

# Project Appraisal Guidelines

## Unit 6.8 Wider Impacts

August 2011

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# 1 Context

## *Background*

- 1.1. 'Wider impacts' is the term given to the welfare impacts of changes in the wider economy additional to transport user benefits. These wider economy changes include changes in productivity, output and employment. Wider impacts only occur if a market failure prevents prices from equalling marginal social costs in a sector of the economy impacted upon by the transport intervention. If perfect competition existed throughout the economy (i.e. prices equalled marginal social costs) the full welfare impact of the transport intervention on the economy would be captured through the assessment of user benefits in isolation.
- 1.2. A number of market failures relevant to a transport appraisal can be identified in addition to the environmental externalities (emissions are automatically calculated within COBA and TUBA). Those covered in this PAG Unit relate to the interface between transport sector initiatives and economic performance. They are:
  - Imperfect competition;
  - Agglomeration economies;
  - Economies of scale;
  - Knowledge spillover effects;
  - Income tax;
  - Immobile labour and/or sticky wages; and
  - Labour market search costs.
- 1.3. The assessment of wider impacts in transport appraisal is 'youthful' relative to the inclusion of the components of transport sector user benefit (e.g. travel time savings). This means that the data and methodologies for incorporating the wider impacts are in an early stage of development. Furthermore, for some of the impacts – particularly those that affect productivity, employment and earnings – a significant amount of data is required in a disaggregate form, and land use modelling may also eventually be required. The calculation of some wider impacts is therefore non-trivial.
- 1.4. This guidance has therefore been written with this in mind. It blends the theoretically desirable with what is practically achievable and realistically relevant to an appraisal. It is recommended that two types of wider impact are always calculated. These concern increased output of firms and employment during construction. For large schemes, expected to affect the largest agglomerations in Ireland, agglomeration impacts may also be calculated. It is however noted that this will require a significant amount of bespoke data analysis. More sophisticated approaches than are detailed here are possible to assess these impacts. Furthermore the inclusion of other impacts is acceptable (e.g. tax benefits from increased labour supply, inward investment impacts, increased competition in the economy impacts). Agreement with the NRA Strategic Planning Unit should be sought before utilising more sophisticated approaches or including other wider impacts.

## 2 Employment Impacts During Construction

- 2.1. Labour market failures such as immobile labour and 'sticky' wages can prevent the labour market adjusting to ensure that all those who wish to work at the market wage can find employment. As a consequence of these market failures, structural unemployment can exist. In areas of structural unemployment, job creation through construction has a positive welfare impact. This welfare benefit is additional to transport user benefits – provided unemployed workers are taken out of unemployment.
- 2.2. Shadow Pricing is the commonly used tool for dictating the welfare benefit of generating employment through construction. For example, a Shadow Price Factor of 0.8 applied to labour costs of construction signifies means the wage that would clear the labour market is 80% of the observed market wage, and hence creating employment through construction would have a welfare benefit of 20% of the wage costs.
- 2.3. Because the last few years have seen virtually full employment, individual construction projects have not necessarily led to job creation, and hence the assumption of a welfare benefit from construction projects has not been valid. This led to the adoption of a shadow price factor of 1.0. Current guidance retains this assumption that a shadow price factor for labour costs shall not be applied.

## 3 Increased Output of Firms in Imperfectly Competitive Markets

- 3.1. A reduction in transport costs (to business and/or freight) allows for an increase in production or output in the goods or service markets that use transport. Better transport provision may result in less congestion and reduce travel times. As a result, business travellers will therefore be able to spend more time working and less time travelling, whilst delivery vehicles will be able to carry out more deliveries in a day. A firm's output would therefore be expected to expand. If markets are perfectly competitive the welfare benefit of this increase in output will be completely captured by the change in consumer surplus (the user benefits).
- 3.2. If, however, markets are not 'perfectly competitive' and this can lead to lower production and higher prices than would exist in the case of a competitive market, normally to the detriment of consumers and the economy as a whole. A transport intervention that leads to an expansion of output in such a situation will deliver a welfare gain, additional to user benefits, as consumers of the goods and services will value any increases in production by more than the cost of the additional units of production.
- 3.3. Theoretically we might expect markets to be slightly imperfect even in developed economies due to product differentiation and transport costs. Through product differentiation a firm attempts to achieve the position of a monopolist so as to maximise its profits. High transport costs can also lead to areas becoming geographically isolated permitting businesses to increase prices above marginal cost.

- 3.4. Whether the goods and services market is perfectly or imperfectly competitive is a difficult question to answer. There is a lack of evidence in Ireland and internationally on price - marginal cost margins. The work undertaken in the UK for The UK Standing Advisory Committee on Truck Road Appraisal (SACTRA) in 1999<sup>15</sup> does not appear to have been taken forward either in the UK, Ireland or internationally. The SACTRA work and that summarised in the UK Department for Transport 2005 guidance<sup>2</sup> therefore constitutes the best available evidence.
- 3.5. The 1999 Study undertaken for SACTRA demonstrated that the wider impact for increased outputs in imperfectly competitive markets could be calculated as a function of business and freight user benefits. These user benefits can be uplifted by a factor that is itself a product of the elasticity of demand and the ratio of the price-marginal cost margin to price. For the UK it is argued that the price – marginal cost margins are approximately 20% of ‘shop’ prices and the average elasticity of demand for goods and services is 0.5. An uplift factor of 10% to business and freight user benefits is therefore applied in the UK to capture the wider impact of increased output of firms.
- 3.6. Recent work for the Scottish Government identified that price – cost margins in very remote areas may be much higher than elsewhere in the UK<sup>11</sup>. Very remote areas are defined as locations that are more than 1 hours travel from a settlement of 10,000 people or more. This conclusion was based on an analysis of the supply of petrol for which a government investigation had recently been completed. As a consequence the Scottish Government use an uplift on business and freight user benefits of 20% for trips with an origin or destination in a very remote area. The limited evidence for this uplift means that the additional wider impact due to remoteness is treated as a sensitivity to the core analysis<sup>13</sup>.

#### *Appraisal Method*

- 3.7. In the absence of specific data for Ireland it is recommended that the UK data and method is utilised. That is:

$$\text{Wider impact of increased output by firms} = 0.1 \times \text{Business and freight user benefits}$$

- 3.8. Business and freight user benefits are defined as the change in consumer surplus for the business and freight modes over all types of use benefit (time savings, vehicle operating cost savings, toll/fare changes, reliability benefits, etc.) Further information on the calculation of Business and Freight User Benefits is provided in *PAG Unit 6.1: Guidance on Conducting CBA*. It should be noted that the 0.1 multiplier should be used for all areas of Ireland.

## **4 Agglomeration impacts**

- 4.1. Agglomeration effects arise because firms derive productivity benefits from being close to one another and from being located in large labour markets. If transport investment brings firms closer together and closer to their workforce this may give rise to an increase in labour productivity above and beyond that which would be expected from the transport efficiency saving alone. Greater productivity in

agglomerations arises from the fact that firms have access to larger product, input and labour markets. Knowledge and technology spillovers are important aspects that make agglomerations make more productive.

4.2. In an international context there is a large body of evidence on how productivity can vary with city size, though unfortunately no data specific to Ireland has been identified. From a transport appraisal perspective the evidence from the UK is probably of most relevance to the Ireland context. This is not only because the economies of the UK and Ireland are most similar (in an international context) but because the UK evidence has been developed very much with the transport appraisal context in mind. For the UK the most recent work in this area has been led by Dan Graham at Imperial College London. The main empirical points that can be drawn from this work are:

- An accessibility indicator based on employment in adjacent zones by industrial sector is a suitable measure of agglomeration. This measure is weighted such that employment in zones closest to the zone of interest have a stronger impact on the agglomeration indicator than employment levels in zones further away. In the UK guidance<sup>3,4</sup> this agglomeration indicator is referred to as 'effective density', though it is also referred to in other documents as economic density and economic mass.
- Productivity elasticities due to urbanisation are larger than those due to localisation economies<sup>8</sup>. Urbanisation relates proximity to economic mass/density in general, whilst localisation relate to proximity to the economic mass/density of a particular sector (e.g. textiles). The UK's current appraisal guidance is centred on urbanisation elasticities. From a policy perspective the fact that the urbanisation elasticities are larger than the localisation elasticities indicates that it is proximity to economic mass in general that is the key driver to labour productivity in an agglomeration context.
- Returns to agglomeration vary by industrial sector. In recent work for the UK Department for Transport, Graham and colleagues estimate an overall agglomeration elasticity of 0.04 across all sectors of the economy, 0.02 for manufacturing and consumer services, 0.03 for construction, and 0.08 for business services<sup>10</sup>. This is relevant as it confirms that causality issues can upwardly bias productivity elasticities.

- Returns to agglomeration vary not only by sector but with the size of the city<sup>7</sup>. What this means is that the percentage uplift in productivity due to a percentage change in economic density varies with city size. For manufacturing, construction, distribution, hotels and catering and IT the percentage uplift for a percentage change in economic density increases as city size decreases. That is it is the smallest towns or cities experience the biggest uplifts for these sectors given for a given percentage change in economic density. In contrast for banking, finance and insurance, business services and public services the percentage uplift increases with city size. That is it is the biggest agglomerations that experience the biggest uplifts in productivity in these sectors for a given percentage change in economic density
- The estimation of how productivity varies with agglomeration (the productivity elasticity to economic mass/density) is very challenging econometrically. One of the principal difficulties is that of *causality*. The causality problem arises as a consequence that accessibility in large agglomerations and between large agglomerations may be high because that is where demand is the highest, rather than because the higher accessibility has created the agglomeration and its associated productivity. Another difficulty is that a substantial component of the observed spatial variation in productivity arises as the most productive workers tend to live in the largest agglomerations. It is very difficult to control for this self-selection process as controls for education and skill levels only go part the way to identifying the most productive workers.
- Empirically it is difficult to separate agglomeration effects on productivity and other impacts such as re-organisation effects and the effect of inward investment. This is because typically in large agglomerations firms have taken advantage of the ability to re-organise their structure to take advantage of economies of scale or density in production. Similarly inward investment is typically located in large labour markets. Thus empirically the effect of agglomeration on productivity is confounded with that of re-organisation and inward investment.
- There remain questions around the causal effect of transport infrastructure on productivity<sup>9</sup>. In his recent empirical work with van Dender, Graham found that variations in productivity between agglomerations may be entirely attributable to differing qualities of labour between locations. That is the effect on productivity due to variations in economic density was not statistically significant. Additionally recent ex post work undertaken by the London School of Economics could find no evidence that firm level productivity had altered as a consequence of motorway investment<sup>6</sup> – though this finding could result from a number of empirical issues in the analysis.

4.3. From a transport appraisal perspective the evidence on how labour productivity varies with economic density has relevance if a small, but important, conceptual step is made. This step is that by improving the quality of transport the resultant change in economic density gives a proportionate change in labour productivity *ceteris paribus*. This is the essence of Venables argument<sup>14</sup>. At this point in time there is no ex post evidence that such a change in transport quality will deliver a productivity

change due to increased economic density – see for example the recent UK work<sup>6</sup>. In part this is due to the difficulty in estimating such an ex post impact given the quality of data available. The argument for the inclusion of agglomeration impacts in a transport appraisal, is at this moment in time therefore based on theoretical foundations.

- 4.4. The UK experience from the inclusion of agglomeration effects in an appraisal is that they only tend to be significant for transport schemes located within, or near, large and dense employment centres. The UK therefore only recommend the calculation of agglomeration impacts if the scheme impacts on an area which has a working population of more than 60,000 at its core and a minimum of 7 jobs per hectare (also at its core)<sup>3</sup>. For rural inter-urban road schemes agglomeration impacts are not therefore significant contributors to economic benefit.
- 4.5. The calculation of agglomeration impacts is data intensive. It requires data at a very disaggregate geographic level on employment and earnings by broad industrial sector. At the minimum it is important to distinguish between employment and earnings in city centres and suburbs. Such data is not readily available in Ireland and bespoke analysis of the census and earnings related datasets will be necessary.
- 4.6. Agglomeration impacts should only be assessed if the road scheme impacts on an urban area with, at its core, a working population of 60,000 and a minimum of 7 jobs per hectare. For rural inter-urban road schemes agglomeration impacts are not expected to be significant contributors to economic benefit.
- 4.7. The primary data required for a quantitative assessment of agglomeration impacts are:
  - Changes in the generalised cost of travel;
  - Economic density elasticities;
  - Employment at the workplace by industrial sector (coincidental with the sectoral definition of the economic density elasticities of productivity) at a reasonably small geographic level. At a minimum the geographic disaggregation needs to distinguish city centre employment and employment in other parts of the city; and
  - Earnings data at the same level of disaggregation as the employment data.
- 4.8. The main difficulty meeting these data needs is the ease by which the employment and earnings data can be sourced. Travel costs can be sourced from the transport model used in other parts of the appraisal whilst UK economic density elasticities of productivity<sup>5</sup> can be used in the absence of new Ireland specific elasticities. However, no employment and earnings data are available in an 'off-the-shelf' format. Employment levels by workplace location can be built up from the Census of Population which includes a survey of the journey to work. Earnings data is more difficult to source. A number of business datasets exist and are held by the Central Statistics Office (CSO). Data confidentiality issues associated with using these data mean that only a basic level of geographic detail is available – county level and for the 'city counties' a distinction between the city centre and the rest of the county. Bespoke analysis of these datasets will be necessary to derive suitable earnings data. It should be noted that such an analysis would need the permission of the

CSO and would need to be undertaken within their data laboratory (due to data confidentiality issues).

- 4.9. The difficulty in obtaining employment and earnings data means that only a qualitative assessment of agglomeration is recommended. Such an assessment should focus on the change in the size of the labour market that can access the densest employment areas – typically the city centre. Any quantitative assessment of agglomeration impacts should only be undertaken after consultation with the NRA Strategic Planning Unit.

## 5 Other Impacts

- 5.1. Other market failures that can give rise to wider impacts are also theoretically possible. From a practical perspective it is however recommended that these impacts are excluded from an appraisal. This is due to either a lack of evidence or the large resource implications needed for their appraisal – or in some instances a mixture of both. The particularly circumstances are for each impact are discussed in more detail below.
- 5.2. **Increased competition in the economy.** A transport intervention by bringing firms closer together can increase the level of competition in an economy, although it could also reduce competition if improved accessibility eliminates local producers. There is however no evidence on how marginal changes in transport costs can affect the degree of imperfect competition in a developed economy. It should of course be noted that transport costs are of course only one of the reasons that imperfect competition exists – product differentiation is another. The elimination of all transport costs therefore would not create conditions of perfect competition. It is anticipated therefore that benefits due to increased competition in the economy will be small.
- 5.3. **Employment benefits from increased labour supply.** For the same reason that employment during construction will generate a wider impact, an increase in the supply of labour will also create a positive impact – providing that labour is supplied by taking workers out of unemployment rather than through increased immigration (or the return of expatriate workers). Given that the impacts of a transport improvement on employment is in the main re-distributional, the required analysis to estimate at the Ireland level the gain in employment and the proportion of that arising to workers previously unemployed is non-trivial, whilst the benefit anticipated is likely to be small (as transport schemes do not generally have a large impact on employment at the national level). The level of resources required to estimate employment benefits from increased labour supply is therefore not proportionate to the resulting improvement in the robustness of the appraisal.
- 5.4. **Tax benefits.** Income tax creates a market failure in the labour market. A transport improvement that affects either the number of people employed in the whole economy or average earnings therefore creates an additional welfare benefit. This is equivalent to the change in income tax revenues. Specifically tax benefits will arise from:

- Increased productivity of workers due to agglomeration impacts;
- Increased supply of labour at the national level; and
- Increased average productivity of workforce due to relocation of businesses/economic activity to more productive locations.

- 5.5. Each of these reasons is very resource intensive in terms of their estimation. Estimating both changes in productivity due to agglomeration and increases in the supply of labour have already been discussed. Predicting where economic activity will relocate to and whether it is relocating from a low productive area to a higher productive area would require at the minimum the some form of Land Use Transport Interaction (LUTI) model<sup>4</sup>. It would also require earnings data by sector at a disaggregate geographic level.
- 5.6. **Inward investment impacts.** Foreign direct investment (FDI) can have a positive impact on an economy. If transport investment can facilitate inward investment then some of the spin off benefits from the FDI can be additional to transport user benefits. One of the principal spinoff benefits are productivity spillovers arising through knowledge transfer and enhanced competition in domestic markets. FDI can also have additional welfare benefits if employment is created in areas of structural unemployment. The difficulty in including inward investment impacts in a transport appraisal has two main themes. Firstly there is little to no reliable evidence on either how transport effects inward investment or how inward investment impacts on productivity<sup>12</sup>. The second theme is that the wider impact of inward investment may be double counted in other wider impacts – most notably agglomeration impacts as confounding means the agglomeration impact measures more than just agglomeration. The impact on employment would also be addressed in the wider impact of employment benefits from increased labour supply.
- 5.7. **Re-organisation impacts.** Reductions in transport costs can allow businesses to centralise activities at fewer sites. This is very noticeable in the freight sector, but is also evident in many other sectors. Re-organisation by businesses occurs as the transport improvement allows them to take advantage of economies of scale in production thereby increasing productivity. The presence of economies of scale is a market failure as prices will depart from marginal social cost. The most effective way of capturing economies of scale in production in a cost benefit analysis is through the use of a spatial computable general equilibrium model. Such models however are beyond the scope of almost all transport appraisals. It is also noted that some confounding of economies of scale effects and agglomeration impacts will occur, if an attempt is made to estimate re-organisation impacts in isolation. Only the very largest projects in Ireland could possibly warrant such a research intensive approach.
- 5.8. **Thin labour market impacts.** The presence of search costs in remote and isolated labour markets leads to a market failure. Employment creation in such labour markets would therefore generate a welfare benefit additional to user benefits. To date however there is insufficient evidence on the functioning of remote labour markets in Ireland and the scale of the search costs relative to the wage. The latter is important as it determines the welfare benefit of increased employment.

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