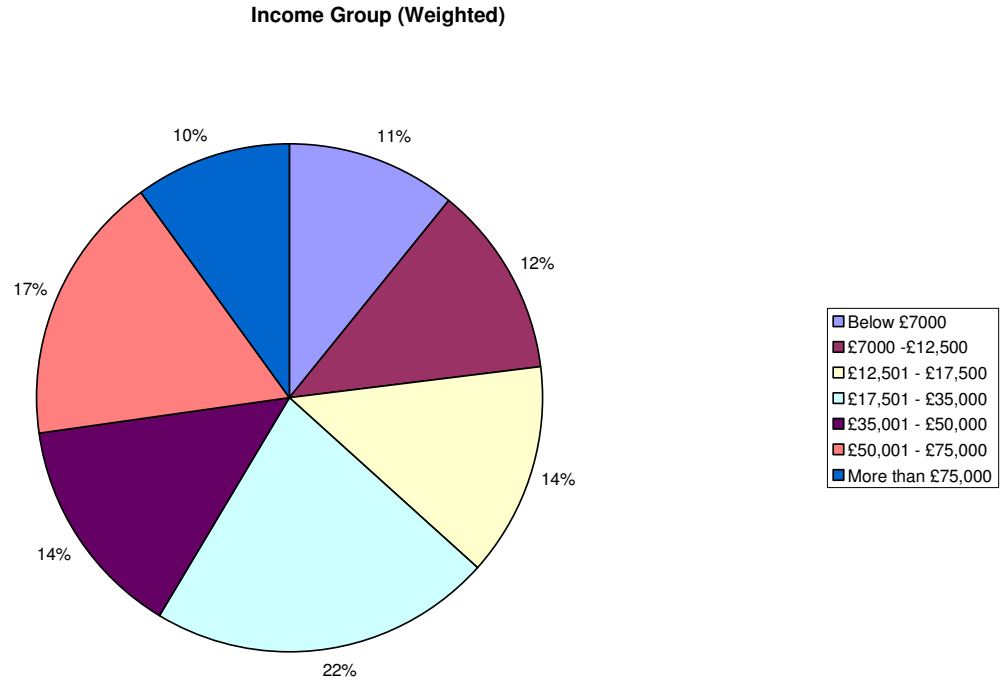
Source: National Rail Travel Survey (2004/05)

Figure C.21: Treherbert corridor: breakdown by household income



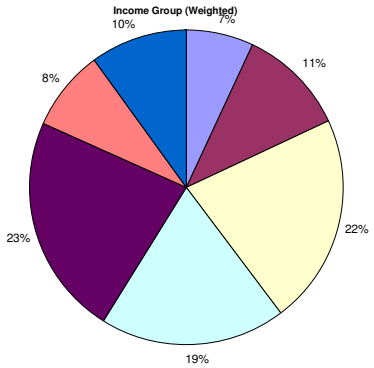
Source: National Rail Travel Survey (2004/05)

Figure C.22: North Wales Coast corridor: breakdown by household income – all journeys



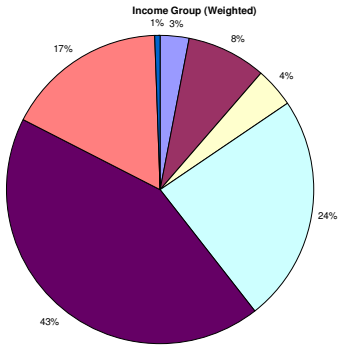
Source: National Rail Travel Survey (2004/05)

Figure C.23: North Wales Coast corridor: breakdown by household income – Wrexham / Shrewsbury journeys



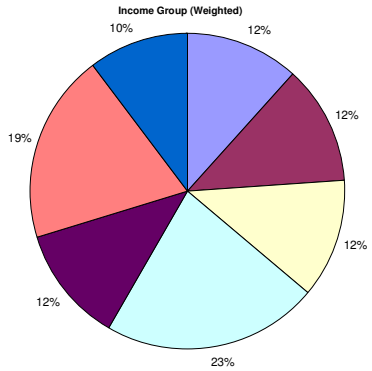
Source: National Rail Travel Survey (2004/05)

Figure C.24: North Wales Coast corridor: breakdown by household income – Marches / Cardiff journeys



Source: National Rail Travel Survey (2004/05)

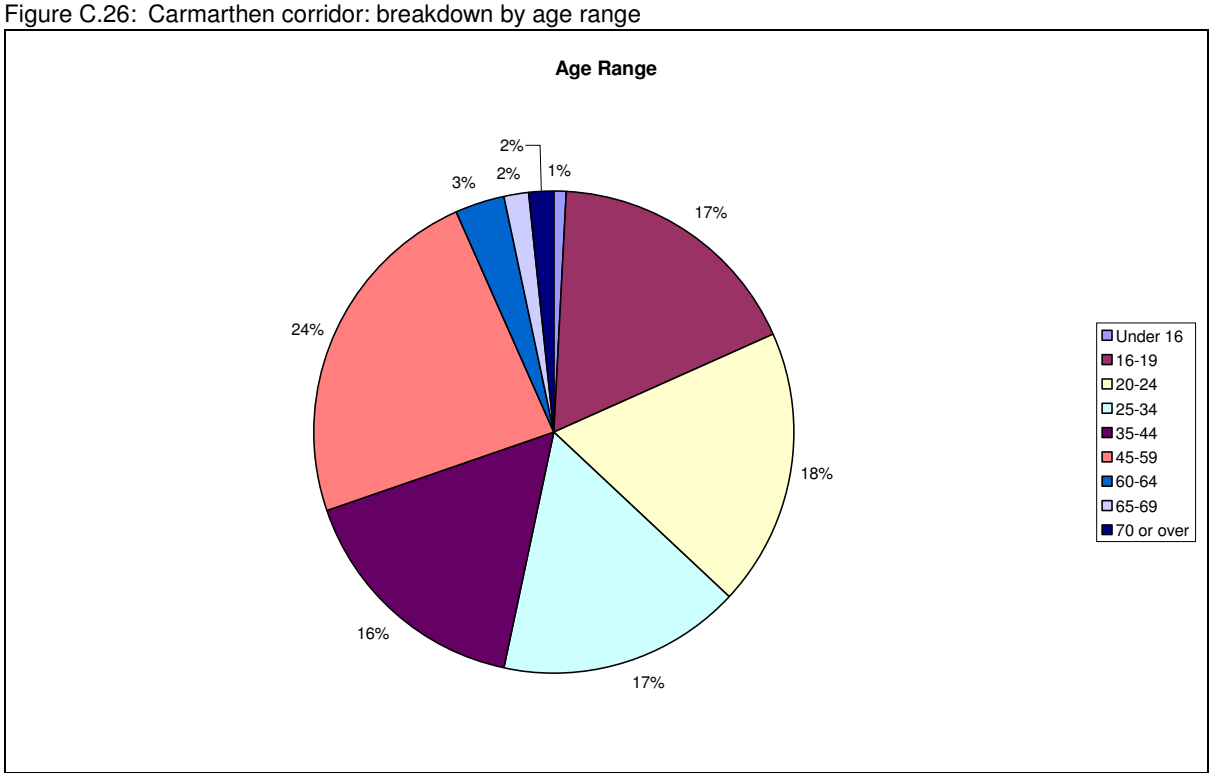
Figure C.25: North Wales Coast corridor: breakdown by household income – North Wales Coast internal journeys



Source: National Rail Travel Survey (2004/05)

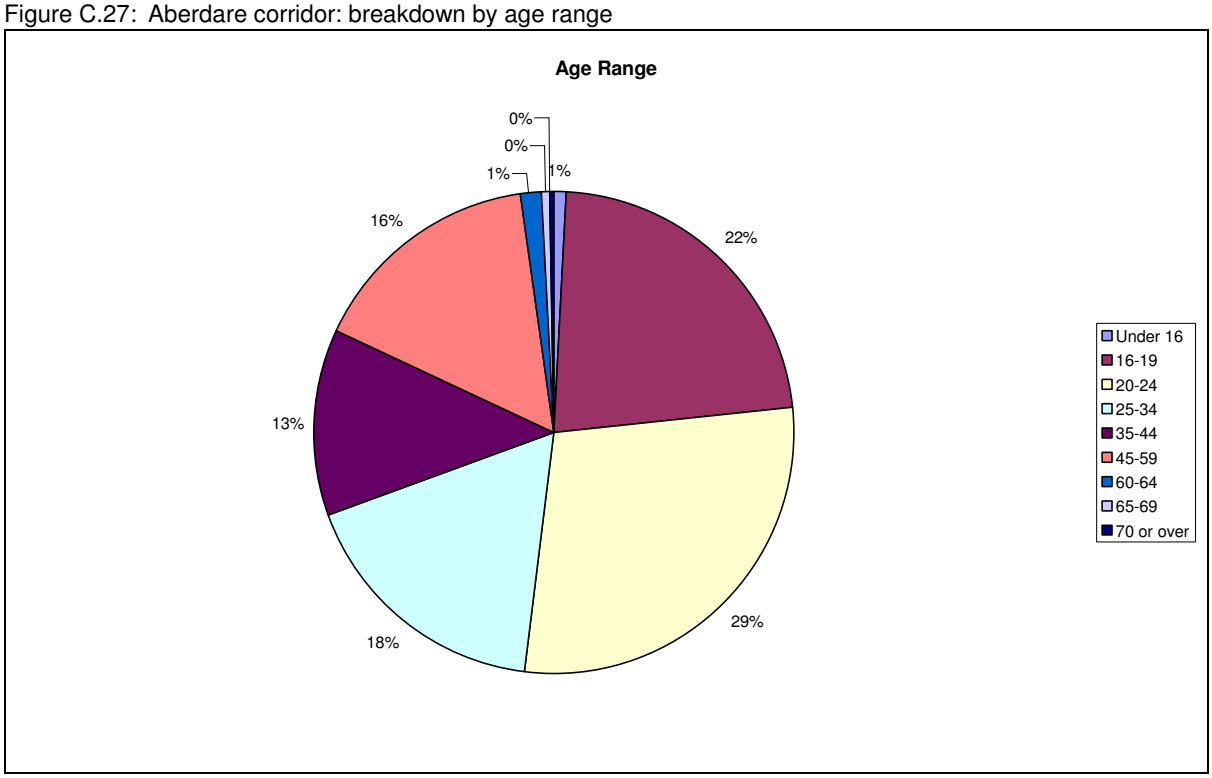
C.5. Travellers' ages

Figure C.26: Carmarthen corridor: breakdown by age range



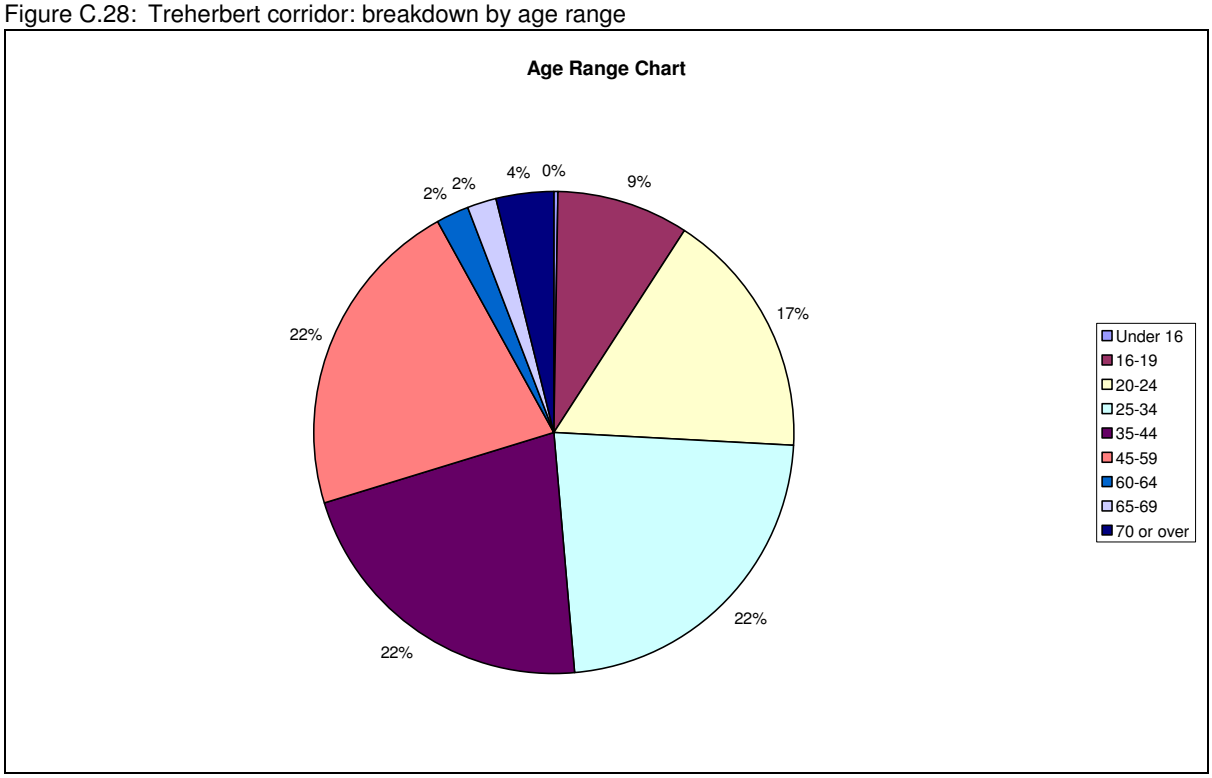
Source: National Rail Travel Survey (2004/05)

Figure C.27: Aberdare corridor: breakdown by age range



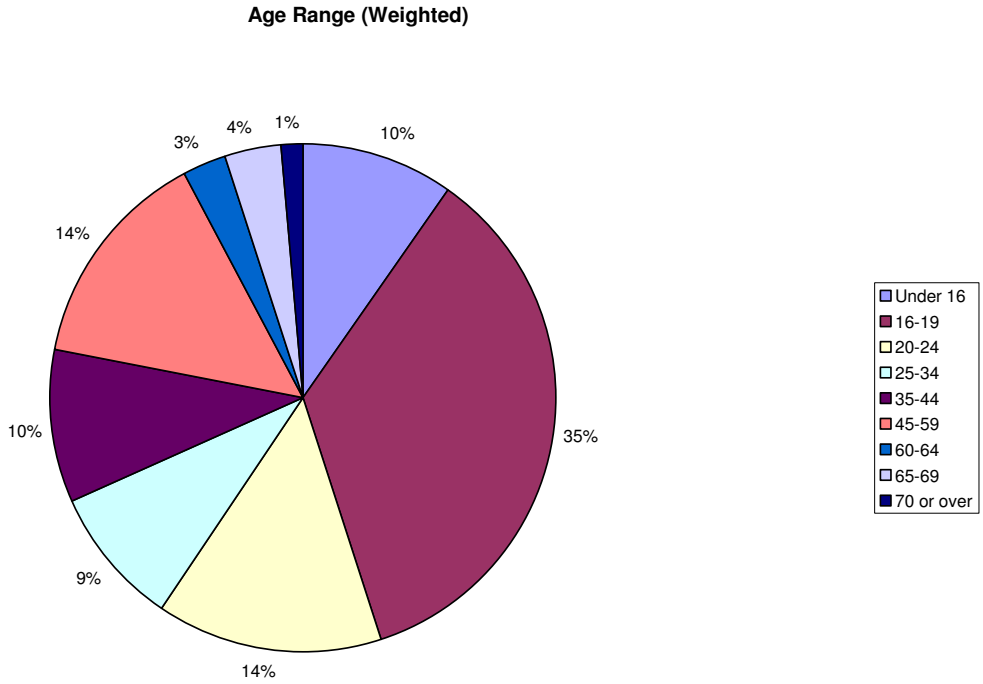
Source: National Rail Travel Survey (2004/05)

Figure C.28: Treherbert corridor: breakdown by age range



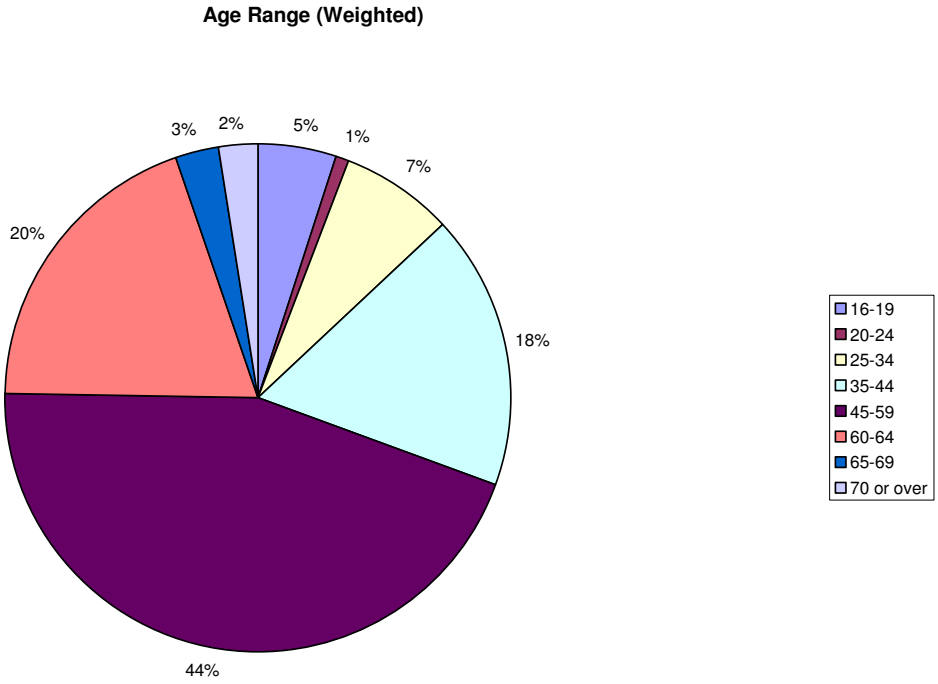
Source: National Rail Travel Survey (2004/05)

Figure C.29: North Wales Coast corridor: breakdown by age range – all journeys



Source: National Rail Travel Survey (2004/05)

Figure C.30: North Wales Coast corridor: breakdown by age range – Marches / Cardiff journeys



Source: National Rail Travel Survey (2004/05)