2017

THE VALUE OF TRANSPORT

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Peak Economics

September 2017

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Final report to HITRANS

Version 3.1

6th September 2017

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Contents

1 Executive Summary

1.1.1.1 Transport infrastructure and services feed through into many different aspects of society creating value through economic growth, delivery of health services, delivery of education services and by making society more cohesive. Taking each of these in turn.

1.2 Economic growth

1.2.1.1 From an economy perspective transport investment creates productivity gains. These stem from the business and freight user benefits and the agglomeration benefits from increasing the size of clusters. The broad evidence base indicates that a doubling of transport stock would grow the economy by 8.5%. However, behind these net benefits there are significant local variations as changes in transport services affect the status quo, leading to displacement of economic activity from one location to another. These effects are hard to study, but where evidence exists it suggests that the displacement effects may dominate the productivity effects at a local level. Obviously displacement effects may be either positive or negative – depending on where the activity is being displaced from and to. These displacement effects are often accompanied with a sectoral shift in employment: for example with a growth in the share of manufacturing (often related to roads based investment) or to a growth in business services (often associated with rail and air based investment). This makes it hard to draw definitive economic findings for a region like the Highlands and Islands though some policy messages stand out as outlined below.

1.2.1.2 Long distance business connectivity by air, road and rail is important. There is good evidence of strong positive economic effects associated with regional airports that provide services suitable for business. An often quoted finding is that a 10% increase in air traffic (passengers) is associated with a 1% increase in service sector employment. The long distance rail network typically caters for knowledge centred service sector businesses. It is these sectors that typically experience growth in the vicinity of train stations following rail improvements. For a rural economy like the Highlands and Islands long distance links are also important for tourism. Improved connectivity, whilst increasing tourism, can also change the nature of the tourist sector – for example increases in day trips may occur to an extent as a result of a reduction in overnight stays in a locality.

1.2.1.3 Good connectivity at a local level (roads and public transport) is also needed as this increases economic mass and productivity – agglomeration impacts. All forms of transport and good land use planning can contribute to this. The broad evidence base indicates that a doubling of economic mass would grow the economy between 4% and 11%. This impact is broadly speaking a balance to returns of increasing the size of a community – which is largest for small communities as often found in rural regions – and the types of industry within the region. Typically the industries with the highest returns to increases in economic mass are those found in the large urban areas, with industries found in rural areas exhibiting much lower returns. Within the UK the economic appraisal guidance on agglomeration effects only addresses the variation by industry, and not the size of the community. When the size of the communities is also taken in to account the effects of increasing economic mass in rural regions has been shown to be positive. Evidence from New Zealand for example indicates that a doubling of economic mass in rural regions can increase productivity by 4%.

1.2.1.4 Transport services at a local level can have important impacts on employment. Putting to one side the discussion on displacement for the moment, the evidence suggests that a 10% increase in public transport accessibility can increase local employment outcomes by 0.5%, though in rural areas this may drop to a tenth (to about 0.04%). It is important to recognise that different transport modes serve different segments of the labour market. Buses in particular seem to serve low income, young, part-time and female workers. Therefore any reductions in bus service provision will disproportionately affect those segments of the workforce.

1.2.1.5 There is a lack of evidence on the economic impact of investment in low volume rural lifeline roads – aside from the evidence on fixed links. As such roads are an important component of the Highlands and Islands this is an evidence gap that may be worth addressing. There is also a lack of evidence on the impact of ferry services on island economies, aside from that of ferry fares. Reductions in ferry fares boost island economies, particularly through tourism. Where reduced fares are passed on to businesses that export off the islands (i.e. haulage rates reduce) exporting businesses also benefit. The evidence on fixed links is mixed. The background economic conditions appear to have a strong bearing on the success of fixed links in stimulating economic growth – a point also referred to later in this summary.

1.2.1.6 Traditional industries within the Highlands and Islands region, the primary sector and in food and drink manufacturing, are all reliant on the transport network – particularly the road network. For these sectors transport investment is primarily about cost reduction. These cost reductions are delivered through improved productivity of the haulage sector. Food and drink manufacturing will also gain productivity benefits from clustering.

1.2.1.7 There is also a need to see the changes induced by transport investment in the context of ongoing changes in our economy – primarily a shift towards a higher skilled, higher wage, service sector economy. Transport can help facilitate this ongoing change. These sectoral changes can also be associated with changes in land use. Service sector based employment tends to cluster to urban areas. Thus a shift towards a more service based economy will naturally reinforce the strength of the urban parts of the region, potentially displacing economic activity from the more rural areas. Transport investment will be part of this story.

1.2.1.8 Transport investment can also insulate against economic shocks. The evidence, however, is that such investment cannot insulate ad infinitum. Furthermore the effectiveness of transport policy as a tool to create economic growth is severely restricted by underlying economic weaknesses (e.g. a lack of skilled workers) or institutional failings. It is therefore important that a local economy has all the right ingredients to encourage growth following a transport investment – particularly access to an appropriately skilled workforce.

1.3 Delivery of Health Services

1.3.1.1 Transport infrastructure and services are valuable to the delivery of health services in two ways. They assist directly in reducing the costs of running the health service - i.e. in reducing the cost of delivering health care for a given level of health needs in society. They can also contribute indirectly by making the population healthier (or unhealthier!) – i.e. reducing society's health needs. With respect to the direct costs of running the health service it is estimated that the health service in Scotland spends a minimum of £94 million

annually on purchasing transport services. However there is a general lack of evidence on how good (poor) transport provision influences its health care delivery costs. This is unfortunate given the current budgetary policy needs of local government. This lack of evidence also applies to remote communities in the Highlands and Islands where the trade off between transport availability and the manner that health care is delivered is very visible. Improving this evidence base would be helpful to further discussions on interactions between the delivery of health care services and transport services and how to maximise the efficiency of both.

1.3.1.2 The only exception to this evidence gap is associated with community transport. Case studies in community transport show for every £1 spent on community transport it saves the public sector £2 with the majority accruing to the health service – though some caution needs to be attached to these findings given the low number of studies reviewed. These benefits derive from for example reducing the need for taxis to transport patients, reducing missed appointments, and supporting independence (thereby delaying the need for domiciliary care).

1.3.1.3 Another feature of the interaction between transport availability and health delivery costs is that the incidence of cost and benefit across government, NHS and households is not equal. In most instances the local authorities seem to bear the cost of providing the transport service, whilst the NHS and households are beneficiaries. The local authorities and the NHS can also shift the costs to households either financial costs (e.g. fares) or social costs (provision of lower quality service). Possibly the very visible nature of these interactions in the Highlands and Islands, particularly the islands, would make the region a good case study to explore whether these institutional barriers can be broken down.

1.3.1.4 The manner that transport and health services are provided by different bodies has led some commentators to suggest that significant institutional challenges to the efficient delivery of both sets of services exist.

1.3.1.5 Transport can also add value by indirectly delivering health benefits. Increasing physical activity, reducing pollutants and affecting road safety. There is an established evidence base that gives social welfare values for reducing car and lorry kilometres/miles. The social value of new transport infrastructure (e.g. cycle paths) in this primary health care role is often shown to exceed its social costs. The social benefits include the human costs (increase in well being), economic costs (reduction in lost output) and material costs (e.g. to the NHS). Whilst the impacts on pollutants and road safety are reasonably well understood a key issue needing to be addressed the ability of transport investments to shift behaviour from a sedentary to active lifestyle. It is only when we observe this transition that we get the health benefits.

1.3.1.6 The actual reduction in costs to the NHS from the primary health care role that transport offers do not seem to have been explored to date, and where they have been reported in the media are actually social values not financial values. This is an evidence gap.

1.4 Delivery of Education Services

1.4.1.1 Undoubtedly transport contributes to the delivery of educational services, with several examples being cited anecdotally in conversations with stakeholders. However it has been hard to find any evidence to quantify the relationship, beyond an estimate of the increase in car trips resulting from reductions in school transport. Of the topics reviewed in this

paper this is the one for which least appears to be known. For example there is a kack of evidence on how the centralisation of schools affects transport costs to households and to local government. This represents a significant evidence gap..

1.5 Social Cohesion

1.5.1.1 Transport availability also contributes to the social fabric of society. It does this in several ways. It can perform an insurance option, that is households value having transport services available for that 'unexpected' trip. Additionally households can also be altruistic and value having transport services available if they are useful to other people – e.g. senior citizens. There is evidence that households are willing to be up to £130 a year for access to bus services even if they do not use them, and up to £249 a year for access to train services.

1.5.1.2 Public transport can help ensure the viability of town centres – for example research indicates that bus represents a third of non-grocery retail and entertainment trips to city centres. It can also help alleviate deprivation (which of course is related to the discussion on the economy). Whilst there is some evidence on these topics the evidence base remains limited and conclusions are therefore tentative.

1.5.1.3 Bringing all this discussion together transport also affects the size of the local population. Populations around train stations have been found to grow as a consequence of improved rail services, populations around regional airports grow faster than at municipalities without airports, and fixed links can have a strong influence on islands populations. Of course underlying economic and social conditions affect the influence transport has on population – where these background conditions are weak, transport investment may have limited or no impact. The role of background economic conditions in particular appears to influence the impact of the fixed links studies reviewed.

1.6 Economic Appraisal and STAG

1.6.1.1 When we value transport it is important to be clear what the unit of valuation is. The cost benefit analysis reported in the Transport Economic Efficiency (TEE) of a STAG, whilst measured in £s, is best thought of as a measure of social well being. It is not a financial measure – as can sometimes be reported in the media and by politicians. The social welfare value of transport investment is calculated through an analysis of the direct impacts of a transport intervention (travel time savings, vehicle operating costs, accidents, etc.) with some add-ons, where relevant, for changes in the wider economy. Such an analysis captures the added value of bringing more resources into economic use. For example the added value of increasing employment is net of the loss of leisure time. Whilst this framework is well developed, one area which is not well understood are the welfare costs of out-migration from remote locations – for example in search of work or better education opportunities.

1.6.1.2 This contrasts to economic impact studies where only monetary or financial flows such as cost reductions or increased wages or profits are captured. Here the value of transport reflects financial measures only – akin to the bottom line on a balance sheet. If these are reported in an appraisal the fall under the Economic Activity Location Impact (EALI) component in STAG. The manner that transport investment can displace economic activity from one location to another and can assist in a structural shift in an economy means that

it is important that the distributional implications of transport policy on different demographic groups is clearly identified.

1.6.1.3 This distributional analysis is also needed if one considers the manner that public sector policy on health and education delivery can shift the cost and benefit burden between different actors (e.g. government, health board and households). It should also be considered if transport policy positively or adversely affects certain demographics – bus services are an often cited example. It is often the case that the distributional analysis is neglected in transport appraisals, with the core focus tending to centre on the calculation of the headline economic indicators. The above discussions demonstrate the error of this, as transport policy often has strong distributive implications.

1.7 Avenues for further research

1.7.1.1 Clearly many of the topics discussed in this paper are at the knowledge frontier. Consequently there are many knowledge/evidence gaps and creating plenty of opportunities for further research. Unfortunately, little of this research is easy to undertake in a robust manner. A lot of the research referred to in this paper is based on an analysis of secondary datasets collected over many years with repeated observations on the same unit: individual, household or firm. The low population densities in the Highlands and Islands makes undertaking these sorts of studies difficult as the sample sizes will be small – should one even be able to access appropriate data.

1.7.1.2 Bearing this in mind a pertinent, tractable and timely line of research might therefore be to restrict further research to how the availability of transport services can have cross-sectoral impacts within the public sector. A number of potential topics within this field stand out:

- the role of air services in delivering health care cost savings in either the Western Isles or Argyll and Bute;
- the role of air and ferry services in delivering cost savings in the delivery of education services in Orkney; and
- an evaluation of the impact of the Shetland Health Board to use ferry transfers to Aberdeen instead of air services.

1.7.1.3 The latter study would also have an economy angle and could also explore some of the challenges faced when trying to deliver cross-sectoral benefits within a fragmented institutional arrangement (fragmented in that the health board, the local authority, the ferry and air operators are all separate bodies). Potential confounding factors at play are competition on Shetland air routes between Flybe and Loganair from September 2017 and the extension of road equivalent tariffs (RET) ferry fares to Shetland routes from early 2018.

1.7.1.4 Another potential avenue of research might be an investigation between the relationship between school contracted bus services and commercial bus services in a remote rural region, and what role these commercial bus services perform in supporting the local economy. This in itself could be timely given some of the bus regulation reforms being considered (albeit at this moment in time these reforms are specific to England).

2 Introduction

2.1 Background

2.1.1.1 Government finances are always limited and stark choices have to be made regarding prioritisation of expenditure between different sectors of government: education, health, transport and social services. Within each sector, such as transport, with limited finance it is also necessary to prioritise transport revenue and capital investment. The challenge is further complicated by the manner that transport services (particularly local ones) facilitate the delivery of health and educational services – thereby making the delivery of those services more cost efficient. The efficiency cost saving will be felt by the agency/government department delivering the health or educational service but the revenue or capital support for the delivery of the transport service often stems from a different government department/agency.

2.1.1.2 To aid the government decision making HITRANS commissioned a desk based study into the value of transport. Within the HITRANS area local authorities incur revenue expenditure on the provision of public transport services: bus, ferry and air. Capital expenditure is also needed to support these services along with maintaining and improving the road network. Within the Highlands and Islands region there is also the need to maintain inter-regional connectivity. Some of the responsibility for this lies with Transport Scotland (the trunk road network and the rail network), whilst local authorities have responsibility for other elements of this intra-regional infrastructure and service provision. A similar story plays out at a national level regarding the connectivity of the Highlands and Islands to Aberdeen, the Central Belt, North of England, the South of England and continental Europe. This review therefore considers the value of transport at two different geographical levels: inter-regional/long distance and intra-regional/local. There is both an interest in rural and urban issues due to the composition of the Highlands and Islands.

2.2 The value of transport

2.2.1.1 When valuing transport it is important to be clear what the unit of valuation is. The cost benefit analysis reported in the Transport Economic Efficiency (TEE) of a STAG whilst measured in £s is best thought of as a measure of social well being. This is because attributes such as visiting friends and family, the pain grief and suffering from a accident and the loss of 'free' time when getting a job are included in the appraisal. This is despite them having no market value (that is you can't go to a shop and buy free time or a reduction in pain grief or suffering). This contrasts to economic impact studies where only monetary or financial flows such as cost reductions or increased wages or profits are captured. Here the value of transport reflects financial measures only – akin to the bottom line on a balance sheet. Arguably government is primarily interested in maximising social well being, but budget constraints mean that it needs to have cognisance on financial outcomes too. Furthermore social well being is closely related to employment and therefore monetary incomes. Employment and productivity impacts are therefore an important element when considering the value of transport. Throughout this paper we have been to clear to identify what is a social welfare value and what is an economic

(financial) value. In some of the media coverage of some of the studies reviewed this distinction has been lost - particularly in relation to health impacts.

2.2.1.2 When valuing transport we also need to ascertain the **added value** of transport. That is it is necessary to consider what would have happened in the absence of a transport service or piece of infrastructure rather than how an economy (say) grew after an investment in transport infrastructure. As Fogel's classic work on US railroads showed this is distinction is very important. This is because in a world without, say, bus services, people won't suddenly stop travelling (albeit some might). However, they will travel by different modes, to different places, at different times and possibly sharing transport with different people. How the counterfactual is defined is therefore important to the value we attribute to transport.[1] Particular care has been made in referencing studies where the counterfactuals have been controlled for. This is in fact particularly challenging econometrically and in part is one of the reasons where there is only a limited number of studies in this subject area[2].

2.3 Methodology

2.3.1.1 The study was entirely desk based literature review on the value of transport. The method adopted was to identify a set of papers through keyword searches using Google Scholar, contacting local stakeholders including HITRANS board members and local consultants and using the University Transport Studies Group email list. Once these papers had been identified these were mined for further references. The papers themselves cite other studies and Google Scholar can also be used to identify papers that cite the key papers identified. The papers were then grouped by theme: economy, health, education and matters related to social cohesion.

2.3.1.2 When citing papers higher cognisance has been given to studies which are clear in the treatment of the counterfactual. Ideally one would adopt the 'What Works strategy and only include those studies that have controlled for the counterfactual at a high level of robustness. However, this would only give a small pool of studies and therefore some relaxation of those standards has had to be adopted. In the main this affects the health section, but in parts it also affects the economy section.

2.4 Report Structure

2.4.1.1 Having set this context the remainder of this report presents the outcomes of the study. The value of transport in delivering economy impacts is considered in the next chapter,

[1] Arguably not all studies define this counterfactual correctly - with recent studies valuing the Scottish rail network and the Scottish Trunk Road Network[65, 66] assuming a counterfactual where those delivering Scottish transport services would not find alternative employment, and employment in alternative transport industries would not expand in the absence of the transport mode being valued.

[2] The What Works Centre on policy evaluation use a 5 level robustness criteria and found that of the 2,300 transport evaluation studies on land based transport they reviewed only 29 met their minimum level of robustness (a level 4 or 5). What Works (2015) Evidence Review 7 Transport. July 2015. http://www.whatworksgrowth.org/policy-reviews/transport/

Chapter 2, whilst the value of transport in delivering health outcomes is considered in Chapter 3. Very limited evidence on the social or financial value of transport services in delivering educational outcomes were identified – but these are detailed in Chapter 4. Chapter 5 then considers the role of transport with respect to social cohesion, particularly its insurance value, its role in alleviating deprivation and its role in retaining and/or growing population. A summary of the key findings and some of the more pertinent research needs are identified in Chapter 6 – the concluding chapter.

3 Economy

3.1 Overview transport and economy impacts

3.1.1.1 To understand the value of transport in the Highlands and Islands it is necessary to understand how our economy is changing and the role of transport within that. This is because transport infrastructure has a very long life and therefore the transport investment has to cater both for today's needs and tomorrow's. We know that over the last 50 years[3] the UK economy has shifted from a manufacturing based one to one based on services. Post war manufacturing comprised almost 80% of British GDP whilst services less than 15%. That has almost reversed now. Over the same period transport costs have declined substantially. Fifty years ago the motorway network was less than 500 miles long and now it is five times that length, the A9 upgrades including the Kessock Bridge were still on the drawing board, 60% of households did not have a car (that figure is now less than 20%), air travel was limited, the first high speed train line in the world had only just opened (the Shinkansen bullet train) and containerization, as a means of transporting freight domestically and internationally, was in an embryonic form. Knowledge has also continued to grow. There has been a seven fold increase in the annual number of people who obtain a university degree since the 1960s. The simultaneous role of technology in reducing the costs of information and communication has also had an influence. A similar story is played out overseas. Transport costs have fallen, knowledge has increased and the nature of economic activity has altered. Developed countries specialise in services, and countries coming from a less developed background have increased their manufacturing base. Looking forward to the future it would be naïve to assume that the economic landscape will remain unaltered for the next 50 years, as background changes will continue.

3.1.1.2 There is an interconnected story transport costs and economic change here. Lowering transport costs emphasises small differences between locations and 'mobile' economic activity shifts location to exploit these differences. There are economic forces that make businesses cluster together (the benefits of proximity, large markets and sharing of knowledge for example) and there are economic forces that make businesses disperse (the costs of congestion, high land rents, high wages). When transport and communication costs are low (as they are now relative to historic levels) businesses that have lower proportions of high skilled workers and take up larger land areas will find the forces of dispersion outweighing those of centralisation. Manufacturing is a case in point. We are seeing in the US and Europe how manufacturing in developed countries is dispersing from heavily populated locations to other parts of a country or even internationally. This has been an important feature of economic change in Europe since the 1950s. The recent announcement that aluminium wheels will be manufactured in Fort William can be seen with this context of a dispersal of manufacturing from its traditional heartlands. In this instance the Highlands and Islands is a beneficiary, but the Highlands and Islands also competes with lower wage regions and nations for 'mobile' manufacturing activity. The textile industry for example is one which has seen a historic decline in the region except in niche markets. We therefore can see gains in one sector and losses in another – in part an example of the so called 'two way road effect'. Thus one can lower transport costs to

[3] For comparison the life of major transport infrastructure in appraisal is treated as 60 years (see Scottish Transport Appraisal Guidance).

benefit exports from a region, in say fish farming, but in so doing it opens up the region to imports (e.g. service related imports). These imports will then compete with local based firms in say the service sector. A study of transport and development changes around Inverness also helps highlight the point. The study concludes that expansion of tourism in the area would not have been possible without the major transport improvements in the area examined. But it also acknowledges that the improvements may have had negative effects in more peripheral parts of the study area, by increasing the pressure to close local health centres or offices in peripheral areas and to service the population from more centrally-located facilities.[4] These examples also illustrate an important feature of transport investment on the economy – the displacement of economic activity between places and between industrial sectors. Local gains invariably are larger than net gains.

3.1.1.3 Not all economic activities are mobile. Those that exploit the environment such as agriculture, fishing and tourism are fixed in location. These are important economic sectors in the Highlands and Islands. Transport can positively affect these sectors by lowering input costs and reducing the costs of selling products. This can make businesses more competitive allowing them to expand output and capture a larger market share – displacing businesses elsewhere in the (global) economy.

3.1.1.4 With the shift to a service sector and knowledge based economy urban centres have grown. The growth of Inverness and its surrounds is a good example of this. Population projections throughout the UK give the highest levels of future growth to urban centres. Furthermore new development tends to concentrate around existing development thereby reinforcing the role of existing urban areas[5]. Transport has contributed to this urban growth. This is in two ways: at a local level and at an inter-urban level. Local transport strengthens local and intra-regional markets including the labour market, whilst inter-city/urban travel is important to facilitate trade between cities and to maintain connectivity between remoter regions (the periphery) and the economic core. There have been a large number of econometric studies on the role of public infrastructure on economic performance some of which have explicitly identified the role of transport infrastructure, and the key findings are picked out below.

3.1.1.5 Before doing so it is worth emphasising that in a mature economy transport is seen as a complement to other more important underlying conditions for economic growth to occur. The right institutional framework and the right economic conditions need to be in place for growth to occur – and one of the most important is having available an appropriately skilled workforce. The transport investment must also be useful – delivering benefits to its users.[6] The largest economic impacts from transport investment therefore typically occur in growing economies where transport is acting as a constraint on growth – as all underlying economic growth factors are in place. If a region exhibits weak underlying structural economic conditions it is unlikely that a transport investment (with no other

[4] Transport Research Laboratory (TRL) (1994) A Study of Transport and Development Changes around Inverness. Project report PR/SC/16/94. Report to the Scottish Office Industry Department. Transport Research Laboratory

[5] For example 1.9% of US was built up or paved in 1992, but almost all recent development is less than 1km from earlier development (Burchfield, Overman, Puga & Turner. 2006. Causes of Sprawl: A Portrait from Space *The Quarterly Journal of Economics* 121 (2): 587-633)

[6] Banister, D. and Berechman, J., 2003. Transport investment and economic development. Routledge. (p318)

policy interventions) will stimulate economic growth. Symptoms of underlying structural weaknesses would include high unemployment, population decline, high levels of worklessness[7] and low wages. Whilst the Highlands and Islands has an average GVA capita and wages lower than the Scotland average, its population is increasing faster than that of Scotland as a whole and unemployment and worklessness is lower than that of Scotland as whole[8]. One would therefore expect that the regional economy is functioning reasonably well. Having said that this is an average picture and there will be pockets where structural weaknesses exist.

3.2 Inter-regional transport connectivity

3.2.1.1 In terms of the value of transport on the economy the econometric evidence, taken as a whole, indicates that transport investment positively affects economic performance. Averaging across all the studies if the stock of transport infrastructure could be doubled the economy (GDP) would grow by 8.5%[9]. Though more recent studies using better data and econometric methods indicate lower growth rates. The increase in economic output stems from productivity increases. Productivity increases through a better use of time (for business travellers) and better utilisation of vehicles (for freight). There will also be productivity gains from increasing economic mass (the pure mass of people and businesses within a certain travel time). Regarding the latter the econometric evidence indicates that a doubling in economic mass (akin to doubling the size of a locality) will increase productivity by between 4% and 11%. Using these literatures a rough rule of thumb would suggest that for every £1 invested in transport infrastructure economic output would increase by about 6.25p[10], suggesting a payback period on the transport infrastructure investment in the region of 16 years. These averages, however, disguise significant variations by mode and region and as per the discussion above some of the (local) economic impacts can be negative – i.e. context is important. As the above section intimated transport de-stabilises the status quo and economic activity shifts as a consequence with some regions losing out whilst some gain.

3.2.1.2 New roads will generate productivity gains and the evidence indicates these productivity gains diminish with distance from the road/highway. Some of this productivity gain is due to improved efficiency (use benefits) whilst some is due to increased agglomeration. The productivity gains may not be equal between area types. For example in a study on the impact of the Spanish motorway network on manufacturing firms in Spain the firms that gained the most productivity were those in suburban areas, with those in rural parts gaining the least.[11] Transport intensive industries also benefit disproportionately from

[7] Often measured as the proportion of 16-64 year olds who are economically inactive.
[8] See HIE (2014) Highlands And Islands Area Profile. May 2014
[9] An average elasticity across all the econometric studies of 0.06 has been found – which gives an 8.5% increase in output for a doubling in the stock of infrastructure. For a doubling of transport. See Melo, P.C., Graham, D.J. and Brage-Ardao, R., 2013. The productivity of transport infrastructure investment: A meta-analysis of empirical evidence. Regional Science and Urban Economics, 43(5), pp.695-706.
[10] Based on an output elasticity to public capital and parameters from Rietveld and Bruinisma (1998 p80) Is Transport infrastructure effective? London: Springer
[11] Holl, A., 2016. Highways and productivity in manufacturing firms. Journal of Urban Economics, 93, pp.131-151.

investment in transport.[12, 13] Thus one would expect transport intensive firms to flourish with investment in transport.

3.2.1.3 The differential impacts of transport investment are further illustrated by the impact of the inter-state highway system in the US on the rural counties it passed through. Here the net economic impact on pre-dominantly rural areas has been small. Given the Highlands and Islands context and the role of major upgrades to interurban routes through the region these studies are of some interest. The inter-state highway network was primarily aimed at connecting different cities across the US, and in so doing it passes through large rural areas. The construction of the network displaced economic activity from rural counties further away from the inter-state highways to rural counties adjacent to it. Firms earnings/employment increased in aggregate by between 6 to 8% in rural counties adjacent to the interstate highway network, but fell in rural counties that were not connected by between 1 and 3%. Retail displacement was significant. There was also a sectoral shift with a move to manufacturing (higher skilled) jobs in the communities connected by the inter-state highway network and reduction in farming earnings/employment.[14, 15] The reduction in farming earnings is a consequence of the employment shift towards manufacturing not the reduction in earnings per agricultural worker per se.

3.2.1.4 Growth due to highway investment has been observed to occur adjacent to large urban areas and cities of moderate size (e.g. greater than 25,000). This is partly due to suburbanisation and partly due to displacement and in cities with a moderate size.[16, 17, 18] With one finding indicating a 10% increase in a city's stock of highways will increase employment by 1.5% over 20 years.[17] The growth in urban areas as a consequence of transport investment makes some intuitive sense when seen through a prism that there is an ongoing structural change in the economy towards the service sector – where the jobs and activity are located in and around cities – and the new transport infrastructure investment further encourages this change.

3.2.1.5 At a more local level the construction of major highways bypass local communities resulting in some negative economic impacts. There is both international and local evidence (e.g. the A9 upgrades) demonstrating this.[19, 20, 21, 22, 23] The economic loss in the

[12] Fernald, J. G. (1999), "Roads to Prosperity? Assessing the Link Between Public Capital and Productivity", American Economic Review, 89, 619–638.
[13] Duranton, G., Morrow, P.M. and Turner, M.A., 2014. Roads and Trade: Evidence from the US. The Review of Economic Studies, 81(2), pp.681-724.
[14] Chandra, A., & Thompson, E. (2000). Does public infrastructure affect economic activity?: Evidence from the rural interstate highway system. Regional Science and Urban Economics, 30(4), 457–490
[15] Michaels, G., 2008. The Effect of Trade on the Demand for Skill: Evidence from the Interstate Highway System. Review of Economics and Statistics 90, 683–701
[16] Rephann, Terance, and Andrew Isserman. "New Highways as Economic Development Tools: An Evaluation Using Quasi-Experimental Matching Methods." Regional Science and Urban Economics 24, no. 6 (December 1994): 723–51
[17] Duranton, G. and Turner, M.A., 2012. Urban growth and transportation. The Review of Economic Studies, 79(4), pp.1407-1440.
[18] Baum-Snow, N., 2007. Did highways cause suburbanization?. The Quarterly Journal of Economics, 122(2), pp.775-805.
[19] Andersen, S. J., Mahmassani, H. S., Helaakoski, R., Euritt, M. A., Walton, C. M., & Harrison, R. (1993). ECONOMIC IMPACT OF HIGHWAY BYPASSES. Transportation Research Record, (1395).

bypassed communities is centred on passing trade in, for example, retail and fuel sales. The nature of this trade means that this local loss is likely to be displaced elsewhere and may not therefore be lost economic activity at the regional or national level.

3.2.1.6 Given that the backbone of the major road network is now complete and investment is now often associated with incremental expansions and upgrades connecting smaller outlying areas to the main network it is useful to consider the expected economic impact of these investments. These incremental type projects do not deliver the same level of accessibility change as the larger projects did (i.e. they deliver small time savings) and as a consequence economic impacts are hard to measure ex post.[24] It has also been argued that in mature economies such as the UK now that transport networks are primarily complete the rate of return on incremental additions to the network is much smaller than the return exhibited when the networks, such as the inter-state highway network in the US, were first constructed.[12]

3.2.1.7 Turning to rail there has been significant interest in the role of trains – particularly high speed trains – on economic performance. The high speed rail literature may seem to have only peripheral relevance to the Highlands and Islands but there are some key points that can be drawn from it. Threshold effects seem to exist on journey times between cities. For example journey times need to fall below 4 hours before the air market is impacted, and if they fall to less than 2.5 hours the air market disappears.[25] It is at these journey times that day return trips become quite feasible and business connectivity between cities is enhanced. At the moment journey times by road and rail to Edinburgh and Glasgow from Inverness are in excess of 3 hours, whilst below the higher threshold are well above the lower threshold.

3.2.1.8 The business long distance rail market serves knowledge-based employment (the high skilled service sectors)[26] and it is these sectors that tend to experience growth – in the vicinity of stations.[27] Tourism is a key component of the demand for rail services and

[20] HIDB (1979) The Economic Effects of Bypasses on Local Business, Transport Research Paper 5, Highlands and Islands Development Board, Inverness

[21] Transport Research Laboratory (TRL) (1994) A Study of Transport and Development Changes around Inverness. Project report PR/SC/16/94. Report to the Scottish Office Industry Department. Transport Research Laboratory

[22] Srinivasan, S. and Kockelman, K.M., 2002. The impacts of bypasses on small-and medium-sized communities: an econometric analysis. *Journal of Transportation and Statistics*, *5*(1), pp.57-69.

[23] Thompson, E.C., Miller, J. and Roenker, J., 2001. The Impact of a New Bypass Route on the Local Economy and Quality of Life. Research report KTC-01-10/SPR-219-00-2I. Kentucky Transportation Center, College of Engineering, University of Kentucky.

[24] Iacono, Michael J; Levinson, David M. (2012). Rural Highway Expansion and Economic Development: Impacts on Private Earnings and Employment. Retrieved from the University of Minnesota Digital Conservancy, http://hdl.handle.net/11299/179816

[25] Nash, C., 2009. When to invest in high-speed rail links and networks? (No. 2009-16). OECD/ITF Joint Transport Research Centre Discussion Paper.

[26] Chen, C.L. and Vickerman, R., 2017. Can transport infrastructure change regions' economic fortunes? Some evidence from Europe and China. Regional Studies, 51(1), pp.144-160.

[27] Bonnafous, A., 1987. The regional impact of the TGV. Transportation, 14(2), pp.127-137.

tourist related activities are an important economic impact.[28] In line with the arguments in the opening section of this chapter – a lowering of transport costs in mature transport networks can result in a dispersal of activity to remoter parts – the improvements in the rail network in northern Europe have been linked to the dispersion of economic activity. There is of course a dispersion from major urban centres to regional centres served by rail[29].

3.2.1.9 As with other transport infrastructure not all the economic impacts are positive. Invariably higher speed rail involved less intermediate stops and a key criticism therefore is that an economic shadow is created along the upgraded line with employment and activity displaced from the intermediary locations to the main locations served. This has many analogies to the arguments of major highways through rural environments -that the local gains are often offset by losses elsewhere. Tourism impacts are also mixed. Better connectivity may result in more visits but fewer overnight stays -so there can be a structural shift in the industries catering for tourists away from hotels towards day trip type activities. Finally and as with other forms of transport, rail investment by itself is unlikely to stimulate significant changes in an economy, however in combination with other policy instruments it can contribute to growth.[30]

3.2.1.10 Looking specifically at the role of rail in the Highlands and Islands economy a study where respondents self-reported their counterfactual to a loss of rail services in the Highlands (e.g. use the car, visit a different part of the UK, etc.) identified just over 1,000 full-time equivalent jobs in the regional economy were indirectly[31] dependent on rail services. The tourism sector especially benefitted from the rail network.[32]

3.2.1.11 Turning to air services and airports in general: there is a small body of literature on the economic and population impacts of air transport. This has a US focus and in the main examines the impact at a metropolitan level, though there is some evidence relating to rural and/or remote airports. Airports (and the air services that serve them) are associated with positive economic growth in the locality of the airport. Increases in air traffic are associated with increases in GDP, a growth in service sector related employment and activity, and with hub airports acting as attractors for high technology jobs. Some studies seem to suggest no change in overall employment levels within a region, whilst others demonstrate employment and population growth. An often quoted finding is that a 10% increase in air traffic (passengers) is associated with a 1% increase in service sector employment.[33]

[28] Varela, C.V. and Navarro, J.M.M., 2016. High-Speed Railway and Tourism: Is There an Impact on Intermediate Cities? Evidence from Two Case Studies in Castilla-La Mancha (Spain). Journal of Urban and Regional Analysis, 8(2), p.133.

[29] Cheng, Y.S., Loo, B.P. and Vickerman, R., 2015. High-speed rail networks, economic integration and regional specialisation in China and Europe. Travel Behaviour and Society, 2(1), pp.1-14.

[30] Vickerman, R., 2017 – in press. Can high-speed rail have a transformative effect on the economy?. Transport Policy (in press).

[31] Excludes those employed in the delivery of rail services.

[32] SDG (2004) The Case for Rail in the Highlands and Islands. Report dated March 2004. Report prepared for Highlands and Islands Enterprise.

[33] Brueckner, J. K. (2003). Airline Traffic and Urban Economic Development. Urban Studies, 40(8), 1455–1469

3.2.1.12 Whilst there are mixed findings on the impact of airports there seems a consensus in the literature that employment and population growth seems most prevalent for airports in rural or remote regions. It is likely that these changes in population and employment effects are largely re-distributive. That is economic activity shifts to the locations with air accessibility from locations which do not have it – though within that there is a shift to service sector related employment. Specifically, econometric tests indicate that increasing air services leads to economic growth in peripheral regions in the US[34] and remote, rural or regional airports in Australia[35]. Small airports also have a positive impact on both economic activity in their locality and on regional per capita income (productivity) have been found.[36, 37, 38] However, not all remote/regional airports deliver growth. This is because certain segments of the travel market tend to deliver more growth than others. For example, regional airports that provide connectivity to the economic core and which cater for business travel are associated with economic growth in their hinterland, whilst those catering for private travel (particularly outbound travel) may reduce economic activity in a region.[39]

3.2.1.13 There is only limited evidence on the role of ferries in contributing to economic performance. In part this is because ferry services operate on fairly well established routes and over the years there have been only incremental changes to service provision. From an economy perspective these incremental changes are difficult to study ex post. An early study for the Scottish Office Industry Department in 1993[40] estimated output elasticities to ferry fares for island exporting industries on a handful of islands (Western Isles, Arran, Colonsay and Raasay). A high degree of judgement appears to have gone into these estimates. The view was that exporting industries on islands would be very sensitive to ferry fare changes. The authors anticipated that a 10% increase in ferry fares would reduce agricultural output by 10%, fish farming by 25%, fish processing by 20%, textiles by 30% and tourism by 10%. This would then have knock on effects on employment and population. The sensitivity to ferry fares is primarily because these sectors of island economies are competing in world markets. Any fare increases therefore have to be met by reducing profits, and if there are no profits then the firm may fold. More recent work

[34] Mukkala, Kirsi, and Hannu Tervo. "Air Transportation and Regional Growth: Which Way Does the Causality Run?" Environment and Planning A 45, no. 6 (June 2013): 1508–20.
[35] Baker, D., Merkert, R. and Kamruzzaman, M., 2015. Regional aviation and economic growth: cointegration and causality analysis in Australia. Journal of Transport Geography, 43, pp.140-150.
[36] Warren, D. E. (2008, October). The Regional Economic Effects of Commercial Passenger Air Service at Small Airports. PhD thesis. University of Illinois.
[37] Button K, Doh S, Yuan J, 2010, "The role of small airports in economic development" Journal of Airport Management 4 125–136
[38] Tveter (2016) studies impacts on population, but as population growth/retention is heavily correlated with economic performance one can interpret that the small municipalities studied have performed better than other municipalities dur to the presence of the air links. Tveter (2016) Effects of airport accessibility on regional development: Evidence from implementation of regional airports in Norway. Nectar Cluster 1 – Networks: The Wider Economic & Social Impacts of Transport Networks, NECTAR C1: workshop, 19-20 May 2016, Molde, Norway.
[39] Allroggen, F. and Malina, R., 2014. Do the regional growth effects of air transport differ among airports?. Journal of Air Transport Management, 37, pp.1-4.
[40] Halcrow Fox Associates, St Adrews Economic Consultants and PA Cambridge Economic Consultants (1993) The Island Economies and the Impact of Ferry Price Changes. Report to the Scottish Office Industry Department (SOID). Report dated 1993.

examining the impact of road equivalent tariff (RET) ferry fares on the Western Isles[41] found that tourism related activities substantially increased due to the reduced ferry fares, but exporting businesses remained largely unaffected by the RET fares. The study found that haulage operators did not pass the ferry fare savings on, resulting in little impact on exporting businesses, whilst tourists were quiet sensitive to the ferry fare reductions. The increase in tourist related activity had knock on affects throughout the local economy, boosting island employment and incomes. The impacts of ferries, however, go beyond pure economy effects. They are lifeline services. A Norwegian study looked at the welfare surplus that Norwegian ferry services generate[42]. This study found that whilst 3% of the services generated a financial profit, almost 80% of them generate a positive welfare surplus. It is clear therefore that financial profitability, in this case, is not a good indicator of the social value for these lifeline links.

3.2.1.14 The primary sector (agriculture, fishing, etc.) is an important contributor to the Highlands and Islands economy as is the food and drink industry (classed as manufacturing). Transport investment can reduce input costs to the farm, or food and drink firm, thereby making them more competitive. The importance of transport in the food and drink sectors in particular is highlighted in a recent Transport Scotland report – with three of the four case studied companies having some link to the Highlands and Islands. The food and drink sector is particularly reliant on the trunk road network and is also identified as one of the growth sectors for the Scottish economy.[43, 44]. In the main the increased competitiveness of the firm will displace activity (potentially at an international level). Net effects at a regional or national level are therefore likely to smaller than at the local level. Where the transport investment can stimulate productivity increases within the sector (e.g. through business user benefits and/or agglomeration gains – see the discussion in the next section) this will be both a gain at a local and a national level.

3.2.1.15 Bringing this section to a conclusion the value inter-urban services hold is dependent on the level of displacement. With 100% displacement the costs cancel out the benefits – unless for some reason decision-makers do not value where population or economic activity is displaced from/to. However transport investment does not just move population and employment around, they can also stimulate/speed up the ongoing structural change in the economy. In particular passenger services such as rail and air strengthen service sector related employment and favour higher skilled jobs. Evidence also indicates a shift to manufacturing related to employment as well in rural regions. Improved connectivity to the economic core of a country can facilitate the economic dispersal of some activities as the costs of doing business in the core are high (high land rents, wages, congestion, crime, etc.). These sectoral changes will lead to productivity shifts in the local economy and this will add value. Having said that, unless the accessibility changes are substantial (which is hard to achieve in mature transport networks), the

[41] Alexander, F., Fuller, P., Gidney, P. and Mowat, I. (2011). Road equivalent tariff-a pilot study in Scotland. In European Transport Conference 2011.
[42] Jørgensen, F., Mathisen, T.A. and Larsen, B. (2011) Evaluating transport user benefits and social surplus in a transport market—The case of the Norwegian ferries. Transport Policy, 18(1), pp.76-84.
[43] Peeling, J., D. Palmer, C. Booth and R. Abell (2017) The value of the trunk road network to society and the economy in Scotland. Report to Transport Scotland. Report dated February 2017
[44] Transport Scotland (2016) How Scotland's Transport Network Supports the Growth Sectors. Report dated October 2016.

economic impacts may be difficult to measure and valuation of the benefits would need to focus on the measurement of the transport user benefits – from an appraisal (STAG) perspective.

3.3 Intra-regional and local economy connectivity

3.3.1 Productivity

3.3.1.1 The role of local markets is very important in the context of economic growth. As outlined in the introductory section the structural shift towards a service sector economy favours locations with strong levels of local connectivity. In part this is because there are benefits associated with clustering. These agglomeration economies result in productivity increasing as the economic mass of the locality increases. One way of increasing economic mass is through better transport connectivity. As mentioned earlier a doubling of economic mass is associated with an increase in productivity of between 4% and 11%. There is however a lot of variation within this range both by industry and by scale. The relationships included in STAG (and webTAG) sit within this range. At their upper end the productivity increases associated with industries supplying producer services (that is services supplied to businesses such as financial and legal services). Such activities are knowledge related. Manufacturing, construction and consumer services (services supplied to consumers) are at the lower end of the range.[45] UK guidance does not provide an agglomeration parameters for primary sector activities (agriculture, forestry and fishing) which are important in a Highlands and Islands context, but looking overseas the New Zealand appraisal guidance would suggest a doubling of economic mass would increase the productivity of the primary sector by just over 2%.[46]

3.3.1.2 Whilst the positive benefits of clustering drive up productivity, the costs of clustering – congestion, high land and labour costs – limit the benefits of clustering. The productivity benefits from increasing the size of the cluster therefore diminish as the cluster expands. The highest returns to clustering are therefore at the lowest existing economic densities.[47, 48] This would suggest that the smaller urban areas found in the Highlands and Islands would exhibit higher returns to increasing economic mass than the larger metropolitan areas. Having said that the most productive industries tend to cluster to the locations with the largest economic mass. The size of the expected agglomeration productivity economy benefits from increased clustering in the Highlands and Islands is then a balance between these two opposing factors. There isn't any specific evidence for the Highlands and Islands but looking to New Zealand research shows there are positive returns to increasing the size of local markets in predominantly rural regions. For example a doubling of economic mass of a locality in the West Coast, Tasman, Nelson & Marlborough regions or in Southland

[45] These agglomeration elasticities are those used in STAG are derived from: Graham D.J., Gibbons S. and Martin R. (2010) The spatial decay of agglomeration economies: estimates for use in transport appraisal, London, DfT.
[46] Appendix A10 in the New Zealand Transport Agency, N.Z., 2016. Economic evaluation manual. NZTA.
[47] Graham, D.J., 2007. Variable returns to agglomeration and the effect of road traffic congestion. Journal of Urban Economics, 62(1), pp.103-120.
[48] Maré, D.C. and Graham, D.J., 2013. Agglomeration elasticities and firm heterogeneity. Journal of Urban Economics, 75, pp.44-56.

would be expected to give about a 4% increase in productivity due to clustering (agglomeration) effects.[49]

3.3.1.3 The value of the increase in productivity from increasing economic mass is unambiguously positive – this contrasts with the discussion on the displacement effects of transport in the context of inter-regional connectivity. The extra output produced both increases welfare and GDP. For this particular impact the productivity increase is valued the same in both welfare terms and GDP terms. That is if the economic mass of a locality doubles then the absolute increase in welfare and GDP would be the same usually between 4% to 11% of (local) GDP (context dependent of course).

3.3.2 Getting people into work

3.3.2.1 Providing for the commute trip is an important economic function of the transport network. How easy the commute is affects how many people work (economist call this 'labour supply') and where and when they work. The predominant mode for the journey to work is car either as a driver or a passenger. Walking, trains, bus and cycling are also used. In places people also commute by local ferry and sometimes even local air services. The choice of mode is not random and there is often a systematic variation in mode choice by income – those on higher incomes choosing train and car and those on lower incomes walking or choosing the bus.

3.3.2.2 To value this important commuting function one needs to compare against a counterfactual in which the commute mode is not available. This could be realistic for one of the minor modes where one could imagine that no train, bus or ferry service operates – due to for example a lack of public subsidy. However, it seems overly hypothetical for car travel, walking and cycling. To evaluate the value of such modes an alternative approach is needed. Typically this needs panel data (repeated measurements over time on the same identity – a firm, a household or an individual) with further controlling for the likely manner that infrastructure investments are targeted either to areas of high growth (due to high anticipated levels of congestion) or to areas of deprivation (so as to encourage growth). Due to these onerous data requirements there are very few such studies in the world. We discuss some of the findings from these few studies before moving on to studies in which the counterfactual is explicitly identified as part of the study (e.g. by asking survey respondents to consider a world without say 'bus services').

3.3.2.3 As mentioned earlier in the US the provision of highways within a city has been found to increase employment – a 10% increase in the stock of highways has been associated with a 1.5% increase in employment. This increase in employment in the econometric model adopted is driven by migration between rural and urban areas (i.e. displacement) as well as by immigration from overseas (displacement at an international level).[17] Other US studies as already noted have also found that urban populations increase as a consequence of highway investment – noting that it is the industries that use a lot of road based transport that benefit (and by a corollary therefore cities with these road using industries that benefit). Employment impacts occur in rural areas and rural towns - but this may represent the displacement of activity from one location to another. In the UK and Spain

[49] Maré and Graham (2013) report an elasticity of approximately 0.06 for these regions.

there is further evidence on the employment impacts of new highways – but these do not offer simple relationships between highway provision/accessibility and employment. [11, 50] Both studies also indicate that employment growth is, at least in part if not in totality, due to migration (displacement effects).

3.3.2.4 In remote rural communities road networks are sparse and a road can often hold lifeline properties. This is in the sense that the population and economy of the community is highly dependent on the road. Alternatives to the road, should they exist, have a much higher time and cost. Many lifeline roads are of poor quality, which can result in physical restrictions on the types of vehicle that are allowed to use them as well as having a negative impact on the remote community they serve.[51, 52] The literature search did not identify any empirical research on the impact on the economy and population from investment in lifeline roads, though there is evidence on the impact of fixed links – which is discussed in Chapter 5.

3.3.2.5 Turning to public transport the evidence here suggests that a 10% increase in local public transport accessibility can increase employment by up to 0.5%.[53, 54, 55] This represents an increase in the labour supply at the household level – that is an increase in the labour market participation. Though it cannot be discounted that there is displacement of employment between regions. Specifically for the UK a positive relationship between bus service provision and employment levels, all other things being equal, has been found. For the UK the responsiveness of employment levels to changes in bus service provision varies by area type with employment in rural areas being the least responsive. The research identified that a decrease of bus journey times by 10% in rural areas would increase employment participation by 0.04%[56], this compares to a national average of 0.22%.

3.3.2.6 Staying with bus travel. Against a counterfactual of no bus services research work indicates that most workers will continue to work either altering travel behaviour or where/when they work. Department for Transport guidance indicates that between 1.8% and 4.4% of bus commuting trips would 'not go' in the absence of bus services, with the variation depending on the level of car ownership in the household. That is between 98.2% and 95.6% of bus commuters would keep working if there was no bus service, with those with access to cars more likely to keep working.[77] Research for Greener Journeys research found a much lower percentage of bus commuters would drop out of the labour

[50] Gibbons, Stephen and Lyytikäinen, Teemu and Overman, Henry G. and Sanchis-Guarner, Rosa, New Road Infrastructure: The Effects on Firms (April 2016). CEPR Discussion Paper No. DP11239. Available at SSRN: https://ssrn.com/abstract=2769855

[51] Halcrow (2004) Investment in Lifeline Rural Roads. Stage 2 report. Report to HITRANS. Report dated September 2004.

[52] Johansson, S. (2006). "Socio-economic impacts of road conditions on low volume roads - Results of literature studies, interviews and calculations with a model and some proposals for road management policies", ROADEX III Northern Periphery

[53] Johnson, Mackie and Shires (2014) Buses and the Economy II. Main Report. Report to Greener Journeys. Report dated: July 2014.

[54] Berechman, J., and Paaswell, R. _2001_. "Accessibility improvements and local employment: An empirical analysis." *J. Transp. Stat.*, 4_2/3_, 49–66.

[55] Ozbay, K., Ozmen, D., and Berechman, J. (2006). "Modeling and Analysis of the Link between Accessibility and Employment Growth." *J. Transp. Eng.*, 132(5), 385–393.

[56] The employment elasticity is 0.0041% for rural areas. Source: Johnson, Mackie and Shires (2014) Buses and the Economy II. Main Report. Report to Greener Journeys. Report dated: July 2014.

market – with 0.6% (5 of 831 surveyed) of bus commuters indicating they would drop out if there was no bus service[57].

3.3.2.7 Turning to rail services there is once again limited econometric evidence on employment impacts. Very recent UK research finds positive employment impacts at a household level (i.e. increases in workforce participation) arising from the new line between Stirling-Alloa and the Robin Hood line (Nottingham to Mansfield). Here a 10% reduction in the distance to a station is associated with between a 0.1% and 0.3% increase in employment levels for the household. A similar analysis of impacts from the Manchester Metrolink did not find any employment impacts for Phase 1 but found an increase in employment in the vicinity of the Phase 2 extension of 7.7%.[58] The Phase 1 development coincided with a slow down in the Manchester economy, whilst Phase 2 formed part of substantial urban renewal program. The differential impacts between phase 1 and phase 2 illustrate the dependency of economy outcomes of transport projects on the background economic conditions and the presence of supportive institutional policies – as outlined in the introductory section of this chapter. Turning to a more local rail investment the strengthened rail services (Invernet) around Inverness have been shown to be popular with house movers [59, 60]– further identifying the correlation between changes in land use (large increases in housing in the Inverness hinterland) and transport policy.

3.3.2.8 The replacement of ferries with fixed links also has significant impacts on the ability of island residents to get to work and be in work. This is of course context dependent with the largest impacts associated with connecting small islands to much larger labour markets, and where the scheduling of the ferry services made it difficult to access employment off the island. Large community impacts have been seen in islands connected to cities, and this is discussed further in Chapter 5. A more local example is that of Berneray and Scalpay where fixed links significantly increased female participation in the wider labour market.[61] Access to employment is a strong determinant of population retention – which is also discussed in Chapter 5.

3.3.2.9 Whilst numbers of jobs or percentage increase in jobs from changes in transport infrastructure of services seem small each new job has a significant income impact for a household and can make a significant GVA or GDP contribution to the local economy. The monetary value to the individual of getting people into work, or the opposite losing them from the workplace, is: the wage minus deductions and any other costs associated with working (bus fares, welfare benefits). From an economy wide perspective the monetary value is the Gross Value Added (GVA) of the job. The social value of getting people into work has to account for the loss of personal time. It is typically much smaller than the monetary impact and is measured in a transport cost benefit analysis by the change in

[57] Mackie, Johnson & Laird (2012) Buses and Economic Growth. Report to Greener Journeys Report dated June 2012

[58] James Laird, Daniel Johnson, Zhenqi Li & Stephen Dixon (2017) Wider economic benefits. Deliverable 1.6. NeTIRail-INFRA. Project funded by the European Commission. Report dated 31st May 2017.

[59] DHC (2008) Invernet 1. Rail Evaluation Study. Report dated March 2008. Report to Highland Rail Partnership.

[60] The Invernet evaluation did not report on any employment impacts (whether they be positive, neutral or negative).

[61] SQW. (Unpublished, 2004). An evaluation of the social and economic impacts of fixed links to the islands of Scalpay and Berneray. A final report to Western Isles Enterprise. Report dated March 2004

consumer surplus[62] of transport users (a user benefit) plus the change in tax revenue (a wider economic impact). It is the latter measure that is embodied in STAG (Scottish Transport Appraisal Guidance). The Department of Transport also cites an average value of £8.17 for every return bus trip that would not go if bus services were withdrawn.[63]

3.3.2.10 Given one finds that incomes of travellers vary systematically with mode then any change in the provision of commuting options by mode will have distributional implications. This is because it will impact on a particular segment of the labour market – thus for example the bus market is dominated by younger age groups, part-time workers and those who do not have a car available[64]. The loss of a bus service would therefore disproportionately affect this demographic group. Similar arguments can be extended for other modes. When considering mode specific interventions it is therefore important to have an understanding of distributional matters.

3.3.3 Better jobs, higher productivity

3.3.3.1 Investment in transport that strengthens local transport networks also affects the location of economic activity. This has been extensively discussed above. These spatial changes change economic density (and therefore productivity). Furthermore where commuting costs fall it can also encourage workers to switch jobs to a higher paid job that is further away. This is the concept of the move to more productive jobs that is considered within transport appraisal guidance in England (webTAG) but as yet does not feature in STAG. There is clearly a GDP impact as the person who switches jobs is now more productive, and for society as a whole a productivity benefit from any increase in economic mass. This GDP impact is one value of the change. From a welfare perspective however this GDP impact exceeds the welfare impacts as it in the main double counts user benefit and does not include all the social costs of additional commuting. The welfare benefit is therefore the transport user benefits plus the change in tax revenues associated with the increase in productivity (guidance indicates this is 30% of the productivity uplift on GDP).

3.3.3.2 In this review I have not been able to identify specific evidence on how changes in road and rail accessibility will stimulate a change in job. However there is UK evidence for bus. It has been estimated from survey work that 10% of bus commuters would change jobs if there was no bus service[57]. The other bus commuters would in the main use alternative means of transport to access there work.

3.3.4 Providing work

3.3.4.1 The actual provision of transport services is in itself an economic activity. Approximately 5% of the workforce in Scotland and slightly more in the Highlands and Islands are

[62] Consumer surplus is the benefit derived from consuming a good. It is the difference between what an individual would be willing to pay for it and what they actually pay for it

[63] DfT (2017) Value of social impact per bus return trip. webTAG Table A.1.3.18. https://www.gov.uk/government/publications/webtag-tag-data-book-july-2016

[64] Seniors form an important component of the bus market, but only form a small proportion of the workforce

employed in the transport and storage sector. The Scottish trunk road network is estimated to generate employment for 31,000 people (including those involved in haulage)[65], whilst 12,800 people are estimated to work in the Scottish rail sector[66], of which there are about 400 full-time equivalent jobs in the Highlands.[32]

3.3.4.2 In remote island communities employment in the provision of port, ferry and air operations is important source of income and helps maintain the vitality of local communities – and the loss of transport services can have an important impact on local communities. Up to about 140 jobs for example are involved in the provision of local ferry services to Unst, Yell, Whalsay and Bressay. If these ferry services are replaced with fixed links there is a need for other sectors in the Shetland economy to expand to accommodate the ferry workers in new employment. There would also likely be a need for them to commute to Shetland Mainland.[67]

3.3.4.3 To answer the question as to what value this employment holds one needs to consider the counterfactual where there is no employment in transport services. If the economy is in full employment then one would expect that those released into the labour market would find work elsewhere. For mainland transport services particularly those located near large urban areas this is likely to be quite realistic. [1] In this situation the value of employment in the transport sector is zero – both from a welfare perspective and from a GDP perspective. In small labour markets, such as those in remote communities it may be difficult to find new work. Workers will either therefore drop out of the labour market or be forced to migrate to look for work. Low unemployment rates in remote communities can appear to disguise difficulties in finding employment as out-migration is a typical response in the search for employment by those living in remote communities.[68] There are clearly going to be a whole range of social welfare and GDP (economic) costs associated with both exiting the labour market or migrating – both to the individual/household and to the island community. The simplest to measure is the GDP (economic) impact which in the case of migration is the GDP impact displaced from the remote community to the one to which the worker has migrated to. Social welfare costs are much harder to measure and, as far as it has been able to ascertain, have not received any attention to date.

[65] Peeling, J., D. Palmer, C. Booth and R. Abell (2017) The value of the trunk road network to society and the economy in Scotland. Report to Transport Scotland. Report dated February 2017.
[66] Oxera (2016). "What is the economic contribution of rail in Scotland?". Prepared for Transport Scotland and the Rail Delivery Group, March 2016.
[67] Reference, University of Leeds and Spyria (2008) Shetland Fixed Links Strategy: Socio Economic Study. Final Report to Shetland Islands Council. Report dated October 2011.
[68] Monk, S., & Hodge, I. (1995). Labour markets and employment opportunities in rural Britain. Sociologia Ruralis, 35(2), 153e172.

4 Health

4.1 Transport and health

4.1.1.1 In understanding the contribution of transport services to health the counterfactual is clearly important. The NHS aims to deliver healthcare that is of high quality, is safe and permits patient choice. The counterfactual of no or reduced transport services is not one of no health care provision but one in which healthcare is provided in different ways. Similarly if transport connectivity is improved one would imagine that the health service would be able to respond by altering its method of service provision to provide patient care in a different way thereby generating a cost saving for itself. Fundamentally there is a balance: should patients travel to health services or should health services travel to patients. The nature of health care has also changed over time with increased knowledge and technology requiring staff with higher skill sets. This tends to lead to specialised centres and can lead to recruitment difficulties particularly in small communities.

4.1.1.2 Health service providers and patients are therefore key users of rural public transport services. For example the NHS is the largest business user of scheduled inter-island air services in Argyll & Bute, and in the 2004 study on air services within the Highlands and Islands[69] 20% of the passengers are patients or health professionals. Ferry and road services in remote rural areas are also important for the delivery of health care services. The easier it is for health care professionals and patients to make short duration return trips the better the service is. Simplistically if a nurse has to spend 3 days on an island due to poor public transport provision (air or ferry service) rather than being able to make a day return trip then more nurses will be required by the health service to deliver the same level of health care. Centralisation of health services can also be efficient from the health board perspective – particularly for specialist treatments. Centralisation however can only occur with good transport links (whether those are used by the patient to access the health centre or the health professional to access the patient). Good transport services therefore help reduce the costs of health care provision.

4.1.1.3 The benefits of transport however extend beyond just cost reductions in how the health service provides health care. Transport services and infrastructure that involve physical activity (walking, cycling, walking to the bus stop or the train station) can play an important part in improving the population's health. This is a direct benefit of the way transport infrastructure is used. Indirectly this will lead to cost reductions in the provision of healthcare. Additionally petrol/diesel vehicles are key contributors to air pollution. Reducing vehicular traffic or switching to 'clean' vehicles can improve the populations health and by doing so indirectly affect the cost of health care provision.

[69] SDG (2004) Highlands And Islands Air Services. STAG Appraisal. Report to HIE. Report dated June 2004.

4.2 Reducing the direct costs of delivering a health service

4.2.1.1 The cost of transport to the NHS is substantial. Audit Scotland[70] estimated that in 2009/10 at least £93 million was spent on transport for health and social care. However, they were critical of the NHS in terms of its record keeping and viewed the £93million as a significant underestimate and made recommendations for joint working across the public sector and with voluntary and private providers for the successful (and sustainable) delivery of health and social care.

4.2.1.2 Whilst the success of individual projects is context specific joint working across the public sector and coordination between services does occur in places. In Argyll and Bute a community transport scheme is funded by the NHS and some health appointments are scheduled around it[71]. In Moray the council has recently taken over the running of the NHS' patient transport service for patient transfer between cottage hospitals. This gives economies through the sharing of resources with the existing Dial-a-Bus service. These examples though seem to be in the minority and six years on from the Audit Scotland report it would be interesting to understand whether much has changed since 2011. Related to that there is a general absence of evidence on the level of cost savings that can be achieved through better coordination, either within the NHS itself or through coordination between the NHS and local authorities.

4.2.1.3 There is evidence that good quality transport services reduce the direct costs of delivering healthcare - though the studies identified all relate to the provision of bus services and community transport in particular. One would expect that having good quality transport available – e.g. that permits day return trips to remote locations (either by road, ferry or by air) – would generate substantial savings in terms of staff costs. Having staff based centrally also assists in recruitment of specialised staff and thereby the safe and effective delivery of quality healthcare. However, we have not found evidence on the level of direct savings of such good quality transport services in the literature – aside from that associated with community transport.

4.2.1.4 Across Scotland community transport schemes receive about £4.5M of public sector funding; of which 90% comes from local authorities and the remainder comes the NHS (2011/12 figures)[72]. Five community transport case studies in the Highlands and Islands were examined as part of a study commissioned by HITRANS[71]. A key element of demand for these services is that of healthcare, but some of the services also offered educational trips. The counterfactual therefore was one in which the health board or the education department in the local authority would have to provide transport in some form– either through taxis or by minibus – and for discretionary trips individuals would either travel by taxi or some other means of transport (or not travel). It was estimated that every £1 spent by the public sector on the community transport case studies saved the public sector £2 against this counterfactual[73]. Interestingly the health service was the primary beneficiary

[70] Audit Scotland (2011) *Transport for Health and Social Care*. Prepared for the Auditor General for Scotland and the Accounts Commission. Report dated August 2011.
[71] Halden et al. (2012) Demonstrating the Value of Transport for Communities. *Scottish Transport Applications and Research conference 2012*.
[72] Age Scotland (2013 pp20-21) Driving Change. The case for investment in community transport.
[73] Actual figures are £250,000 of funding costs saves £500,000 of public sector costs.

of these cost savings, but only funded one of the transport schemes – the others receive substantial local authority grants .

4.2.1.5 Another area where good transport services reduce health care delivery costs is in the reduction of missed appointments or Did Not Attends (DNAs) and in reducing the need for domiciliary care (home visits) – thereby raising the productivity of health care staff. It is estimated that each missed appointment costs the NHS approximately £133 and if a reduction of 10% in missed appointments could be achieved through better patient transport this would save the NHS £74.5million a year.[74] A 2008 pilot research project by Argyll and Bute Health Board found that the introduction of a voluntary car scheme in Dumbarton reduced DNAs by 1% though the cost saving itself is not reported[75]. Cost savings associated with other community transport schemes transporting patients to GP surgeries are reported to have resulted in savings of £30,000 per year for one scheme and for another a saving to the NHS of £18 per patient trip compared to a cost to the transport provider of £9 per trip. That is for every £1 the transport scheme cost to deliver it created £2 of cost savings for the health service. With respect to timetabled bus services there does not seem to be any evidence on the effect of a withdrawal or re-instatement of a timetabled service on DNAs. Appraisal guidance estimated against a counterfactual of no bus services indicates that bus service withdrawal may reduce health trips by up to 9% (concessionary pass holder with no car available) but there is no indication as to whether these 'lost' trips are to health appointments or to for example the chemist[76, 77]. A comparative study on the impact of the concessionary fares travel scheme found no impact on health of concessionary fare travellers[78] – the implication being that with pre-concessionary fares essential health care trips were provided for either by the patient, the family or the NHS - with the patient having the option of using the timetabled bus network.

4.2.1.6 This evidence demonstrates the shared nature of the delivery costs of both transport and health care between public sector agencies. It should not be forgotten that costs are also shared between the public sector and households. A lot of community transport schemes will charge fares for example which can ensure that financial costs are spread between private and public sector. The benefits (and costs) of varying the transport quality – stylistically slow and cheap versus quick and expensive – also shifts the social cost between the public sector and households. The public sector picks up the financial cost of providing high quality transport services (albeit, and as evidenced above, better quality services can bring about some cross-sectoral savings), whilst the household is a major social beneficiary through reduced travel times and better quality of life. The five community transport projects in the Highlands and Islands mentioned earlier deliver travel time savings with a social welfare value more than 3 times the financial cost to the public sector (against a

[74] Urban Transport Group (UTG) and the Community Transport Association (CTA) (2017) Total Transport: a better approach to commissioning non-emergency patient transport. Report dated March 2017.
[75] Scottish Government 2008 cited in Canning, Thomas and Wright (2015) Research into the Social and Economic Benefits of Community Transport in Scotland. Transport Scotland.
[76] Mott MacDonald and ITS (2013) Valuing the social impacts of public transport. Report dated: March 2013. Report to the Department for Transport.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/226802/final-report.pdf
[77] DfT (2017*) Bus Diversion Factors. webTAG Table A.1.3.17*.
https://www.gov.uk/government/publications/webtag-tag-data-book-july-2016
[78] Kelly, E. (2011) *A Ticket to Ride: Does Free Bus Travel Promote Active Ageing?* UK: University of London (University College London).

counterfactual of alternative transport arrangements). 40% (£71M in 30 year present values in 1998 prices and values) of the direct benefits to households (the consumers surplus) from the proposed air fare reduction and re-timetabling of air services in the Highlands and Islands were predicted to stem from the better timetabling -with health related travel forming 20% of the demand[69].

4.2.1.7 The recent decision by NHS Shetland to make the default transfer of patients to Aberdeen by ferry rather than air is a good example of the substitutability between financial costs to the health service and welfare/well being costs to households. The proposals are expected to save the health board £1M a year but patients require two 15 hour journeys on a ferry with all the inconvenience that causes instead of a return flight of 50 minutes duration each way[79]. This loss of personal time is a welfare cost to households. If it requires exctended absences from work, there will also be an economic cost to businesses and potentially households. There is also the potential for wider consequences of this decision in terms of air and ferry capacity to/from Shetland with associated economic and social consequences for island residents, which have not formed part of the decision-making[79].

4.2.1.8 This example brings into a clear focus the potential cross-sectoral consequences of individual public sector actions and the need to bring external consequences in to the decision making – as Audit Scotland recommended[70]. This is of course an institutional challenge and arguably the current institutional framework does not lend itself to this form of joint public sector working in anything but at the margins[80, 81]. Collaborative plans are therefore reduced to a form of "pressure levying" –which is for example one of the key objectives of the Grampian Health and Transport Action Plan[82].

4.3 Transport's value in delivering a healthy population

4.3.1.1 Transport can indirectly contribute to reducing the costs of health care by improving the health of the population through: less accidents[83, 84, 85, 86], less air pollution[87, 88, 89] and

[79] NHS Shetland (2017) *Board Paper 2017/09*. Dated 14 March 2017. http://www.shb.scot.nhs.uk/board/meetings/2017/0314/2017_09.pdf

[80] Halden, D. (2014). Shaping the future: Case studies in UK accessibility planning. *Transportation Research Procedia*, 1(1), pp.284-292.

[81] IEW Brown & N Tyler (2004) Community-run rural bus services: can theoretical cross sector benefits be realised in practice. *Proceedings of TRANSED2004: The 10th International Conference on Mobility and Transport for Elderly and Disabled People Hamamatsu, Japan, May 23-26, 2004*

[82] JMP (2014) Grampian Health and Transport Action Plan http://foi.nhsgrampian.org/globalassets/foidocument/dispublicdocuments---all-documents/NHSG_Nestrans_HTAP_2014.pdf

[83] Transport Scotland (2015)Safety. Section 8. Scottish Transport Appraisal Guidance – Technical Appendix. http://www.transport.gov.scot/report/j358676-08.htm

[84] DfT (2014) Social Impact Appraisal. TAG Unit A4.1. https://www.gov.uk/government/publications/webtag-tag-unit-a4-1-social-impact-appraisal-november-2014

[85] Hopkin and Simpson (1995), Valuation of road accidents, TRL Report 163.

[86] Jones-Lee (1994), 'Safety and the saving of life: the economics of safety and physical risk'. In: Layard and Glaister, Cost-Benefit Analysis

[87] DEFRA (2013) Impact pathway guidance for valuing changes in air quality. May 2013. Available at: https://www.gov.uk/government/publications/air-quality-impact-pathway-guidance [downloaded March 16th 2017]

increased physical fitness[90, 91, 92, 93]. Increased social interaction and reduced loneliness are other ways that transport assists people's well-being[94, 95, 96]. The different transport modes contribute differently in this regard. Cheaper or quicker private motorised transport gives people better access to activities, but public transport provides opportunities for social interaction[95, 97, 98] and increased physical fitness accessing and egressing bus stops and rail stations[99]. Walking and cycling clearly have a positive outcome on physical fitness. Mode shift to public transport, to walking or cycling as well as the improvement of unsafe roads/transport infrastructure can also change the number of accidents as well as reduce road noise[100] – noting that there is a link between noise exposure and health[101, 102, 103, 104,

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[88] DEFRA (2015) Air quality: economic analysis. Available at: https://www.gov.uk/guidance/air-quality-economic-analysis [downloaded March 16th 2017]

[89] Royal College of Physicians (2016). *Every breath we take: the lifelong impact of air pollution.* Report of a working party. London: RCP, 2016

[90] Ekelund, U., Ward, H. A., Norat, T., Luan, J. A., May, A. M., Weiderpass, E., ... & Riboli, E. (2015). Physical activity and all-cause mortality across levels of overall and abdominal adiposity in European men and women: the European Prospective Investigation into Cancer and Nutrition Study (EPIC). The American Journal of Clinical Nutrition, ajcn-100065

[91] Kahlmeier , S., N., Cavill, H. Dinsdale, H. Rutter, T. Götschi, C. Foster, P. Kelly, D. Clarke, P. Oja, R. Fordham, D. Stone, and F. Racioppi. (2011) Health economic assessment tools (HEAT) for walking and for cycling: Methodology and user guide [online]. [Accessed 30 August 2013]. Available from: http://www.euro.who.int/__data/assets/pdf_file/0003/155631/E96097rev.pdf

[92] Woodcock, J., Edwards, P., Tonne, C., Armstrong, B. G., Ashiru, O., Banister, D., ... & Roberts, I. (2009). Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. The Lancet, 374(9705), 1930-1943.

[93] Woodcock, J., Franco, O. H., Orsini, N., & Roberts, I. (2011). Non-vigorous physical activity and all-cause mortality: systematic review and meta-analysis of cohort studies. International Journal of Epidemiology, 40(1), 121-138

[94] Age Concern (undated) Loneliness and Isolation Evidence Review. http://www.ageuk.org.uk/documents/en-gb/for-professionals/evidence_review_loneliness_and_isolation.pdf?dtrk=true

[95] Judith Green, Alasdair Jones and Helen Roberts (2012) More than A to B: the role of free bus travel for the mobility and wellbeing of older citizens in London. *Ageing and Society*, Available on CJO 2012 doi:10.1017/S0144686X12001110

[96] ODPM (undated) *Making life better for older people. An economic case for preventative services and activities*. http://webarchive.nationalarchives.gov.uk/20080910192639/http:/www.cabinetoffice.gov.uk/~/media/assets/www.cabinetoffice.gov.uk/social_exclusion_task_force/publications_1997_to_2006/making_older_people%20pdf.ashx

[97] Gray, J, Shaw, J and Farrington, J (2006) "Community Transport, Social Capital and Social Exclusion in Rural Areas", *Area*, 38(1), 89-98

[98] Martikke, S and Jeffs, M (2009) "*Going the Extra Mile: Community Transport Services and their Impact on the Health of their Users*", Transport Resource Unit, Greater Manchester Centre for Voluntary Organisation, http://www.gmcvo.org.uk/node/1822

[99] For a review see Mackett (2014). Has the policy of concessionary bus travel for older people in Britain been successful. *Case Studies on Transport Policy* **2**: 81-88.

[100] Noise can be a problem in rural areas as well as more heavily trafficked area (see for example: Transport for Quality of Life (2008) *Traffic Noise in Rural Areas: personal experiences of people affected*).

[101] Basner M, Babisch W, Davis A, Brink M, Clark C, et al. (2014) Auditory and non-auditory effects of noise on health. *Lancet*. 2014; 383: 1325–1332

[102] Babisch W. (2014) Updated exposure-response relationship between road traffic noise and coronary heart diseases: a meta-analysis. *Noise Health*. 2014; 16: 1–9

[103] Sorensen M, Andersen ZJ, Nordsborg RB, Becker T, Tjonneland A, et al. (2013) Long-term exposure to road traffic noise and incident diabetes: a cohort study. *Environ Health Perspect*. 2013; 121: 217–222

[105]. Arguably good public transport networks, particularly community transport, are also important in maintaining old people's independence thereby delaying when they may need to be taken into residential care[71, 98, 106, 107].

4.3.1.2 Increasingly transport, or more accurately how people transport themselves or are transported, is seen as a key element of primary health care. There is a clear consensus in the literature that transport has an influence on people's health, however, the field remains an area of ongoing research – with the evidence gap being quantifying the link particularly in relation to how transport policy itself affects health. This is because the link between transport policy and health is indirect. For example, a change in transport infrastructure will affect mode choice, which affects the level of physical activity, which in turn affects health. The link between physical activity and health is understood, but how does transport policy affect physical activity by demographic segment? Having said that there is quantitative evidence in some areas on how changes in transport policy change health outcomes – and in these instances it is possible to place a value on transport.

4.3.2 Safety

4.3.2.1 One of the more developed areas is that of safety. Transport related accidents impose costs on the health service, reduce the levels of economic output and consumption in the economy and impose a welfare cost on those involved in the accident and their relatives (pain, grief and suffering). It is an area in which there is a long history of research and for road in particular accident prediction models are well developed. Potential initiatives that can reduce accidents are segregation of different road users e.g. using guardrails to prevent pedestrians entering the carriageway, pedestrian crossings or other forms of traffic control, speed limit reductions, engineering solutions to reduce speed and better street lighting. Conversely budget setting pressures that lead to policies that increase accident risk, e.g. the turning off of street lights[108], may have an accident cost.

4.3.2.2 In the UK a value of just over £1.5M is used for a fatality, dropping to just under £13,500 for a slight casualty. Medical and ambulance costs form a small component of the overall cost – and are a financial cost born by the health service. The majority of the costs of a casualty are associated with welfare (the human costs: pain grief and suffering), though lost economic output is not insignificant either. For the average accident the human costs comprise 70%, economic output 19% and health care costs 5%. The remainder are accident specific costs (damage, police, admin).

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[104] Miedema HM, Oudshoorn CG. (2001) Annoyance from transportation noise: relationships with exposure metrics DNL and DENL and their confidence intervals. *Environ Health Perspect*. 2001; 109: 409–416

[105] van Kempen E, Babisch W. (2012) The quantitative relationship between road traffic noise and hypertension: A meta-analysis. *J Hypertens* 2012;30:1075-86

[106] Age Scotland (2013) "*Driving Change: The Case for Investing in Community Transport*", http://www.ageuk.org.uk/Documents/EN-GB-SC/Still%20Waiting%20campaign/Driving%20Change.pdf?dtrk=true [accessed March 2017]

[107] Carr, M., T. Lund, et al. (1994). Cross-sector benefits of accessible public transport. Crowthorne, Transport Research Laboratory https://trl.co.uk/sites/default/files/PR039.pdf

[108] http://www.dailymail.co.uk/news/article-4236618/Great-street-light-switch-85-councils-dim-lights.html

TABLE 4-1: UK CASUALTY VALUES

Table A 4.1.1: Average value of prevention per casualty by severity and element of cost £ (2010 prices and 2010 values)				
Casualty type	Lost output	Human costs	Medical & ambulance	Total
Fatal	534,984	1,020,343	919	1,556,245
Serious	20,611	141,781	12,486	174,878
Slight	2,178	10,379	924	13,481
Average, all casualties	9,203	35,007	2,280	46,490

Source: DfT (2014)[84]

4.3.2.3 If transport policy affects the level of vehicle traffic (e.g. through mode shift to/from rail or bus from car) then this will change the number of road accidents. The Department for Transport has estimated the benefit of adding or subtracting 1 car-km of traffic for different area and road types in the UK – this is known as the marginal external costs of car. For the Highlands and Islands the road types 'rural A roads', 'rural other roads' and 'other urban other roads' are most appropriate. For rural A-roads and 'rural other' roads this is 0.7p/car-km rising to 3.0 p/car-km on 'other urban' roads (2010 prices and values).[109] Using the above proportions in the previous paragraph one can then estimate the cost to the financial costs to the health service, to the economy and to society in general. For lorries the marginal external costs are 5.7p/lorry-mile in rural areas and 5.4p/lorry-mile in urban areas (2020 values, 2015 prices).[110]

4.3.3 Air pollution

4.3.3.1 Transport policies that affect air pollution include those that impact on mode share and how clean, in a fuel sense, the vehicles are. Initiatives that change driver behaviour can affect fuel consumption and therefore emissions too. Air pollution is seen as a major health issue with an estimated 40,000 deaths a year attributed to it in the UK with an annual social cost in excess of £20 billion. The £20 billion figure is a willingness to pay figure and "reflects a mixture of healthcare costs, lost productivity, and 'welfare' or 'utility', placing a value on good health per se". [111] The actual costs to the health service from poor air pollution have not been estimated[112], and the social cost of air pollution cannot therefore be disaggregated into human, health and productivity costs in the same way that the social costs of accidents can. It should be noted that the aggregate social cost

[109] DfT (2016) WebTAG DataBook. Table A5.4.2. https://www.gov.uk/government/publications/webtag-tag-data-book-july-2016

[110] DfT (2014) Mode Shift Benefit Values: Refresh. Department for Transport. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/389725/mode-shift-benefit-values-refresh.pdf

[111] RCP and RCPCH (2016) Every breath we take. The lifelong impact of pollution. report of a working party. https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution

[112] House of Commons Environmental Audit Committee (2010 p22) Air Quality Fifth Report of Session 2 Volume 1. https://www.publications.parliament.uk/pa/cm200910/cmselect/cmenvaud/229/229i.pdf

figures estimated for air pollution in the UK have been mis-reported in the press as a cost to the economy or the NHS rather than a social cost[113].

4.3.3.2 As with accidents the Department for Transport has estimated the marginal costs of air pollution from adding 1 car-km of traffic for different area and road types in the UK. If transport policy increases or decreases the number of car kilometres the expected social cost for air pollution is expected to be negligible in rural areas and 0.1p/car-km in 'other urban' areas.[109, 114] For freight the values are 0.1p/lorry-mile for rural and urban areas.[110] These low values reflect low population densities and the 'local' atmospheric conditions.

4.3.4 Noise

4.3.4.1 A similar situation with respect to the state of knowledge regarding the costs of air pollution on health is applicable to noise. Increased noise levels cause health issues, but what the cost of those are to the health service is uncertain. Social values of traffic noise reduction/increase are however available from willingness to pay studies. As before these values are viewed as constituting the full social value in which economic, health and welfare costs are mixed in. The marginal social costs of noise pollution is 0.1 p/car-km in rural and 'other urban' areas.[109] For freight the values are 3.4p/lorry-mile for rural and 16.7p/lorry-mile for urban roads. [110]

4.3.5 Increasing physical activity

4.3.5.1 Increasing physical activity is viewed as important to reduce the incidence of disease – particularly those related to circulatory or weight related conditions. The methods used to value these health benefits, for example the World Health Organisation's HEAT method91, and the Integrated Transport and Health Impact Modelling Tool (ITHIM)[115] typically use the value of a statistical life (approximately £1.5M in Table 4-1). As such values estimated using these tools are social values and do not represent the costs to the health service.

4.3.5.2 In contrast to accident modelling which is quite mature, forecasting the changes in the level of physical activity brought about by a transport policy is at an early stage of development. Benefits are not uniform; those with sedentary lifestyles gain the most from small increases in physical activity, and benefits of additional activity also vary by age. The modelling is further complicated by the fact that the impacts span a range of different medical conditions affecting both mortality and morbidity. There remains substantial research to be done in this field but the evidence to date suggest the health benefits from

[113] NHS publication reports the £20 billion as a cost to the economy and compares it to the cost of running the NHS: http://www.nhs.uk/news/2016/02February/Pages/Air-pollution-kills-40000-a-year-in-the-UK-says-report.aspx

[114] Campaign for Air Pollution Public Inquiry reports the £20 billion as a cost to the NHS. http://cappi.org.uk/true-cost-of-air-pollution-to-the-nhs-each-year-could-be-53-58-billion/

[115] Woodcock, J., Givoni, M. and Morgan, A.S. (2013) Health impact modelling of active travel visions for England and Wales using an Integrated Transport and Health Impact Modelling Tool (ITHIM). *PLoS One*, 8(1), p.e51462.

increasing active travel can be large – certainly relative to the costs involved.[116, 117, 118] For example using the HEAT methodology health benefits of €1,310 per new commuting cyclist per year in the EU25 countries has been estimated. This is equivalent to €0.57 per km. The comparable figures for walking are €1.04 per km.[119] In New Zealand average values per km have been estimated as between NZD$1.77 - $2.51/km for cyclists and NZD$3.53 - $5.01/km for pedestrians – with the lower values being associated with those who have higher existing physical activity levels.[120] Equivalent values for the UK are not available as Transport Scotland's and the Department for Transport's guidance does not give per kilometre values recommending a context specific assessment instead.

4.3.5.3 It has not been possible to identify any study where the financial benefits to the NHS of increased active travel has been identified. A number of claims in the popular press exist but these seem to be either a mis-interpretation of the social value of active travel or based on simple extrapolations of spending. On the latter for example a study using the ITHIM to predict changes in disease if cycling had a 10% mode share predicted a reduction in "of nearly 5% in the burden of heart disease, diabetes and stroke and 4% in the burden from dementia"[121]. Based on estimated costs to the health service of £5 billion for heart disease, strokes and type 2 related diabetes a 5% reduction in disease would simplistically imply a 5% reduction in cost giving a £250M saving.[122] Whilst one needs to treat this figure with a high degree of caution it does illustrate that the potential financial savings to the health service of a more physically active population could be large. Further research on this is needed though, particularly if we wish to attach confidence to the marginal costs to the health service of a localised active travel initiative. Of course the transport policy challenge of obtaining a 10% mode share in cycling, including in a region such as the Highlands and Islands, is not trivial either.

4.3.5.4 A variety of studies have identified that public transport users are more active and less obese than car drivers[99, 123], however, translating this transport behavioural change (car to public transport use) into a financial impact on the health service remains elusive. Social valuations of the additional physical activity associated with increased public transport use

[116] Saelesminde (2004.) Cost–benefit analyses of walking and cycling track networks taking into account insecurity, health effects and external costs of motorized traffic. Transportation Research Part A, 593-606
[117] Willumsen, E. and Roehl, A. (2010) Economic Assessment of Cycle Projects-Methodology and Cases. In *European Transport Conference, 2010*.
[118] Davis, A. (2014) *Claiming the Health Dividend: A summary and discussion of value for money estimates from studies of investment in walking and cycling.* Report to the Department for Transport. https://www.gov.uk/government/publications/economic-case-for-active-travel-the-health-benefits
[119] Rabl, A. and De Nazelle, A. (2012) Benefits of shift from car to active transport. *Transport Policy*, 19(1), pp.121-131.
[120] Genter, J. A., Donovan, S., Petrenas, B. & Badland, H. (2008.) *Valuing the Health Benefits of Active Transport Modes*. New Zealand Transport Agency Research Report 359
[121] Woodcock (2016) *Modelling the Health Impact of a 10% cycling mode share. Briefing document prepared by Dr James Woodcock for British Cycling*.
https://www.britishcycling.org.uk/zuvvi/media/bc_files/campaigning/British_Cycling_Cambridge_University_research_summary.pdf
[122] British Cycling (2016) *More cycling would save the NHS £250 million per year, new research shows*.
http://www.efds.co.uk/news/608-more-cycling-would-save-the-nhs-250-million-per-year-new-research-shows
[123] For a review see Littman (2016) *Evaluating Public Transportation Benefits*. Report for the American Public Transportation Association.

are reliant on, for example, the HEAT or ITHIM methods or variations of these (just as if the policy was directly targeted at either walking or cycling).

4.3.5.5 Finally it is worth repeating that there is also a need for caution in interpreting the physical activity benefits from transport interventions. This is because the benefits are associated with shifting people from a sedentary to active lifestyles. Whilst it is clear how active travel transport interventions can create a large increases in physical activity, it is not yet clear whether this is the result of those who are already active becoming more active, or whether it is a result of sedentary people becoming active. For example a study on the impact of the concessionary fares travel scheme found that, whilst there was an increase in physical activity amongst retired people, the self reported health outcomes of those using the scheme did not alter.[78] The implication being that those who increased their activity levels, due to the availability of free bus travel, were already sufficiently active from a primary healthcare perspective.

4.3.6 Supporting Independence

4.3.6.1 If people are not able to live independently then they may require either more domiciliary social care (home visits) or may need to move into a residential home. The existence of good public transport services – particularly for those who give up driving – can be an essential part of maintaining independence. Clearly maintaining independence is financially beneficial to the NHS, as domiciliary visits and residential care is expensive. In this literature search only two studies have been identified that have attempted to place a value on transport services that help maintain independence. The oldest study identified potential cross-sectoral savings of community transport of between £30,000 and £40,000 per annum per 1,000 people.[107] This is in 1994 prices and adjusting for inflation would suggest an approximate 50% increase giving values in 2017 prices of between £45,000 and £60,000 per 1,000 people. For one of the Highlands community transport projects case studied much higher savings of £25,000 per person per year were estimated. This it was suggested led to a potential cost saving of £1.25M. The authors however are cautious in the level of robustness that can be attached to this figure. [71]

4.3.6.2 These values are clearly financial and do not include welfare/well-being components that individuals may attach to being able to maintain their independence. No such value was found in the evidence base. Such a welfare value however would be included in the aggregate welfare/well-being value (to the bus user) associated with each bus trip (for all the motivations for valuing a bus service). This value is £3.84 for concessionary pass holders and £8.17 for non-concessionary pass holders per return trip (2010 prices and values).[76, 109]

5 Education

5.1.1.1 Education like health is a statutory service that needs to be provided – though in this case only up to the age of 16. From 16 onwards education is at the discretion of the individual. As part of its statutory commitment local authorities may need to transport children to school if there is no school within a 'guideline' distance. If the travel time to the school is too far to transport them in a day pupils may have to board during the week only returning home at weekends. There are several examples of schools with hostels catering for high school age pupils in the Highlands and Islands. The most obvious are those on the islands, but there are also schools with hostels on the mainland serving very remote communities.

5.1.1.2 The education landscape within the Highlands and Islands exhibits characteristics that are not found in more densely populated areas. Firstly there are a number of very small schools for primary age children. Secondly air and ferry services are used to transport teaching staff to islands where a school can be supported but is not sufficiently large to support specialist teachers five days a week every week. For schools with hostels air services are also used to carry pupils to school on either Sunday night or Monday morning returning home on Friday afternoon. In Orkney education related trips comprise 40% of the demand for inter-island air services.[124] This is not unique to the Highlands and Islands as these methods to delivery educational services also occur in Canada and Australia.[125]

5.1.1.3 No papers have been found that specifically identify the trade off between the supply of transport services and the supply of educational services and quantified this financially or in welfare terms. It is evident though that transport services play a role in how educational services are delivered. The now historic main road upgrades in the Highlands have reduced the need for children to attend schools with hostels when reaching high school age. More recently the fixed links in the Outer Hebrides have again reduced the need for children from Vatersay, Eriskay, Berneray and Scalpay to attend schools with hostels. For children who still attend schools with hostels the provision of air services (e.g. in the Orkney Islands and Aygyll and Bute) allow them to return home at weekends and specialist teachers to travel out to the islands. Clearly these transport services have or currently assist in maintaining remote island populations. Furthermore they also have implications for the council's budget. For example the use of air services to help supply educational services would against a counterfactual of providing a fully staffed high school on the islands the provision of the air services would create budget savings for the education department. Against a counterfactual of providing all schooling at schools with hostels the air services increase the financial burden of the transport department, but deliver welfare benefits to islands residents – which importantly may have an impact on the sustainability of the island economies, in population and economic terms.

5.1.1.4 The recent pressure on local authority budgets has meant that school bus travel has been reviewed and in some cases reduced. It has been estimated that since 2008 this has

[124] Peter Brett Associates (2016) Orkney Inter-Island Transport Study Strategic Business Case - Options Appraisal Report. Report dated October 2016.
[125] Email communication with Professor Rico Merkert, Chair in Transport and Supply Chain Management

resulted in an extra 100 million car journeys per year[126] – with all the costs associated with those. The welfare costs of these extra car trips do not appear to have been estimated.

5.1.1.5 Within remote rural communities within the Highlands and Islands the sparseness of population make the running of bus services difficult without a subsidy. In places anecdotal evidence provided by some of the stakeholders interviewed indicates that contracted school services allow operators to run additional services at a low marginal cost. There is therefore an inter-dependence between school contracted services and commercial services in some parts of the Highlands and Islands. In places these commercial services are important for economic activity (e.g. transporting tourists). As far as it has been possible to ascertain the extent of these interactions – between school contracts and commercial services – has not been documented, nor has the impacts on the local economy been identified.

5.1.1.6 At a much more tactical level community transport can assist in the provision of some educational services (e.g. trips away from school) and some community transport services successfully tender for school contracts and then use the surpluses from these to cross-subsidise other activities – such as those discussed in the previous chapter.[71]

[126] Campaign for Better Transport (2016) School Transport Matters. April 2016

6 Social cohesion

6.1 The Insurance Option

6.1.1.1 Transport services even when they are not used provide 'security' as a backup or insurance option. The backup maybe as a reserve mode if the car is not available. Alternatively it may be a back up destination – such as somewhere they may need to travel to find work (e.g. if they lose their current job). In economic terms this is known as an option value. Option values are social values and may also manifest themselves in property prices and therefore have monetary element too. This monetary element will accrue to homeowners on sale of property and landlords in the monthly rental income.

6.1.1.2 STAG[127] gives the option value for buses as £78 per household per year (2010 prices and values) rising to £130 if non-use values (e.g. for altruistic motives) are included. The evidence suggests that the more useful a bus service is the higher the option value up to a point. Thus option values increase quite dramatically from poor quality bus services to ones which offer viable commuting opportunities, but after that the evidence indicates there is little increase.[128] The £130 per household per year figure relates to good quality bus services. A US study identified valuations for a rural bus network which varied in quality across the network about 40% of this figure (i.e. around £52 per household)[129], whilst an estimate for a UK average bus service is about 30% of the STAG value. Whilst not an option value it is also worth noting that the Department for Transport attributes a value of £3.84 (concessionary pass holder) and £8.17 (non-concessionary traveller) for every bus trip that would not go (i.e. would not go by a different mode, etc.) if the bus service was removed.[63]

6.1.1.3 For train services STAG gives an option value of £149 (2010 prices and values) rising to £249 if non-use values are included. Again these values vary with quality of service, with lower quality services that do not offer many commuting opportunities having lower values than this. Values of approximately a third of these have been estimated for UK rural services with no commuting options.[130, 131]

6.1.1.4 Whilst one would expect road, air and ferry services to hold option values these aspects of transport infrastructure do not appear to have been studied – aside from one unpublished study that found that a fixed link holds no option value (risk premium) against a counterfactual of a high quality 24 hour ferry.[132]

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[127] See STAG Table 11.1 http://www.transport.gov.scot/report/j358676-11.htm

[128] Laird Johnson Corso and Tucta (2013) Option values in bus networks - STAR Conference

[129] See Table 4 in Laird et al. (2009) Option and non-use values and rail project appraisal. Transport Policy 16 (2009) 173–182

[130] Laird, J., Geurs, K. and Nash, C., 2009. Option and non-use values and rail project appraisal. Transport Policy, 16(4), pp.173-182.

[131] Johnson, D., Jackson, J. and Nash, C., 2013. The wider value of rural rail provision. Transport Policy, 29, pp.126-135.

[132] LAIRD, J.J. (2008) Modelling the Economic Impact of Transport Projects in Sparse Networks and Peripheral Regions. PhD Thesis. University of Leeds.

6.2 Supporting Town Centres

6.2.1.1 A significant proportion of public transport trips are shopping and entertainment related. For example across Great Britain 27% of bus trips are shopping related[133]. As bus and train services typically serve town centres then they typically help support town centres. For example research indicates that bus represents 33% of non-grocery retail and entertainment trips to city centres with an average spend per trip is £54[134]. The equivalent value for rail is about £79.[135]

6.2.1.2 Changes in public transport services would be expected to change the number of shopping trips. For a reduction in say bus services behavioural responses would include reducing the frequency of the trips and making a bigger shop or altering purchasing patterns (by shopping closer to home or buying a different basket of goods). The Department for Transport's diversion factors indicate that between 15% and 37% of shopping trips by bus would not occur if bus was not available.[77]

6.2.1.3 In determining the value of this loss of shopping trips one needs to define the counterfactuals carefully. This is because household expenditure will occur anyway with or without the public transport. The public transport service determines where the money will be spent and what it might therefore be spent on. In the context of household expenditure the net effect is likely to be zero in monetary terms – as increases in expenditure elsewhere in the economy cancel out reductions in places served by public transport services. The effect would differ from zero if increases elsewhere (e.g. to online retail or mail order companies) were viewed as holding little or no value to decision-makers, or reductions in certain places (e.g. small town centres) were viewed by decision-makers as more problematic.

6.2.1.4 From a social welfare perspective the value of a loss of bus services serving retail destinations would be captured in the reduction in user benefits in the STAG economic appraisal.

6.3 Deprivation

6.3.1.1 Public transport services by increasing access to employment, education, health services and other services can reduce levels of deprivation – thereby promoting social cohesion. For buses recent research shows that a 10% reduction in bus journey times reduces deprivation levels by 3.6%[136]. This is driven by access to town centres where employment and other opportunities are often located (2%), with the remainder driven by access to health care (hospitals and GPs). Improvements in deprivation levels would be associated with improvements in employment outcomes, education outcomes, health outcomes and

[133] 2009 & 2010 National Travel Survey (source: Mackie, Johnson & Laird (2012) Buses and Economic Growth. Report to Greener Journeys Report dated June 2012).
[134] Johnson, Mackie and Shires (2014) Buses and the Economy II. Main Report. Report to Greener Journeys. Report dated: July 2014.
[135] Estimated from table 4-8 in Johnson, Mackie and Shires (2014) Buses and the Economy II. A survey of expenditure of visitors to city and town centres. Report dated December 2013.
[136] KPMG and Johnson (2016) A Study of the value of local bus services to society. A report for Greener Journeys. August 2016

income (as these comprise the deprivation metric). For the most deprived neighbourhoods this research estimate that a 10% reduction in bus journey times of 10% reductions would improve employment deprivation by 2.7%, income deprivation by2.8%, increase post 16 education outcomes by +0.7%, entry to higher education by +0.1%, increase in adult skills by +1.4% and a reduce years of potential life lost by 0.9%. Some of these outcomes have been argued to contribute to the social value of buses – with KPMG and Johnson estimating they add up to a third of the total benefits of bus services[136]. Internationally research also shows the positive benefit that bus services have on reduce welfare dependence and increase employment opportunities[137].

6.3.1.2 Similar evidence for public transport services other than buses has not been identified.

6.4 Population

6.4.1.1 Population growth and retention depends on many factors: economic, health, education amongst them. We would expect where transport investment is able to contribute positively to the economy, health and educational wellbeing of the population then populations will grow or for remote communities or at the very least by retained.

6.4.1.2 Chapter 2 of this report discussed the employment impacts of transport investments. One of the key push and pull factors to migration and population changes are economic. Population changes therefore invariably follow employment changes[138]. Summarising we see displacement effects most notably in rural areas – both between rural areas themselves and between rural areas and urban areas, with typically major infrastructure investment favouring urban growth and the general structural shift in the economy towards a higher skilled economy and one based on services. This evidence is not repeated here.

6.4.1.3 As part of this story the impact of rail services on employment has been mentioned. Train services often serve urban centres where the job growth is located -whilst population/housing growth occurs around the stations along the line. As mentioned this is evident in the Inverness area where a large proportion of the users of the Invernet service were home movers, but it is also evident elsewhere. For example populations around stations along rail commuter routes in West Yorkshire have increased by 8% against control areas due to the opening of new stations.[139]

6.4.1.4 We have also discussed that air services to peripheral regions that provide business level connectivity have a positive impact on employment. Population studies support this too. For example the Norwegian policy to use (new) air services to support a dispersed population in the late 1960s and early 1970s increased population and employment at municipalities receiving an airport by 1% per annum between 1970 and 1980 (the period analysed). This is seen as displacement from other municipalities. The average size of a

[137] Dagney Faulk and Michael Hicks (2010) , "The Economic Effects of Bus Transit in Small Cities," Public Finance Review 38, no. 5 (September 2010): 513–39

[138] Additionally if population does not increase with employment, employment growth will be curtailed as there are limits to the amount of labour households will supply.

[139] Blainey, S.P. and Preston, J.M., 2010. Gateways to prosperity? The long term impacts of new local railway stations. In European Transport Conference, 2010.

municipality studied was 7,700 people – so quite comparable to the Highlands and Islands context.[140] It has also been found that in Wisconsin (in the US) between 1980 and 1990 air services (and highways) have a positive impact on rural population levels. They had no impact at the urban level.[141]

6.4.1.5 In remote island communities replacing ferries with fixed links is an important policy tool. The evidence on their success at retaining population is however mixed. If this is seen through the prism of the underlying economic forces of centralisation, dispersion and increasing urbanisation as part of structural changes in the economy discussed in Chapter 2 along with the pressures on the delivery of health services in Chapter 3 this is likely to be expected. Fixed links to islands close to metropolitan centres have stimulated substantial growth in island population and economic output as the cities have effectively spilled out onto the islands.[142, 143] For remoter islands structural change is also evident with a shift from agriculture to tourist related industries and also to professionals who can work remotely.[142, 144] Structural change can also occur at a more obvious scale . For example the construction of the causeway to Cape Breton, by giving mainland access to a deep water ice free port on Cape Breton, stimulated investment in industry (including an oil refinery and a pulp and paper mill). There was a large change in land uses resulting in the commercial centre of the island moving to Port Hawkesbury (which increased in population by 45%).[145] On small islands with limited facilities social change has also been evident with for example, and as mentioned earlier, increased female participation in the labour market.[61] The economic forces that lead to these changes are still small relative to 'external' economic forces, such as general shifts from a manufacturing base to a service sector base within an economy or the general downturn of a sector e.g. steel manufacturing or deep sea fishing. By providing a positive economic shock to the island economies the fixed links can 'insulate' the economies for a short while from negative background economic trends. The alleviation of tolls from the fixed link to Skye was viewed, for example, to have insulated the Skye economy from fuel price shocks.[146] The evidence however is that there is generally a return to trend unless the island economies themselves embrace the external structural changes that are occurring in the economy – islands located closest to metropolitan centres are one example of this.

[140] Tveter (2016) Effects of airport accessibility on regional development: Evidence from implementation of regional airports in Norway. Nectar Cluster 1 – Networks: The Wider Economic & Social Impacts of Transport Networks, NECTAR C1: workshop, 19-20 May 2016, Molde, Norway.
[141] Guangqing (2012) "The Impacts of Transport Accessibility on Population Change across Rural, Suburban and Urban Areas: A Case Study of Wisconsin at Sub-County Levels." Urban Studies 49, no. 12 (September 2012): 2711–31.
[142] GUAY, L. (2007) Two Islands in the Saint Lawrence River. In: Baldacchino, G. (Ed.). (2007). Bridging Islands: The Impacts of Fixed Links. Charlottetown, PEI: Acorn Press
[143] KÄLLGÅRD, A. (2007) Sweden , Islands and Bridges. In: Baldacchino, G. (Ed.). (2007). *Bridging Islands: The Impacts of Fixed Links*. Charlottetown, PEI: Acorn Press.
[144] ROYLE, S.A. (2007) Islands off the Irish Coast and the 'Bridging Effect'. In: Baldacchino, G. (Ed.). (2007). Bridging Islands: The Impacts of Fixed Links. Charlottetown, PEI: Acorn Press.
[145] HUNTER, M. R. & CORBIN, C.(2007) Built for Going Away The Canso Causeway Epic, in Three Acts. In: Baldacchino, G. (Ed.). (2007). Bridging Islands: The Impacts of Fixed Links. Charlottetown, PEI: Acorn Press.
[146] DHC (2007) Evaluation of the Economic and Social Impacts of the Skye Bridge. Report to Highlands and Islands Enterprise. Report dated 22 February 2007.

6.4.1.6 Recent ex post Norwegian work has quantified this variability in the impact of fixed links. These studies have found that on average populations increase.[147, 148, 149] On average over 11 fixed links average population growth was 2% after 5 years and 6 % after 15 years (against the counterfactuals). [149] However this disguises substantial variation with some islands experiencing large population growth and others experiencing a static or declining population (against the counterfactuals). Islands close to urban areas experience large growth[148, 149] but elsewhere results are more mixed[147, 149]. Traffic flows on the fixed links are not good indicators of population change (possibly due to the two way road effect) and interestingly land use change in the main exhibits a lot of inertia with few impacts in the first few years after opening but with effects still being experienced some 15 years after construction.

[147] Andersen, S.N., Nilsen, Ø.L., Gutiérrez, M.D. and Tørset, T., 2016. Impacts on Land Use Characteristics from Fixed Link Projects: Four Case Studies from Norway. Transportation Research Procedia, 13, pp.145-154.
[148] Gutiérrez, M.D., Andersen, S.N., Nilsen, Ø.L. and Tørset, T., 2015. Impacts on land use characteristics from ferry replacement projects. Two case studies from Norway. Transportation Research Procedia, 10, pp.286-295.
[149] Eivind Tveter, Morten Welde, James Odeck (2016) Does Fixed Links Affect Settlement Patterns?
A Synthetic Control Approach. Working Paper. September 2016.

7 Conclusion

7.1.1.1 Transport infrastructure and services feed through into many different aspects of society creating value through economic growth, delivery of health services, delivery of education services and by making society more cohesive.

7.1.1.2 From an economy perspective transport investment creates productivity gains – business and freight user benefits and the agglomeration benefits from increasing the size of clusters. The broad evidence base indicates that a doubling of transport stock would grow the economy by 8.5%, whilst transport improvements that could double economic mass would grow the economy between 4% and 11%. However, behind these net benefits there are significant local variations as changes in transport services affect the status quo and lead to displacement of economic activity from one location to another. These displacement effects may dominate the productivity effects at a local level and obviously may be either positive or negative – depending on where the activity is being displaced from and to. This makes it hard to draw definitive economic findings for a region like the Highlands and Islands though some policy messages stand out.

7.1.1.3 Long distance business connectivity by air and road and rail are important. There is good evidence of strong positive economic effects associated with regional airports that provide services suitable for businesses. Good connectivity at a local level (roads and public transport) is also needed as this increases economic mass and productivity. All forms of transport and good land use planning can contribute to this.

7.1.1.4 Traditional industries within the region in the primary sector and in food and drink manufacturing are all reliant on the transport network – particularly the road network. For these sectors transport investment is primarily about cost reduction. These reductions are delivered through improved productivity of the haulage sector. Food and drink manufacturing will also gain productivity benefits from clustering.

7.1.1.5 There is also a need to see the changes in the economy induced by transport investment in the context of ongoing changes in our economy – primarily a shift towards a higher skilled, higher wage, service sector economy. Transport can help facilitate this ongoing change. It can also insulate against economic shocks, but evidence suggests that transport investment cannot insulate ad infinitum. Furthermore the effectiveness of transport policy is severely restricted by underlying economic weaknesses (e.g. a lack of skilled workers) or institutional failings. It is therefore important that a local economy has all the right ingredients to encourage growth following a transport investment.

7.1.1.6 Transport infrastructure and services are valuable to the delivery of health services in two ways. They assist directly in reducing the costs of running the health service - i.e. in reducing the cost of delivering health care for a given level of health needs in society. They can also contribute indirectly by making the population healthier (or unhealthier!) – i.e. reducing society's health needs. With respect to the direct costs of running the health service it is estimated that the health service in Scotland spends a minimum of £94 million annually on purchasing transport services. However there is a general lack of evidence on how good (poor) transport provision influences its health care delivery costs. This is unfortunate given the current budgetary policy needs of local government. This lack of evidence also applies to remote communities in the Highlands and Islands where the trade

off between transport availability and the manner that health care is delivered is very visible.

7.1.1.7 The only exception to this evidence gap is associated with community transport. Case studies in community transport show for every £1 spent on community transport it saves the public sector £2 with the majority accruing to the health service – though some caution needs to be attached to these findings given the low number of studies reviewed. These benefits derive from for example reducing the need for taxis to transport patients, reducing missed appointments, and supporting independence (thereby delaying the need for domiciliary care).

7.1.1.8 Another feature of the interaction between transport availability and health delivery costs is that the incidence of cost and benefit across government, NHS and households is not equal. In most instances the local authorities seem to bear the cost of providing the transport service whilst the NHS and households are beneficiaries. The local authorities and the NHS can also shift the costs to households either financial costs (e.g. fares) or social costs (provision of lower quality service). The manner that transport and health services are provided by different bodies appears to pose some institutional challenges to the efficient delivery of both sets of services.

7.1.1.9 Transport can also add value by indirectly delivering health benefits. Increasing physical activity, reducing pollutants and affecting road safety. The social value of new transport infrastructure (e.g. cycle paths) in this primary health care role is often shown to exceed its social costs. The social benefits include the human costs (increase in well being), economic costs (reduction in lost output) and material costs (e.g. to the NHS). The actual reduction in costs to the NHS from this primary health care role do not seem to have been explored to date, and where they have been reported in the media are actually social values not financial values. Whilst the impacts on pollutants and road safety are reasonably well understood a key issue needing to be addressed the ability of transport investments to shift behaviour from a sedentary to active lifestyle. It is only when we observe this transition that we get the health benefits.

7.1.1.10 Undoubtedly transport contributes to the delivery of educational services. However it has been hard to find any evidence to quantify the relationship. Of the topics reviewed in this paper this is the one for which least appears to be known. Transport availability also contributes to the social fabric of society. It does this in several ways. It can perform an insurance option and it can help ensure the viability of town centres – particularly public transport – and it can also help alleviate deprivation (which of course is related to the discussion on the economy). Whilst there is some evidence on these topics the evidence base remains limited and conclusions are therefore tentative.

7.1.1.11 When we value transport it is important to be clear what the unit of valuation is. The cost benefit analysis reported in the Transport Economic Efficiency (TEE) of a STAG whilst measured in £s is best thought of as a measure of social well being. This contrasts to economic impact studies where only monetary or financial flows such as cost reductions or increased wages or profits are captured. Here the value of transport reflects financial measures only – akin to the bottom line on a balance sheet. If these are reported in an appraisal the fall under the Economic Activity Location Impact (EALI) component in STAG. The manner that transport investment can displace economic activity from one location to another and can assist in a structural shift in an economy means that it is important that

the distributional implications of transport policy on different demographic groups is clearly identified. This distributional analysis is also needed if one considers the manner that public sector policy on health and education delivery can shift the cost and benefit burden between different actors (e.g. government, health board and households).

7.1.1.12 Clearly many of the topics discussed in this paper are at the knowledge frontier and there could many opportunities for further research. Not all of this research is easy to undertake. A lot of the research referred to in this paper is based on an analysis of secondary datasets collected over many years with repeated observations on the same unit: individual, household or firm. The low population densities in the Highlands and Islands makes undertaking these sorts of studies difficult – should one even be able to access appropriate data – as the sample sizes will be small.

7.1.1.13 Bearing this in mind a pertinent, tractable and timely line of research might therefore be to restrict further research to the topic of how the availability of transport services can have cross-sectoral impacts within the public sector. A number of potential topics within this field stand out: the role of air services in delivering health care savings in either the Western Isles or Argyll and Bute, the role of air and ferry services in delivering savings in the delivery of education services in Orkney and an evaluation of the impact of the Shetland Health Board to use ferry transfers to Aberdeen instead of air services. The latter study would also have an economy angle and could also explore some of the challenges faced when trying to deliver cross-sectoral benefits within a fragmented institutional arrangement (fragmented in that the health board, the local authority, the ferry and air operators are all separate bodies).). Potential confounding factors at play are competition on Shetland air routes between Flybe and Loganair from September 2017 and the extension of RET ferry fares to Shetland routes from early 2018.

7.1.1.14 Another potential avenue of research might be an investigation between the relationship between school contracted bus services and commercial bus services in a remote rural region, and what role these commercial bus services perform in supporting the local economy. This in itself could be timely given some of the bus regulation reforms being considered (albeit at this moment in time these reforms are specific to England).