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Wider Economic Impacts of Regional Air Connectivity

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WIDER ECONOMIC IMPACTS OF REGIONAL AIR CONNECTIVITY

Final report to the Department for Transport

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1 INTRODUCTION

1.1 Background

As part of the aviation strategy the government is assessing the connectivity available to the UK's nations and regions, and how targeted interventions could be used to improve this.

There is a wide range of claimed benefits of regional connectivity, including those felt directly by users as well as spillover effects into the wider economy. This desk top research aims to clarify the extent and validity of these benefits in a regional air connectivity context, and whether certain interventions may release these benefits to a greater or lesser extent. This research may then feed into a broader piece of work to develop a methodology, sufficiently robust enough that it could then be used for the identification and appraisal of levers to encourage greater regional air connectivity.

1.2 Research questions and scope

Two research questions have been posed:

1) How relevant are wider economic impacts (WEIs) in the appraisal of government support for regional air connectivity?
2) Do these impacts vary by the type of government support?

In this context **regional** refers to a location more than 3 hours from London by train. Cities sitting close to the boundary of such a three hour arc include: Middlesbrough, Newcastle, Carlisle, Swansea, Exeter. Cities in Scotland and Northern Ireland lie well outside this arc. Inter-regional services are also of interest, where they connect into a large airport. Thus routes into Manchester, Bristol or Birmingham from Scotland or Northern Ireland would be candidates.

The types of **government support** mechanisms can be classified by whether they are route based, passenger based or airport based. Route based policies include public service obligations (PSOs) and start-up aid. Passenger based policies would include policies that either allocate tickets to certain residents or allowed certain residents discounted air tickets. Airport based policies could include discounting airport charges, ring fencing slots or financial support for the regional airport. Appendix A gives a more detailed description of the potential policy measures.

This is a desk based study and in this context, how **relevant** a WEI is, is assessed on the basis as to whether the market failure is likely to exist in the regional economy, and if it does whether the economic impact of improved regional connectivity will be **affected** by the market failure. Relevant could also be seen as relevance to a transport appraisal, in that it materially affects the outcome of the appraisal by for example moving the project between value for money categories. This will be very context dependent, and will depend on a number of factors including the market structure, how well the pass through mechanism from user benefits to the economy is functioning and the depth of the market failure. The WEI will be larger the larger the market failure ceteris paribus.

This aspect of relevance would need to be assessed through empirical case studies, and is therefore out of scope of the current work.[1]

1.3 Report structure

This paper therefore has the following structure. Following this introductory chapter, Chapter 2 presents evidence on how air connectivity can affect regional economic performance. In Chapter 3 we then create a framework of WEIs, taking as our starting point WebTAG and the framework SDG(2013) created for the Airports Commission. We also draw from the broader literature on this topic. Given a typology of settlements that might be served by regional air connections we then identify which of these WEIs would be relevant in which situation, before going on to discuss what empirical evidence there is on their scale. Unfortunately this evidence is very limited. Here we also use the term '*economy impacts'* to refer to the economic impacts on GDP, productivity and employment, which are distinct from the economic impacts on welfare embodied by the WEIs. In Chapter 4 we then broaden the discussion by considering the second research question directly, as to whether the relevance of the WEIs will vary by type of government support. Chapter 5 presents our conclusions.

2 ECONOMIC IMPACTS OF REGIONAL AIR CONNECTIVITY

2.1 Economic Geography and Accessibility

Part of understanding the economic impact of changes in regional air connectivity is an understanding of how regional economies are changing and the role of transport within that. We know that over the last 50 years the UK economy has shifted from a manufacturing based one to one based on services. Post war production comprised 76% of British GDP whilst services were less than 15% (ONS, 2016a)[2]. That has almost reversed now. The economic importance of London and the South East has also increased over this time (see for example Roses and Wolf, 2018 Maps 9 and 10). Over the same period transport costs within the UK have declined substantially. Fifty years ago the motorway network was less than 500 miles long and now it is five times that length, air travel was limited, the first high speed train line in the world had only just opened (the Shinkansen bullet train) and freight containerization was in an embryonic form.

[1] We are not aware of any regional air connectivity case studies in the literature to draw on either.

[2] An alternative 2016 ONS publication (ONS, 2016b) has production comprising 42% of the 1948 economy, not the 76% presented in ONS (2016a). The difference is no doubt due to which industries are classified as services and which are classified as production in 1948 vis a vis today. ONS (2016a) uses a consistent definition between 1948 and today.

There is an interconnected story between 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 to more peripheral regions outweighing those of centralisation to the core regions. Manufacturing is a case in point. We are seeing in the US and Europe how manufacturing in developed countries is dispersing from core regions to other regions of a country or even internationally. This has been an important feature of economic change in Europe since the 1950s. In contrast we see a continued centralisation of service related activities to core regions (see e.g. Combes et al., 2011).[3]. Regional air connectivity is part of this story, as it contributes to the total accessibility of a region.

Not all economic activities are mobile. Those that exploit the environment such as agriculture, oil and gas, mining, fishing and tourism are fixed in location. These can be important economic sectors in the regions. Transport can positively affect these sectors by lowering input costs and reducing the costs of selling products – for tourism this relates to the lowering of travel costs for tourists wishing to travel to the region. Air transport, with its predominant focus on passengers can have a direct impact on the tourism market but is likely to only have an indirect influence on primary sector activities. Perhaps the exception is the oil industry which draws 'off-shore workers' from a large geography, who often travel by air to their points of departure to the North Sea (e.g. Aberdeen, Hartlepool, Norwich).[4]

We can therefore see that a lowering of transport costs, of which air connectivity is part, can influence regions in different ways. Increased air connectivity may increase the number of tourists travelling to a region, may increase the attractiveness of a region for manufacturing to disperse/re-locate to, but may also lead to services being imported to the region by more efficient service sector business located in the core and to outbound tourism from the region. This is the so called 'two way road effect'. This example also illustrates an important feature of transport investment on the economy – the displacement of economic activity between places and between industrial sectors. The gross gains for the winning region(s) invariably are larger than the net national economic gains.

[3] Noting that consumer services (e.g. retail and primary healthcare provision) tend to follow (i.e. co-locate with) population, whilst producer services (e.g. finance) are more mobile.

[4] The oil industry also uses the air travel as a key input into the production process: flying workers from land bases (the points of departure) to off-shore production platforms by means of helicopters. These activities however use contract services, rather than commercial passenger services which are the focus of this paper, and we do not consider them further in this paper. We do note however that the presence of such contract services obviously improves the commercial viability of regional airports, but on the downside can negatively impact on surroundings because of noise. The flying pattern of helicopters is flexible and they do not need runways, hence they do rarely congest air space and the airport apron.

There have been a small number of econometric studies on the role of air connectivity on net regional economic activity, and the key findings of these are picked out below.

Before doing so it is worth emphasising two points. The first is that in a mature economy transport is seen as an enabler when other more important underlying conditions apply. 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 (Banister and Berechman, 2003). The transport investment must also be useful – delivering benefits to its users. 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 policy interventions) will stimulate economic growth. Symptoms of underlying structural weaknesses would include high unemployment, population decline, high levels of worklessness[5] and low wages. The context to any government intervention on regional air connectivity will therefore be very important.

The second point is that changes in the economy will lag behind changes in the transport system. In the first place transport behaviour needs to adjust, from which economic behaviour will then adjust – subject to the caveat on transport-economy frictions made above. In terms of the time it takes transport behaviour to adjust we may be looking at up three or more years based on the evidence of toll roads 'ramp-up' periods (see e.g. Bain, 2009). We are not aware of specific evidence on the time it takes for air travel behaviour to adjust to new routes, though air route start-up aid has a maximum duration of three years after which it is expected that a new route would be commercially viable[6]. Drawing this aspect of policy together with the evidence on toll roads ramp-up arguably periods of two to three years could be expected after which transport behaviour will have adjusted. However, longer term effects due to changes in the economy may still affect air transport travel demand after this time – particularly to the regional services at which start-up aid is directed. Looking at economic responses Melo et al.'s 2013 meta-analysis on the productivity impacts of transport infrastructure identify short-run elasticities of approximately 60% of the long run elasticity. One may consider a temporal categorisation of impacts. In the very short run, a new route could generate traffic over night. Medium-term effects where e.g. buyer-supplier relationship adjust could come within 2-5 years. The long term effects could appear say after at least 5-10 years where (re)location may take place. The full economic impact of new infrastructure will take time to appear in the economy and arguably may take more than a decade for the full effect to be realised.[7]

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[5] Often measured as the proportion of 16-64 year olds who are economically inactive.

[6] See DfT guidance on applications for route start-up aid between January 2015 and February 2018. https://www.gov.uk/government/publications/airports-with-fewer-than-5-million-passengers-per-year-start-up-aid

[7] Duranton and Turner (2012) for example analyse the economic impact of the US's inter-state highway network on urban growth over a twenty year period.

2.2 Ex post evidence of the economic impacts of regional air connectivity

There is a small body of literature on the ex post 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 regional airports. Airports (and the air services that serve them) can cause positive economic growth in the locality of the airport. Increases in air traffic can lead to increases in GDP, growth in service sector employment and activity, and for hub airports can act 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) causes a 1% increase in service sector employment (Brueckner, 2003).

Whilst there are mixed findings on the impact of airports there seems a consensus in the literature that airports in peripheral regions have some stimulating effect on employment and population growth. 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 (Mukkala and Tervo, 2013) and remote, rural or regional airports in Australia (Baker, Merkert and Kamruzzaman, 2015).

Small airports also have a positive impact on both economic activity in their locality and on regional per capita income (productivity) (Warren2008; Button, Doh and Yuan, 2010; Tveter, 2016).

The importance of air connectivity to businesses was illustrated in case studies of two airports in remoter parts of Norway (see Box 2-1). Proximity of an airport was ranked second in location specific factors for businesses in remote regions, with businesses in the service sectors and with offices, departments or sister companies in other regions or abroad valuing it the most (Halpern and Bråthen, 2011, 2012).

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 (Allroggen and Malina, 2014).

Population studies support the view that air services that provide business level connectivity can support regional economic activity 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 municipality studied was 7,700 people (Tveter, 2016). 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 Guangqing (2012). Halpern and Bråthen's work (2011, 2012) presented in Box 2-1 support this with an illustration of the positive opinions of air connectivity held by residents local to remote airports.

BOX 2-1: CASE STUDY ON THE RELEVANCE OF AIR CONNECTIVITY TO REMOTE REGIONS

The air transport system may play an important role in exploiting the scale effects in both human capital and natural resources in remote areas. However, there will certainly be large variations among regions depending on their existing resource base. Halpern and Bråthen (2010 and 2011) contains a case study on two airports in remote regions in Norway, Ålesund and Brønnøysund, where Brønnøysund is by far the most remote area.

Firstly, looking at residents local to the airports. 87% of respondents from across both regions strongly agreed that their region was better connected nationally and 58% internationally because of the local airport,. The lower figure for international connectivity is likely to be a consequence of the range of air services that are available at the airports, which are largely domestic versus international. 67% of respondents strongly agreed that they have better opportunities for holidays, 54% that they have better access to health services, 50% that they have better contact with friends or relatives, and 41% that they are able to do their job better. The presence of the local airport seemed to be important for the retention of residents in both regions. 70% of the respondents strongly agreed that they are more likely to continue living in the region. This varies from 75% for residents around Brønnøysund to 63% around Ålesund, and the difference in average response for the two regions is significant. This suggests that while local airports are important for the retention of residents in both regions, the level of importance is significantly greater for residents in the most remote region. The main impacts from the local airports on businesses are the ability to serve a larger market (15% of respondents rated this factor as very important), promote exports (10%), and enhance competitiveness (8%). The local airport is considered as important for the economic performance, like increasing turnover (12% of the businesses) and strengthening profitability (8%). The influence of the local airport on investment decisions is generally positive, through influencing inward investment. 66% of respondents in both regions combined stated that they invested more in their region than they would otherwise have done, and the share was larger in the most remote region.

Turning now to businesses. It is difficult to quantify the importance of local airports to businesses. Halpern and Bråthen (op cit) asked respondents to estimate what proportion of their turnover is dependent on air services at their local airport. The largest proportion of respondents (39%) reported no connection between turnover and air services. However, 61% of respondents estimate that at least 1% of their turnover is dependent on air services at their local airport. Almost a quarter of respondents (23%) estimate over 20% and 7% estimate over 60%.

Respondents were asked to rate the importance of a number of key location factors for their business. Contact with customers is ranked first according to the proportion of respondents that consider the factor to be very important (44%). Proximity of an airport and general quality of life are ranked joint second (36%). This means that over a third of the respondents consider proximity of an airport to be a very important key location factor for their business. Access to a local market is ranked fourth (34%). Access to a qualified workforce is ranked fifth (25%).

Proximity to an airport is more important to businesses in the service sectors, such as hospitality and services, finance and insurance, energy, real estate and business, and transport and warehousing. Proximity to an airport is also found to be more important for businesses with offices, departments or sister companies in other regions or abroad compared to businesses that have offices, departments or sister companies in the same region. Catalytic effects may be quite significant in certain areas, and this issue should be pursued in future research.

Halpern and Bråthen (2011, 2012)

2.3 Ex post HSR evidence on regional economic performance

The limited number of ex post studies on the economic impacts of regional air connectivity mean it is useful to consider other studies that concern high speed travel that can act as substitutes for air services. The high speed rail literature therefore is of interest – where it relates to regional economic growth. Here we see similar points to that observed in the air connectivity literature: namely positive economic growth particularly associated with service sector employment and tourism.

The business long distance rail market serves knowledge-based employment (the high skilled service sectors) and it is these sectors that tend to experience growth (Chen and Vickerman, 2017) – particularly in the vicinity of stations (Bonnafous, 1987). Tourism is a key component of the demand for rail services and tourist related activities are an important economic impact (Varela and Navarro, 2016). However, 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.

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. This is a dispersion from major urban centres to regional centres (Cheng et al., 2015).

Finally, and as with other forms of transport, high speed 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 (Vickerman, 2018).

2.4 Discussion

This brief review of the empirical literature identifies that, despite the "two way road" effect, there are positive economic impacts in the vicinity of airports from good quality regional air connectivity. This in the main manifests itself as an increase in service sector related employment. In part this represents a structural shift towards the service sector and in part it also represents a growth in population and employment. Regional air connectivity can also increase tourist related activities – providing inbound tourism dominates outbound tourism. The type of tourist who wants to visit natural or man-made sites which are fixed in location or trace their ancestry is of particular interest. We would also expect improved regional air connectivity to re-enforce the tendency for manufacturing to disperse from the core to the regions. Manufacturing predominantly requires good road connectivity, but the needs of firms for some workers to travel between different plants points towards the need by manufacturing for some form of high speed connectivity – such as that provided by air services.

If employment and economic activity in the vicinity of regional airports with good connectivity is higher than elsewhere ceteris paribus, then we would expect that inward investment in the region has historically also been higher. It is likely that this growth and investment is displaced from elsewhere, most likely from within the UK, but also potentially from overseas. Regional air services might therefore be seen as an aid to distributional policies aimed at achieving an even growth across regions – particularly given that we expect our economy to grow in and around urban areas where airports are situated and in the service sector, which benefits the most from air services.

From this, it is concluded that key diagnostic tests as to whether an increase in regional air connectivity will generate 'economy impacts'[8] (from which WEIs may then flow) would include:

1. Is the traffic likely to be diverted from land modes, other air routes or generated? If generated, is it displaced from elsewhere in the UK?
2. Is the air service under consideration likely to generate additional business travel from the region?
3. Is it likely to generate net positive tourism to the region (i.e. the increase in tourism to the region more than compensates for any increase in outbound tourism)?

These tests have been cast in the context of changes in travel demand, even though we see the cost changes brought about by new air services to be the driver behind regional economic change. The causation will run from a change in generalised cost, to a change in travel demand, to economy impacts via various channels to be discussed below, to wider economic impacts (WEIs).

[8] We use the term *economy impacts* to specifically refer to GDP, productivity and employment economic impacts, which are distinct from though overlapping the pure welfare economic impacts embodied by the WEIs.

Finally, it is always worth reminding ourselves that context is important. Transport connectivity rarely stimulates economic activity when there are structural weaknesses in an economy and no sectors with comparative advantage to be gained. For improved air transport connectivity to facilitate growth, connectivity needs to be a constraint on the economy and/or the improvement needs to occur at the same time as investment in instruments that directly address any structural weaknesses that are present.

3 WIDER ECONOMIC IMPACTS

3.1 A framework of market failures and wider economic impacts

Wider economic impacts are surpluses created by a transport initiative that occur in secondary markets that are additional to transport benefits (transport consumer and producer surpluses). They therefore only occur if market failures exist in the secondary markets. The source of the market failure may be a technological externality or may arise due to a lack of or over- regulation or a particular market. SACTRA (1999) identified three core market failures: agglomeration externalities, taxes on wages and imperfect competition in commodity markets arising from a variety of sources (product differentiation, natural monopolies, spatial monopolies, etc.). Since their seminal work the number of sources of market failure and therefore the number of potential WEIs has expanded. Drawing from work commissioned by the Airports Commission (SDG, 2013), our own research (e.g. Laird and Mackie, 2014; Mackie, 2016; Laird and Venables, 2017) and a review of the implementation of WEIs in transport appraisal guidance (Wangsness et al, 2017) we have developed a listing of market failures. This is presented in Table 3-1 and represents our framework for viewing WEIs. At this stage it is worth noting that inclusion in the framework does not imply that there exists a robust evidence base on the market failure and its associated WEI(s).

TABLE 3-1: A FRAMEWORK OF WEIS

Market Failure		Wider Economic Impact (WEI)		Included in WebTAG (2018 version)
Productivity effects	Agglomeration externality	Urbanisation		Yes
		Localisation		---
	Knowledge spillovers	Inward investment (e.g. foreign direct investment)		---
		Increased competition arising from increased trade		---
		Innovation impacts in the construction and transport sector		---
Capital Markets	Tax on the return on capital (business profits)	Increased investment in capital		Yes (albeit indirectly)
Labour market	Taxes on the supply of labour	Increased labour supply from a change in commuting costs	Changes in the number of people choosing to work	Yes
			Changes in the number of hours worked	---
		Move to more, or less, productive jobs		Yes
	Spatial mis-match between labour demand and housing, immobility in housing market, sticky wages/over-regulated labour market	Excess labour supply effects	Employment impacts from building transport infrastructure	---
			Employment impacts from operating transport infrastructure	---
			Displacement of labour to region with excess supply of labour	---
			Labour demand impacts from increased output due to international trade	---
	Search costs due to lack of mobility/options	Thin labour market effects		---
Land market	Over or under regulated land market	Interaction with inefficient land-use regulation		---
	Non-marginal costs and/or imperfect information	Coordination failure		---
Commodity markets	Monopolistic competition arising from e.g. product differentiation, spatial monopolies, etc.	Output change in imperfectly competitive markets		Yes
		Increased competition as a result of better transport (reducing monopolistic competition)		---
	Indirect taxation	Output change in markets distorted by inefficient indirect taxation		---

Sources: Own work, DfT (2005), SDG (2013), Wangsness et al. (2017).

The starting point for our framework is SACTRA(1999) and WebTAG. This identifies relevant market failures as: agglomeration externalities, monopolistic competition and taxes on wages; and the WEIs of agglomeration benefits, increases in labour supply (from more people working and more hours worked), move to more (or less) productive jobs, output change in imperfectly competitive markets

and increased competition as a result of better transport.[9] We distinguish agglomeration externalities between urbanisation and localisation. Urbanisation economies relate to the benefits of being in close proximity to economic mass in general, whilst localisation economies relates to the benefits of being in close proximity to similar firms or workers in the same industry. The latest version of WebTAG discusses the differences between these two aspects of agglomeration. WebTAG also includes the proportion of Corporation Tax paid by businesses from changes in output arising from changes in labour supply and move to more (or less) productive jobs – this is in addition to changes in labour taxes. The distortion that creates this additionality is that Corporation Tax lowers the return on capital and leads to an under-investment in capital.[10]

Drawing from SDG(2013) work for the Airports Commission we now identify further market failures and WEIs. SDG identify five wider impact categories associated with air connectivity: regeneration, agglomeration economies, creative destruction/spillovers, gains from trade and information knowledge. The *regeneration* category refers to the value of displacing economic activity for distributional reasons – such as the re-balancing the economy arguments discussed in the following section. As such this is not a wider economic impact, as it is not specifically related to a market failure, and we do not include it in our table. Their discussion on a*gglomeration economies*, the productivity gains from proximity between economic agents, is couched in a similar manner to WebTAG and refers to urbanisation economies.

SDG(2013)'s creative destruction/spillovers and g*ains from trade* refer to several different productivity effects, which we try to separate out as follows. It is often claimed that foreign direct investment (FDI) directly increases productivity in an economy by bringing in new technologies and/or working practices, but also creates a knowledge spillover as local incumbents learn from the foreign entrant. Increased trade (from lower transport costs) typically increases both imports and exports. This allows regions to specialise, and for industries with localisation agglomeration economies this will lead to a productivity gain - which forms a WEI. Increased trade exposes firms to more competition, which leads to innovation driving further productivity gains. Incumbent firms exposed to imports have to become more productive, and firms that export have to have high productivity vis a vis their competitors to be able to export. These productivity effects, which arise from increased competition by for example adopting the practices of competitors, are additional as the knowledge that created the productivity gain is spilled over into other parts of the economy. We therefore place them in the productivity section of the framework with knowledge spillovers as the market failure.

Gains from trade (and lower transport costs in general) can also lead to firms re-organising production to take advantage of economies of scale (e.g. concentrating production in fewer sites).

[9] DfT(2005) identified *Increased in labour supply due to more hours worked* and *increased competition as a result of better transport* as WEIs, but these have now dropped out of the latest version of WebTAG (DfT, 2017a)

[10] This is not explicit in WebTAG, which only alludes indirectly to this distortionary effect with a reference to an OECD report on the distortionary effects of different forms of taxation on economic growth.

This re-organisation leads to an increase in freight and business traffic, which if measured correctly gives an accurate measure of the value of re-organisation (Mohring and Williamson, 1969). Economies of scale and re-organisation impacts do not therefore feature in our table of WEIs, as with a well specified demand model re-organisation benefits are captured in the transport user benefits.

The final category identified by SDG(2013) concerns *information and knowledge*. The argument here is that lower transport costs lower barriers in understanding new markets. Therefore by lowering transport costs businesses are more likely to enter new markets, thereby stimulating growth through the mechanisms already discussed. It is not clear to us that there exists an additional market failure (and accompanying WEI) additional to those already included in our table.[11] The cost of information in this framework is acting in a manner similar to transport costs. We have therefore excluded this from our framework.

Wangsness et al. (2017) undertake a review of 23 countries national project appraisal guidelines or practices[12]. They identify 12 WEIs considered important within these guidelines, but also find that of those 12 only half are mentioned by more than one country. Agglomeration impacts and output change in imperfectly competitive markets are the most widely accepted. They also consider that a number of the WEIs identified in some countries guidelines are not well founded theoretically or empirically – but they do not specify which of these they are. Thus while they report what is in the different countries' guidelines it is important that we consider whether the WEI they report has a robust theoretical foundation. Using our table as a reference, the first WEI they identify that we have not already discussed is *innovation impacts in the construction and transport sector*. The argument underlying this is that an increase in the demand in these sectors, will in a competitive environment, lead to increased innovation. In the UK these arguments have been used as part of the narrative of HS2 and Crossrail – that is investment in these mega projects will make UK construction businesses more productive and competitive internationally. We see this as a type of knowledge spillover, and it is closely related to the argument of increased competition from international trade.

The largest sub-group of WEIs that appear in other countries' guidance, but are not discussed in WebTAG and did not feature in the SDG(2013) framework, are those associated with an excess supply of labour – that is structural unemployment. The relevance of structural unemployment to the economic appraisal of transport schemes that 'divert' economic activity from strongly performing regions to lagging regions was first identified by Elhorst and Oosterhaven (2008) in the context of a high speed rail link between the north and south of the Netherlands. Internationally guidelines appear to distinguish between different elements of this sort of WEI: construction

[11] If there is a market failure it would be in the market for information.

[12] The 23 countries comprise the Nordic countries, the remainder of the EU15, USA, Canada, Switzerland, Australia, New Zealand and Japan. A handful of the 23 countries do not publish guidelines

impacts, operation impacts[13] and impacts associated with increased output. Where output is displaced between regions (as opposed to being net additional to the UK) a WEI would only be created if the labour market in the region where jobs are destroyed is operating efficiently, whilst that in the region where the jobs are created exhibits market failures giving rise to an excess supply of labour. Laird and Mackie (2014) consider, in the Scottish context, that this sort of WEI is more associated with urban areas than rural areas. In rural areas those in search of work tend to migrate to urban areas. Thus the remote rural labour markets in the UK tend to clear.

The labour market WEI associated with *thin labour markets* is reported by Wangsness et al. It was first identified as being relevant to transport appraisal by Pilegaard and Fosgerau (2007), and further identified by Laird and Mackie (2014) as being relevant to remote rural regions that experience an increase in employment. The underlying argument is that segments of the labour market experience high mobility costs (i.e. search costs), and this then creates a monopsonistic labour market (for those labour market segments). Such segments are typically women and low skilled workers. Increases in labour supply that draw more of these type of workers into the labour market therefore create an additional WEI (Pilegaard and Fosgerau, 2007). Laird and Mackie (2014) showed that this WEI is also relevant when displacing high skilled employment from well functioning labour markets to remote labour markets, where these search costs are prevalent.

Wangsness et al. identify two WEIs associated with the land market: interaction with *inefficient land-use regulation* and *co-ordination failure*. Their paper does not identify the guidance which documents where these WEIs are detailed, but to our knowledge they were first discussed in a transport appraisal context in the TIEP report (Venables et al., 2014). To our knowledge there has been no research on their relevance to transport appraisal. The arguments underlying these WEIs go as follows. The planning environment can at times seem overly restrictive, with large imbalances in land prices between agricultural land and land with planning permission – particularly on the fringes of growing cities. If it is overly restrictive and inefficient then increased development will generate a WEI (*inefficient land-use regulation*). Whether intentionally or not applications of the Dependent Development guidance in WebTAG (DfT, 2017b) by using differences in agricultural and residential/commercial land prices as part of its land value uplift guidance implicitly assume this market failure persists in the UK, though as far as we are aware there is no research to support this position.[14] Arguably the *co-ordination failure* WEI is more associated with countries without strong institutions. Where institutions are strong, they correct for the co-ordination market failure by bringing different actors together to overcome the non-marginal costs in development. Arguably the UK has a good planning context, even though it could always be improved – certainly when

[13] The operation of transport services is an important employment source in many remote regions, particularly rural areas (Laird and Mackie, 2014)

[14] The existence of differences in price cannot be taken to imply that there is a market failure, as planning authorities need to ensure that externalities of development are internalised – which in itself will give rise to price differences between agricultural land and land with planning permission.

compared against less developed countries – and we would see this market failure having little relevance to the UK, though research would be needed to confirm that.

Wangsness et al. identify that some countries list *re-organisation* benefits as a WEI. For the reasons discussed earlier we do not consider this to be a WEI. Wangsness et al. also identify a WEI which they term *contributions to promoting international relations*. Our position on this is that it is not absolutely clear what the market failure is that is associated with *promoting international relations,* and how it affects the economy. We can see that there can be benefits of stability and peace through better communication, but would consider that these 'external' benefits lie outside of the WEI framework, and may be more akin to the re-balancing arguments discussed below. WEIs have to be specifically associated with a market failure, and are not just non-use benefits per se. We have not therefore included these WEIs in our framework.

Finally, we include a WEI that is not present in any of the above literature sources – that associated with indirect taxation. Indirect taxation, like taxes on wages, is an important revenue source for government, but it can also distort the economy (when it is not used to correct for a market failure). If economic output therefore increases as a consequence of the transport investment then a WEI associated with indirect taxation will also occur.

3.2 The re-balancing agenda

Reducing productivity disparities among regions is a policy goal of the Government. Structural change in the economy over the last century has gone hand in hand with the growth in regional imbalances. As a recent report puts it,

The phenomenon is termed 'the North-South divide' to reflect the fact that much of the growth has been concentrated in the south of the UK, particularly in and around London, while the rest of the country has been characterised by deindustrialisation; only the regions of London and the South-East have levels of productivity above the UK average. Thus, in the UK context, rebalancing is focussed on rejuvenating former industrial heartlands.

(OECD/ITF, 2018)

In our view, this broad policy goal has a mixture of political, social and economic content which extends well beyond the wider impacts which are likely to be captured in a transport cost-benefit analysis compliant with WebTAG.

- In political terms, it is considered by many to be unfair or unjust that regional economic disparities have grown so large as to conflict with the 'opportunity society' and threaten social cohesion;
- The Green Book argues that the marginal utility of income is higher at lower levels of real income, so this might support costless transfers of economic activity of given value from high income to low income regions;

- There are arguments that the economy might be run closer to capacity if it is well-balanced across sectors and regions than if it is less well-balanced;
- There are arguments that it is desirable to maintain population in remote places and that air travel is an enabler of that;
- There are arguments of a 'making better use' nature. Suppose for example that infrastructure is congestible; with given capacity there are social costs when systems are close to capacity and/or LRMC is upward sloping because capacity costs are high. Then there are efficiency gains if economic activity and population can be located in places where there is spare capacity in infrastructure (transport, energy, water, health, education) rather than places where there is no spare capacity. Essentially this is a second best argument that the price of infrastructure use does not equal social marginal costs, and the P : MSC ratio differs across places for various reasons of standard prices, or in some sectors the use of queueing or rationing rather than pricing.

The policy focus is on achieving reallocation of resources within regions to more productive economic activity. So the policy question for the economic narrative is whether interventions of particular kinds would be likely to foster this aim in a cost-effective way.

There is a distinction to be drawn between the effects listed in this section and in the previous one. In that section appeared wider impacts on which there is guidance and which could in principle be included in the economic case if it was proportional to do so and the evidence was available. The effects in this section may or may not be important to particular cases but they are a mixture of equity and efficiency and are unlikely to be measurable. Ideally the efficiency aspects of these would appear in the Economic Case as non-quantified impacts with a discussion of their likely significance to the case under consideration. The political and social aspects would more readily find a place in the Strategic Case, where we would expect the overall balance of costs and benefits to be brought together, whether quantified or not. In practice it might be judged preferable to include all these 'even wider impacts' in the Strategic Case because disentangling the economic, political and social elements is not considered to be worthwhile. Whichever route is chosen, we believe these impacts should be enumerated as far as possible.

One source of evidence on the perceived value of economic activity in the re-balancing arguments that could potentially bridge between the Economic and Strategic Cases is the evidence on the cost per job of previous government interventions. The Homes and Community Agency (HCA) guidance note based on historical expenditure levels on employment creation suggests that as a benchmark the gross acceptable cost per net additional job created government expenditure is between £28,700 and £51,000. This represents an NPV figure. Projects that have job creation solely in mind are at the lower end of the range and projects with wider objectives are at the higher end (such as cross-cutting regeneration or where the end use is for a specialist purpose) (HCA, 2015). On one hand this could be interpreted as the value of creating employment that helps re-balance the economy, but on the other it is not clear what social costs it represents. Is it an altruistic benefit associated with seeing dispersed levels of employment? Or does it actually represent some understanding of the costs and benefits of creating employment in places that need it? Or does it ultimately just reflect political interests?

3.3 Implications for appraisal practice

What does all this mean for appraisal practice? The first thing to say is that thin air routes are likely to be quite heterogeneous in terms of the function they play in the regional economy so that a single template is unlikely to be appropriate.

Our starting point would be the demand forecasts for the route, the financial performance and the assessed user benefits. This should include an assessment of where the traffic is coming from, to what extent it is diverted from other airports and modes and to what extent generated. The wider impacts can only occur if transport sector impacts occur, so the place to start is with the transport cost benefit analysis. If there is no generated traffic there will be no, or at best very limited, wider economic impacts.

If transport sector impacts occur then impacts on the wider economy may also occur. The principal channels from the transport sector to the wider economy have been discussed in the previous chapter. We would expect these to vary from case to case – particularly in scale, but also in how they manifest in the economy. Generalising we would expect growth in economic activity in the regions, which is most likely displaced from elsewhere in the country. This growth is most likely in the service sector, but air services also support tourism and regional manufacturing. This growth is likely to stimulate an increase in productivity in the region through an increase in competitive effects associated with more trade and attracting inward investment. If the regional activity is displaced then we are interested in both regional effects (as part of the re-balancing arguments) and net effects. However, none of these growth effects are additional unless market failures are present in the regional or national economies. To this extent context is everything. It is very likely that the types of market failure that are relevant will vary between different projects, as the regional economies will vary in the market failures they exhibit and the industrial sectors that are relevant.

To illustrate the importance of context it may be helpful to think of a typology of regional locations of the following kind: large regional centres with a population greater than 100,000, large towns, and small towns with populations less than 15,000. For each of these we consider some of the economic conditions including the typical key industrial sectors that may be relevant, which then points towards the pertinent market failures and WEIs.

Large regional centres far from the national capital (and London) with populations greater than 100,000. Such places could include Aberdeen, Dundee, Carlisle, Belfast, Middlesbrough, etc. Such places have reasonably large populations and universities and very likely some growth industries (e.g. computer gaming industry, bio-technology) – that is they have a reasonably large economic mass. The economies will have both services and manufacturing elements to them. However, they may also suffer from the malaises of post-industrial cities with pockets of severe deprivation including high levels of unemployment. Such places would be expected to be on the strategic road and rail networks so how much accessibility is added, and its value would be important to establish. Then the impact on business development and the regional labour market would probably be the most important channel to assess. Relevant market failures would include agglomeration effects:

urbanisation (if population is expected to increase) and localisation (if increased specialisation is expected), and WEIs associated with displacing employment (move to more productive jobs and excess labour supply effects). Inward investment and the associated productivity effects will be important locally, but may reflect displacement from elsewhere in the UK. In the Strategic Case re-balancing arguments will be important.

Large remote towns. Such places would include places like Derry, Newquay, Barrow-in-Furness, Inverness. Again these towns are likely to be on the strategic road and rail networks but several hours from London by land or via the nearest other airport Some of these towns may suffer high unemployment levels, but others may not. Like the large regional centres the local economy will have important manufacturing and service sector companies present. However, in contrast to the large regional centres, tourism is likely to be a much more important economic sector, and the local economy is likely to be dependent on a handful of large enterprises. Again inward investment (to the region) will be seen as a very important benefit of improved regional air connectivity. In terms of market failures: the smaller sizes of the towns and dependency on a few large enterprises would suggest that localisation impacts are likely to be of more relevance than urbanisation economies. Again inward investment would be of value for local productivity changes, though the relevance of the employment type impacts will be very context dependent. Are local labour markets thin? Have high unemployment rates been persistent over many years?, etc. In the Strategic Case re-balancing arguments will be important.

Small towns with say populations less than 15,000. These may include places like Aberystwyth, Penzance/Truro, Oban, Fort William, Wick/Thurso and the larger towns on the islands: Stornoway, Kirkwall and Lerwick. Smaller rural settlements may also feature here, for example: Bangor, Porthmadog in north west Wales and Broadford/Portree on the Isle of Skye. Here industries that are fixed in location are likely to be very important to the local economy: tourism of natural sites and primary sector industries. Air connectivity would support the tourist sector and may also be needed by primary sector businesses that are part of larger national or international organisations. Social arguments about sustaining the population, enabling working away and commuting back home and other lifeline forms of behaviour such as access to major hospitals will be very relevant. The market failures of principal relevance are likely to be those associated with employment: increasing employment in thin labour markets and reducing regional unemployment (noting that in remote communities out-migration often means that unemployment levels remain low). In the Strategic Case re-balancing arguments and social arguments regarding sustaining a distributed population will be important.

There are examples of multi-national companies and network industries that have located themselves in remote areas, and they are clearly dependent on reliable air services. Another issue is that some important sectors (like oil and gas, fisheries and industry clusters) are less footloose because they are dependent on natural resources, local skills and local industrial networks. If this kind of resource base becomes less productive without an airport in the vicinity, then there may be industry specific agglomeration effects (localisation) present, and not just relocation effects or regional re-balance effects that are often zero-sum games. A third issue is how economic players in remote areas interact with their markets in buyer-supplier relationships. *A priori,* one could expect

that the probability of finding markets and collaborators are significantly higher for businesses in central areas.

In all the situations displacement of economic activity between different parts of the UK is central to the economic arguments. This then brings to the fore what the relative value of economic activity is in different parts of the country. When we get agglomeration gains in the benefitting region, there may be corresponding dis-agglomeration effects elsewhere. This may be most relevant for urbanisation type effects. If the improvements in regional air connectivity are likely to lead to an increase in specialisation across the nation then the localisation agglomeration gains might be more easily viewed as net additional. The increases in productivity through increased inward investment in a region, may come at a cost of reduced productivity from displaced productivity gain elsewhere in the UK. However, if the marginal increase in productivity in a remote region is greater than the marginal loss of productivity in a region that already experiences large volumes of investment then there may be a net productivity gain from the increase in the regional inward investment.

The same is true for displacing employment – if the cost of losing jobs in one region is less than the benefit of creating jobs in the targeted region then there is a net additional benefit. Clearly therefore where the jobs are displaced from is very important. If all the regional air connectivity does is displace activity between the remoter regions of the UK then there is likely to be no net benefit – e.g. the Highlands and Islands' gain could be Northern Ireland's loss. The counterfactual situation without regional air services could be that labour and capital will seek towards central areas and henceforth more classical agglomeration effects may give rise to higher productivity. Counteracting forces may then be negative effects like capacity constraints in factor markets like the transport and real estate markets. How the productivity in the core and the periphery balances out in the end, becomes a complex matter to assess. There are likely to be location-specific variations, too.

The challenge of course in all of this is valuing these WEIs in an appraisal, as we will discuss in the next section the WEIs we argue to be of most relevance to regional air connectivity have not been well studied and limited evidence on them exists. Additionally, proportionality considerations would probably limit the assessment to a relatively simple one but the essential question remains the same – given intervention X, what can credibly be expected to happen relative to the Reference Case, how much of this is displacement and how much net generation, and is displacement advantageous in rebalancing terms.

3.4 Appraisal challenges

In the discussion above we have identified that relevant WEIs to regional air connectivity are those associated with: localisation agglomeration economies (industry clustering effects), inward investment (giving rise to knowledge spillovers), structural unemployment, and thin labour markets. Unfortunately none of these have been parameterised in WebTAG, and arguably the parameterisation of some of them is on the knowledge frontier. Obviously each of them also

requires an estimate of the expected economic impact from the improved regional air connectivity, which is likely to be non-trivial.

There exists a literature on localisation agglomeration economies which can be drawn from. See for example reviews by Rosenthal and Strange (2004) and Combes and Gobillon (2015). These localisation economies are typically smaller than the urbanisation ones (such as those in WebTAG) and attenuate more quickly with distance (Graham, 2007; Melo et al, 2009). The Department is currently investigating the possibility of jointly estimating new urbanisation and localisation agglomeration elasticities. To our knowledge localisation elasticities have never been applied in an appraisal before, and we are not therefore aware of how significant or not productivity gains from them will be (for any appraisal).

There is some evidence on how FDI, inward investment and gains from trade affect productivity and therefore output – see rows 4, 5 and 6 in Table 3-2. However, the precise relationship between air connectivity and increased FDI, inward investment and gains from trade is less certain. The Airports Commission commissioned PWC do undertake some empirical investigations in this area (see Airports Commission, 2015) finding output elasticities to changes in international passenger flows of around 0.3. These elasticities suggested large and relevant productivity gains associated with gains from trade. However, Laird and Stroombergen (2015) in their peer review of this work consider this to be out of step with the literature and an order of magnitude too large. This highlights the difficulties of empirical work in this field, but also the large range of estimates that is also found in the literature. Furthermore it is likely that only some of this evidence base properly unpicks the causal relationships from the correlations. Furthermore in the regional air context, with inward investment being displaced from one region to another, we are primarily interested in the relative differences in marginal productivity from inward investment in a region *vis a vis* inward investment in a more central part of the country. To our knowledge such empirical work has not been undertaken.

Turning to the employment related WEIs, there is a well established theoretical and empirical methodology for shadow pricing labour under conditions of structural unemployment. This approach values the additional surplus created by displacing employment from a region with no unemployment to one with very high levels of unemployment. Work undertaken by the authors (see Mott MacDonald, 2014) indicates that these benefits can be substantial if in the counterfactual high unemployment levels persist over the appraisal period. It is however hard to forecast the local unemployment rates, and the results are very sensitive to what is assumed regarding the level of unemployment in the counterfactual.

The evidence on thin labour markets is very limited. Laird and Mackie (2014) argue that all workers in very remote labour markets experience search costs, and therefore displacing employment to such labour markets can generate economic surpluses additional to user benefits. To calculate the welfare benefit of creating employment in very remote regions they utilise Manning's (2003) finding that for the UK economy as a whole that the marginal product of labour is 20% higher than the wage. For their (road) case studies they found that thin labour market WEIs could form up to 21% of the PVB, if all the employment is created in a remote region. Laird and Mackie identify the need for more research in the parameterisation of these effects.

TABLE 3-2: EVIDENCE ON PRODUCTIVITY EFFECTS OF AIR CONNECTIVITY

Effect	Low	High	Comments
Tourism			
Tourism Spending			*DfT Aviation Demand Model*
GDP			*Neglegible*
Migration			
City/ Region Size			*Neglegible*
City/ Region Attractiveness			
City Region Size	0.05	0.15	EL of regional service sector employment wrt air passenger traffic:
Agglomeration	0.04	0.12	EL of productivity wrt effective employment density:
Airport Density			*No quantitative evidence*
Agglomeration	0.04	0.12	EL of productivity wrt effective employment density:
Investor Access			
Inward Investment			*Several empirical studies, but evidence is not sufficiently relevant or robust*
Creative Destruction/ Spillovers	0.05	0.15	EL of productivity in manufacturing sector wrt stock of FDI:
Input Access			
Imports			*Evidence impacts on trade of shipping costs and times, but none directly relevant for aviation*
Gains from Trade	0.5	1.2	EL of GDP wrt trade (imports + exports)
Market Access			
Exports			*Evidence impacts on trade of shipping costs and times, but none directly relevant for aviation*
Gains from Trade	0.5	1.2	EL of GDP wrt trade (imports + exports)
Information/ knowledge			*Evidence shows exporters are more productive, but effect not separable from Gains from Trade*
Outward Investment			*A lot of evidence on the drivers on FDI, but none considering aviation in a robust way*
Information/ knowledge			*Some evidence showing outward FDI raises productivity, but not dealing with self-selection bias*

Source: SDG (2013 p70)

As far as we are aware there has been no attempt to apply these market failures to any regional air connectivity appraisal. It is therefore open to conjecture as to the likely scale of the WEIs in relation to user benefits. Our expectation based on the broad literature on WEIs is that the WEIs discussed above will be substantially less than the user benefits. In the literature individual WEIs are known to contribute between 5% and 30% of user benefits context dependent[15], with inter-city projects at the lower end of the range. To our knowledge the maximum evidenced additionality is about 60%, when summed across all WEIs. Including WEIs in an appraisal might therefore shift the Value for Money category up a level, if a project currently falls just below a category boundary, but is unlikely to shift it between two Value for Money categories. We do not see that the WEIs associated with regional air connectivity will be any different. In fact if WEIs for regional air services are predicted to be at the upper end of this evidence base, we would question their veracity. This is because if market failures in the region are large it is likely that they will block some of the transmission mechanisms between transport and the economy (see the discussion in Section 2.1).

A final appraisal issue is the timescale over which WEIs are expected to occur and how that compares to the appraisal period – the maximum duration of a PSO is five years, with three year

[15] See for example Figure 1.5 Average economic returns from government expenditure with GDP impacts added in: wider BCRs in Eddington (2006 Volume 3 p129).

PSOs being common in the UK to date. As discussed in Section 2.1 'economy impacts', and therefore WEIs, over this time period will be limited, with the majority of the impacts only appearing towards the end of the period. If appraisal periods are taken to finish at the point the government support mechanisms terminate then the role of economy impacts and WEIs in the appraisal of government support is limited. This appears to be at odds with government policy which requires that there needs to be an economic benefit for the region from improving the connectivity (DfT, 2015) and appears to indicate a disconnect. However, we do not see that such a disconnect should occur as the appraisal period should be set to ensure that differences between the Do Minimum and Do Something counterfactuals are fully represented.[16] If differences between the counterfactuals continue past the end of the intervention period the appraisal period should be extended, and not artificially truncated to the end of the government support period. We see this playing out in three ways. We discuss this in the context of PSO route support, though it can be extended to any government intervention:

1. For routes that are commercially viable immediately following the end of the government support (e.g. start up aid) then it would be expected that the economy impacts, whilst lagging the transport impacts, will still appear in the economy of the Do Something counterfactual earlier than they would have done in the Do Minimum counterfactual. The appraisal period should therefore be set to ensure that all differences between the Do Something and Do Minimum counterfactuals are fully captured – this is likely to be longer than the period of government support.
2. For routes that are not likely to become commercially viable until the long term – e.g. fifteen or twenty years – but for which a positive transport business case is expected for each re-tendering (e.g. every three or five years). Here we would also suggest undertaking a standard appraisal of the concession for the current tender period with the government support ceasing at the end of the concession – as per the situation if the route became commercially viable at the end of the concession period. Additionally we would suggest examining the economic case should the concession be re-tendered multiple times. This latter test is because the lagged nature of the economy impacts will mean that they will not fully appear until the later tender periods, and secondly because once government has committed to a revenue support subsidy it can be hard to withdraw it. Looking at the transport business case over the potentially full lifetime of revenue support may therefore aid decision making.
3. For routes where government support is needed to maintain a service that a commercial operator is wishing to withdraw. Here the Do Something counterfactual would have a level of economic activity comparable to the current state, whilst in the Do Minimum counterfactual there would be a loss of economic activity. Here we might expect the lag in the Do Minimum to be shorter than for an economic growth scenario, as business losses are

[16] For infrastructure appraisal the appraisal period should reflect the expected life of the asset. At the end of the assets useful life the Do Minimum and Do Something counterfactuals should converge.

hard to maintain. Other than that the appraisal would be similar to situations (1) and (2) described above.

The lack of evidence on the economic impacts and the market failures in regional economies that may benefit from regional air services also lead us to the view that there is a need for more evaluation evidence to help substantiate the business case. This can be both econometric, as presented and discussed in Chapter 2, but may also be of a more qualitative nature – as per the study of air transport on businesses located in Molde, Norway presented in Box 3-1.

Furthermore, it is worth emphasising the importance of measuring the direct transport benefits correctly. This is always the case for transport appraisals, but given the likely short term nature of the government support measures being considered, the lagged nature of the economy impacts and the uncertainty in the measurement of the WEIs, it is very likely that the transport business case will depend first and foremost on the direct benefits and costs – including any shadow pricing of slots reserved for regional air services at capacity constrained airports. Appendix B presents a summary of the key issues that need to be considered in the measurement of consumers surplus when assessing the direct benefits from air transport services. To this would need to be added changes in the producer surplus of transport operators (e.g. those in the air sector), and any shadow pricing costs of reserved slots at capacity constrained airports.

BOX 3-1: AN EXPLORATIVE SURVEY ON CATALYTIC IMPACTS

Catalytic impacts comprise effects from air transport that are not included in the direct, indirect and induced effects. What may be of particular concern is how air transport affects industrial and residential location, and also how the level of economic activity is affected. The underlying question is to what extent a given airport is a premise for economic activity in its catchment area. In that sense the catalytic impacts may be important for the traffic level in general.

In a study from 2005 (reported in Bråthen et al, 2006), a structured questionnaire was sent to all members of the trade associations in the catchment area around Molde airport, Norway. The response rate was fairly low (15 %, 78 respondents), but it was decided to investigate how these respondents adapted to the air transport system. Only indicative generalisations to the whole population could be made. The main purpose was to look into the share of the firms' activity level that was dependent upon the present air transport system.

As compared to the actual industrial structure in the area, the general service industry and financial services are clearly overrepresented in the data set while the construction industry is somewhat underrepresented. Retail, the energy industry and other industries are at the representative level while the public sector and fisheries/agriculture are clearly underrepresented.

The responding firms had an average employment of 82 man-years and average sales of 123 MNOK (1.5 MNOK per man-year, 1 € = NOK 8.3 at the time). The firms were asked how much of their sales, apart from delivery to the air transport sector, were dependent on the transport services at Molde airport. This share is what is denoted as catalytic sales. 14 firms did not have any such sales, and 16 firms did not answer the question. Among the remaining 48 firms, the catalytic sales constituted 24 % of total sales. The average share for all respondents was 14 %, which corresponds to 0.36 MNOK of catalytic sales per man-year. The largest catalytic sales for one firm were 2.6 MNOK per man-year, which was a firm in the tourist charter industry. In total, the catalytic sales among the respondents amounted to BNOK 1.2. It is worth noting that three larger firms were responsible for ¾ of this amount.

The electro-mechanical industry appeared to have a higher share of catalytic sales than other sectors (see Table 1). This was due to the fact that two firms with around 175 man-years each and sales of between MNOK 300 and 400 reported a share of 100 % of catalytic sales. These firms operated in markets where it was well known that their products and services were subjected to just-in-time demand.

Table 1 Man-years, sales (MNOK) and catalytic sales

	Services			Mech. industry and energy			Other sectors		
	Min	Max	Average	Min	Max	Average	Min	Max	Average
Man-years	1	1000	60	2	192	78	3	1700	99
Sales	2,5	2000	115	4	400	142	1,97	1200	114
Sales per man-year	0,5	7	1,92	0,5	8,1	1,8	0,59	5	1,15
Catalytic sales (CS)	0	24,6	3,59	0	400	52,9	0	224	10,31
CS per man-year	0	2,1	0,34	0	2,31	0,48	0	2,63	0,26
% CS			16 %			37 %			12 %

Molde and the surrounding area have around 33 000 employees which corresponds to around 29 000 man-years. A large share of the employment is related to production of goods and services for the region itself. Our data set of 78 firms had 6400 man-years, which was 22 % of the total employment in the catchment area. The sales for the firms in the data set amounted to BNOK 9.6. The firms who did answer the question of catalytic sales employed around 3500 man-years. Of these, 850 man-years were reported as catalytic employment.

As stated earlier, the data set do not allow for any statistical generalisation. But considered only from the respondents alone, 850 catalytic man-years is extremely high as compared to the direct employment of 107 man-years and the average multiplier of 1.8 for catalytic employment in Europe. As stated, the data set counts for 22 % of the employment in the area, and one might think that the total catalytic sales may well be two or three times higher in total, amounting to around 3.5 BNOK and around 9 % of the region's employment.

Of course, these numbers are encumbered with substantial uncertainty. In addition to the generalisation problem, we may also face a reliability problem because the detail of what adaptation to the counterfactual situation without Molde airport was not examined. There are however reasons to believe that the airport affects the economic activity level in general, and also the industrial structure. This is due to the fact that multi-national companies and network industries have located themselves in the area, and they are clearly dependent on reliable air services. Another issue is related to the fact that some important parts of the electro-mechanical industry within shipbuilding and off shore constructions are less footloose because they are dependent on local skills and local industrial networks, at least in the short to medium run. If this kind of resource base becomes less productive without an airport in the vicinity, then there are productive catalytic effects present, and not only relocation effects that are often zero-sum games. A third issue is related to how economic players in remoter areas interact with their markets in buyer-supplier relationships. A priori, the probability of finding markets and collaborators are significantly higher for businesses in central areas. Hence, the air transport system may play an important role in exploiting the scale effects in both human capital and natural resources in remoter areas. However, there will certainly be large variations among regions depending on their existing resource base. This pilot study gives only a hint on that catalytic effects may be quite significant in certain areas, and that this issue should be pursued in future research.

For businesses, contact with customers is ranked first according to the proportion of respondents that consider the factor to be very important (44%). Proximity of an airport and general quality of life are ranked joint second (36%). This means that over a third of the respondents consider proximity of an airport to be a very important key location factor for their business. Access to a local market is ranked fourth (34%). Access to a qualified workforce is ranked fifth (25%).

Proximity to an airport is more important to businesses in the service sectors, such as hospitality and services, finance and insurance, energy, real estate and business, and transport and warehousing. Proximity to an airport is also found to be more important for businesses with offices, departments or sister companies in other regions or abroad compared to businesses that have offices, departments or sister companies in the same region.

Source: Bråthen S, S Johansen and J I Lian (2006).

4 VARIATIONS BY GOVERNMENT SUPPORT

4.1 Types of government support

As discussed in the introduction the types of government support can be classified by whether they are route based, passenger based or airport based. PSOs and start up aid are types of route based support. Ticketing support mechanisms, either some form of rationing/allocation or price discounts, all based on residency would form part of the passenger based mechanisms, whilst airport based reductions in air passenger duty (APD), landing charges or the ring fencing of slots would be airport based. Appendix A gives a more detailed description of the potential policy measures.

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4.2 WEIs by government support

What drives the real economy response is the change in accessibility resulting from the level of transport services plus possible adjuncts like option value – the latter feeding into location choice decisions. The user benefits, and the possible wider economic impacts, may vary by the type of government support. The question is whether different policy instruments have differential impacts on agent behaviour, and there may well be. We can for example see distinctions between price based mechanisms (e.g. air discount schemes and APD), those associated with addressing information asymmetries (e.g. start-up aid) and those associated with providing a certain level of service in terms of connectivity (e.g. PSOs). We can also envisage that the different instruments available will have different levels of 'effectiveness' in delivering £1 of government money to business and leisure air travellers – and hence to the regional economy. The pass through mechanism will depend on market structure (including that of the air sector), and how targeted the instrument is. These considerations would of course be a focus of the standard appraisal. In the discussion below we therefore only consider how the WEIs identified in the previous section may vary in relevance by type of support instrument.

Whether these support measures give different WEIs and of different sizes is determined firstly by whether they generate different levels of economic impact, and secondly whether they typically occur in different contexts (implying that the market failures will be different between the different instruments). On the first of these matters we defined three diagnostic tests arising from our review of the economic impacts of regional air connectivity as to whether economic impacts would be relevant. These are:

1. Is the traffic likely to be diverted from land modes, other air routes or generated? If generated, is it displaced from elsewhere in the UK?
2. Is the air service under consideration likely to generate business travel from the region?
3. Is it likely to generate net positive tourism to the region?

If the answer is yes to some or all of these questions then we would expect there to be some changes in the economic performance of the regional economy. We therefore consider the government support options within this context.

In general, there are reasons to believe that regional business activities prefer predictable conditions, including the quality of transport infrastructure and transport services. Predictability is important because expectations can affect location and expansion plans. Hence, uncertainty about the long-run transport policy affecting transport level of service can make locating in remoter areas less attractive. Locating to more central areas following from such uncertainty may trigger negative self-reinforcing effects because of increasing returns to scale in the cost functions, hence reinforcing the potential competitive disadvantages of such location decisions. As stated above, pure economic productivity may or may not be weakened because of such behaviour, but the fulfilment of regional rebalancing objectives may be adversely affected. We would therefore expect that government support mechanisms that offer stability to be more useful to businesses, thereby stimulating more business travel. Investment in infrastructure is clearly one of the most stable forms of government support. In contrast government revenue support, along the lines of those considered here, have the potential to be withdrawn at any time (e.g. reductions in Airport Passenger Duty (APD)), or may be withdrawn once the existing contract period has finished (e.g. a PSO route). It will therefore be important that government gives a signal of stability, for example that if there continues to be good value for money revenue support will likely continue with contracts being renewed etc. This will then help promote a stable environment that will facilitate business investment. Of course these considerations need to be weighed against considerations of value for public money in the event that route performance does not come up to expectation. It follows that is important to ensure that the government support gives the right incentives to provide the services in an efficient way where competition, on for example PSO contracts, is working, and that other forms of support are neutral with respect to specific operators.

We are not in the position to judge which of the government support measures mentioned above is most efficient in terms of ensuring the best accessibility. This would be one of the functions of the core appraisal, as already mentioned, and is likely to be context-dependent. Part of the core appraisal needs to consider the shadow costs of reserving slots at capacity constrained airports. Whilst all of the government support options may lead to some shadow costs being applied, those that allow the market to determine which slots are used by which operators to serve which routes are likely to impose the lowest shadow costs. Therefore it may be expected that slot reservations, or route PSOs may have higher shadow costs than those aimed at reducing airport charges, APD or air fares. Given that the issue of shadow costs of capacity is primarily a Heathrow issue, it may be necessary to distinguish carefully between the benefits to the region of access to London and via London to the rest of the world. These considerations may for example lead to assessing the feasibility of routing PSO services into secondary hubs, and then on by existing commercial services to Heathrow.

In our view passenger based options (e.g. Airfare Discount Schemes) aimed at residents in remote areas are unlikely to generate tourist travel or much business traffic. Primarily these schemes would be seen through the lens of a social or distributional initiative. Having said that they may help retain population in remoter areas, which against the counterfactual would suggest higher levels of

employment than in the Do Minimum counterfactual. Possibly the only WEI of relevance here would be that associated with thin labour markets.

Reduced transport costs to all travellers can be brought about through airport based support (e.g. reduced APD). APD may differ between airfare classes and all passengers pay, therefore all passengers benefit. This will be of importance for inbound travellers, like visiting key personnel for the local industry and tourists. If tourism is expected to be an important sector through which employment growth will occur then the employment WEIs will be relevant in this context, but which ones will be context dependent (structural unemployment, or thin labour markets).

Regional airport route start-up support[17] is primarily aimed at bringing forward the operation of a route that would be commercial within three years. Partly this support mechanism is aimed at addressing the risk of starting a new operation in the presence of information asymmetries and possibly asset specificity (e.g. where a particular aircraft or technology is needed to serve a regional airport). A number of regional air services have been supported in this way[18]. The channels by which they will influence the economy and the WEIs they will generate will be similar to that of PSOs.

Ring-fencing slots for regional air services without specifying which air service is another government support regulatory option. For this option the airport or airlines would decide which routes to serve and at what frequency. There is a risk that for thin air routes this may lead to a degree of insecurity in the route viability as perceived by regional businesses, as airlines may continually experiment with route options and ring-fencing may not go on forever. This insecurity may reduce the economy impacts and therefore the WEIs. From a pure economic efficiency perspective there is also a risk that this option may lead to inefficient outcomes, as the shadow costs of slots at capacity constrained airports will not be factored into the decision making of the airports and airlines.

PSOs have the potential advantage over the above mentioned support measures in that they can be tailored to combine an economic assessment of accessibility, that includes the shadow pricing of slots at capacity constrained airports, with regional policy objectives, e.g. by demanding a minimum of two return flights per day to ensure the possibility for a day trip to important destinations or nodes. Arguably, one can claim that PSOs gives the largest repertoire in regulating the level of service in a way that augments predictability for the users in systems with thin routes. The PSO would therefore be expected to create the largest economic impacts as, if serving a remote destination, the air service would be able to give a positive answer to each of our economic performance diagnostic tests. Each of the WEIs in section 3.3 may therefore be relevant – context

[17] For start-up aid offered between 2015 and 2018 this was limited to a maximum of 50% of the airport charges faced by the airline (DfT, 2015).

[18] DfT (2015) *New regional air routes offer fast journeys across UK and Europe*. Press release. 2 december 2015. https://www.gov.uk/government/news/new-regional-air-routes-offer-fast-journeys-across-uk-and-europe

dependent (e.g. remote city, town, or small town and the types of industries present in these locations). We would expect that PSOs to overseas destinations to influence the economy through the same channels as domestic PSOs would – though as with other instances of cross-border trade non-geographic 'trade-costs' (e.g. language and cultural differences) may dampen their impact vis a vis domestic routes. The WEIs between domestic and overseas PSOs would therefore be similar. The difference between the two though is likely the inter-linkage between the regional economy and the destination economy (e.g. London versus Amsterdam/Netherlands). In the main we would expect stronger inter-linkages within the domestic market. However, where international tourism or international business links are very important to a regional economy an overseas PSO may bring about substantial regional economic benefits, although one should be aware of the "two-way road" problem described previously.

We would also note that PSO services can be specified in many different ways. In the main the requirement to have two return flights a day to permit day return trips with a full day at the destination is seen as the basic PSO standard. Where air services are viewed in the pure context of lifeline services where social arguments dominate a lower specification of one flight a day may be specified. A real example could be the Benbecula to Glasgow air service, where the timetabling only permits 4 hours in Glasgow Airport or about 1 hour in Glasgow city centre.[19] PSO services that do not permit day return trips with a reasonable amount of time at the destination would be expected to deliver very different levels of economic impact from those that do.

It may also be relevant to consider PSOs against corresponding surface transport alternatives, most often private cars, buses or rail transport. An observation from some Norwegian regions is that the parallel transport opportunities from other modes should be seen more thoroughly in connection with an air transport PSO. One reason for this has to do with a centralized responsibility for purchasing of PSO services, whereas the surface transport like buses and passenger ferries are in the hands of the regional government. This may entail principal-agent issues that may be better handled if the responsibility for air PSOs are at the same level as other relevant transport modes. Another argument could be asymmetric information between the regional and central level with respect to the real needs for the demanded route and/or level of service in question put forward by the local or regional community. In Norway, transfer of responsibility to the regions was first suggested by Hervik et al (1999), and transfer of responsibility for air PSO services to the Norwegian regions is planned from 2024 on.

As concluding remarks on PSOs, it should be underlined that the main reason for PSO services are twofold; they should contribute to regional balance and welfare, and they should make more efficient use of the society's disposable resources under such relevant policy constraints. Hence, a strict economic justification for PSO (or any other regional support for that sake) has in most cases to rely on local rather that global optimisation of productivity, measured through direct user benefits and possible WEI. Connectivity between central and peripheral areas can result in

[19] The Barra to Glasgow air service also does not permit day return trips, but in part this is due to the tidal nature of the air strip.

productivity gains from linkages between economic agents, in particular given the regional rebalancing objectives. These linkages can for example be in the form of changes in commuting patterns including access to qualified key personnel, larger diversity in the labour market and better use of less footloose resources.

5 CONCLUSIONS

Wider economic impacts (WEIs) of regional air connectivity only happen if there are direct transport impacts. Therefore a good estimate of travel demand and the direct user benefits from improved accessibility to/from a region is the basis from which analysis of WEIs should proceed. Evidence suggests that good quality air services can stimulate the local economy, though in the context of regional air services the majority of this may be displacement. The likely most important WEIs in this context will be localisation, clustering, inward investment and labour market impacts from strengthening the regional economy. The market failures that create these WEIs will vary from place to place – so context is important and not all these WEIs will be relevant to every situation. So a good analysis of the sources of market failure in the affected regions is likely to be needed. In some cases, air services may be just one part of a broader case for intervention.

The main channels that connect air connectivity and the regional economies are likely to be business travel from the region and tourism effects (inbound net of outbound). The balance between diversion from land modes and generation (and where from) is relevant. In very remote places, however, provision of education and health services using air travel becomes important and the case for support becomes social more than economic. However, our focus here is on services where the Economic Case is predominant.

Displacement within the UK is very likely to be a consequence of improved regional air connectivity. Therefore we are interested in where the activity is displaced from as well as the local economic impacts. Given displacement from an appraisal perspective we are interested in differences in the WEIs in the region versus the area it is displaced from (that is the net effect). This is the same concept as applied in the Move to More (or Less) Productive Jobs in WebTAG.

The manner that regional air services tend to favour growth in regional employment, particularly in the service sector – which is the sector that the economy continues to increase its specialism in – would suggest that regional air services may have a role to play in policies associated with re-balancing the economy. The evidence on which this assessment is based is limited, and more evaluation evidence on the contribution of regional air services to regional economies is needed. The rebalancing arguments are consistent in several dimensions to the WEI framework discussed in this paper. However, given the current state of knowledge we see little immediate prospect of quantifying them in the Economic Case and consider they should remain part of the Strategic Case.

Overall, the cases for support are likely to be quite heterogeneous. We have set out a framework of market failures and associated WEIs which might facilitate some structuring of the cases. To illustrate this we also propose a stylised typology of places, based on expectations of which

industries will be present and what sort of market failures will be present, with some expectations of what sort of impacts are likely to be credible.

In our view the WEIs that are likely to be relevant to the appraisal of government support for regional air connectivity, in the main, sit outside of WebTAG. There is little evidence on their parameters and their importance within an appraisal. We would, however, consider it likely that as with other more well studied WEIs, they will be much smaller than user benefits. Therefore their inclusion in the appraisal would at best move the proposal up one Value for Money category. There would need to be something seriously wrong in the regional economy for the inclusion of WEIs to shift a proposal up two or more Value for Money categories, and if such large market failures are present in the regional economy one would then question the ability of a transport project to have much impact on the economy – as the pass through mechanisms are likely to be blocked. As with the transport appraisal in general, our view is that WEIs are likely to be of second order importance to the direct benefits and costs of the regional air services. This then emphasises the importance of ensuring the direct transport costs and benefits are well represented in the appraisal – including any shadow pricing of slots if relevant.

We have reviewed the different types of government support instruments. Generally we think the PSO approach is best suited to delivering air services preferred by businesses. Under the PSO approach, service levels can be specified and a degree of certainty given to the customers for the duration of the franchise. We would see that the variation in relevance of WEIs to be more dependent on the context of the region being served than on the type of government support instrument used. However, certain instruments (e.g. discounts for residents in a region) lend themselves to certain contexts (e.g. very remote and small towns) in which particular market failures (and therefore WEIs) will be present. Thus it is likely that the types of WEIs relevant in the appraisal of different government support instruments will vary systematically with the support instrument, but this is down to context not the instrument per se.

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APPENDIX A: POLICY TOOLS FOR REGIONAL CONNECTIVITY

[This note was developed by DfT as one of the background notes for this commission]

Route-based policies

1. **Public service obligations (PSOs)**. These typically involve part-subsidising an airline to operate a route to a peripheral or development region, on the basis that the current level of connectivity is not sufficient to support economic or social development. In the UK this also involves the removal of air passenger duty (APD) from the route to ensure commercial viability. PSOs can in theory not involve a direct subsidy, and just be subject to the removal of APD (unfunded PSOs). PSOs are 'closed' if the operation of a given route is restricted to one airline, and 'open' if not. PSOs can also involve the ring-fencing of an airport slot if necessary to maintain the level of service at appropriate times of the day.
2. **Start-up aid.** Similar to PSOs, though to be provided on a short-term basis on the understanding that the route is currently commercially viable, though not provided. Corrects an informational market failure, as airlines are not aware of the commercial viability of the route. Usually provided for 3 years, part subsidising the aero charged levied on the airline in question.
3. **Traffic distribution rules (TDRs)**. Directing certain traffic away from a given airport within an airport system. E.g. in 1991 the UK had these in place to prevent whole plane cargo services or general or business aviation operating at Heathrow or Gatwick within periods of peak congestion.

Passenger-based policies

4. **Tickets allocated to certain residents.** For example, those living in deprived areas / an income lying below a certain threshold have discounted air fares, regardless of the route in question.
5. **Ticket discounts for local residents**. Making air services more affordable to residents of deprived / remote communities by subsidising their travel on *certain* routes. Currently applied in the UK as part of the air discount scheme for the highlands and islands.

Airport-based policies

6. **Discounted airport charges for regional connections**. Reductions in / removal of landing and take-off (and other misc.) charges at certain airports. Can be targeted at certain routes or a blanket policy.
7. **Ring-fencing slots for regional connections**. Would involve segmenting the market for slots between those that are open to all connections and those ring-fenced for domestic use.
8. **Financial support for regional airports**. Provision of direct capital to certain / multiple regional airports to ensure they remain operational / can sustain certain strategically important routes.

APPENDIX B: CONSUMER SURPLUS FOR REGIONAL AIR TRANSPORT SERVICES

[This Appendix is sourced from: Bråthen S and K S Eriksen (2007). Economic Impact Assessment for Analysing the Viability of Regional Airports in Norway. In: Van Geenhuizen M, A Reggiani and P Rietveld (Eds): Policy Analysis of Transport Networks. Ashgate, Aldershot, UK.]

The direct user benefits should be assessed thoroughly when evaluating a PSO route. When the effects of a PSO route on existing smaller airports should be offered or not, one might end up analysing the effects of an airport closure in addition to the operating costs of the route itself compared with the user benefits of keeping up the route (Bråthen and Eriksen 2007). We will show a simplified analytic concept that can be adapted to new routes/new airports as well, where improved connectivity reduces travel costs and increases the passenger volumes.

In case of an airport closure, a large share of the passengers will presumably use an adjacent airport or surface transport as an alternative. Some will abstain from travelling because of the increase in total travel costs. This is the opposite effect of generated traffic from e.g. improved connectivity. The economic loss/gain from changes in air transport connectivity is calculated as shown in a conventional demand scheme (Figure 1), assuming no capacity constraints.

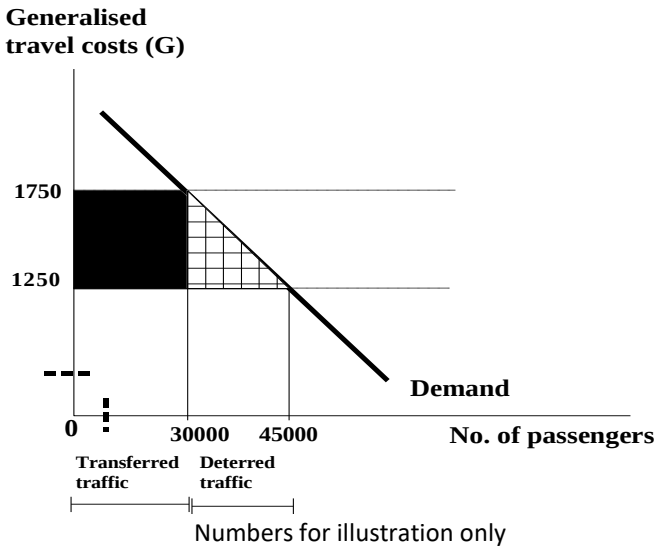

FIGURE 1 : ECONOMIC LOSS FOR AIR PASSENGERS FROM AIRPORT CLOSURE

Figure 1 shows how the change in consumer surplus (CS) can be calculated. The difference in generalised travel costs (1750 minus 1250) together with the deterred/induced traffic (45000 minus 30000 in the Figure) is used in order to calculate the values of the black and crosshatched areas. In cases of PSO closures, the black area is the change in consumer surplus for those who will still travel with alternatives after a PSO closure, while the crosshatched area is the loss for those who are

deterred because of the higher travel costs (in the Figure, 'transferred' becomes 'existing' and 'deterred' becomes 'induced' in cases with connectivity improvements). The value of the change in CS discounted over an adequate number of years (e.g. 25) is:

$$N_T = \sum_{i=1}^{25} \frac{X_{1i} + X_{0i}}{2} (G_1 - G_0)(1+r)^{-i}$$

where

N_T = Net present value of the CS loss/gain, e.g. 30 years.
X_{1i} = Transferred/existing traffic, year i.
X_{0i} = Transferred/existing + deterred/induced traffic, year i.
G_1 = Generalised travel costs, alternative transport.
G_0 = Generalised travel costs by using the PSO route
r = Social discount rate.

N_T is calculated for business travels and leisure travels separately, and the results are summarised. Segments like domestic and international travels can be assessed. In order to assess the amount of transferred and deterred traffic, a transport more or less advanced transport network model has to be applied. The value of travel time (VOT) are usually based on handbook values, where the VOT for business travels are normally higher than the VOT for leisure travels.