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Infrastructure investments to promote sustainable regions

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Abstract

Transport infrastructure is often used as an instrument to reach political objectives. One such objective is to promote robust and sustainable regions. A sustainable region is often defined as a region with positive population growth. The implied mechanism between infrastructure and population growth is that infrastructure investments enlarge regions so that the labour markets increase in size. Larger regions provide a better foundation for attractive industries, leading to more jobs, influx of labour and population growth. Alternatively, and closely related, that improved infrastructure gives regions improved accessibility, and that this allow industry to remain in the region even though distance and uncertainties in transport provide pressure to relocate to regions that are more central.

Our discussion and findings are based on quantitative analyses of Norwegian regions using register data on population, industry, commuting, road infrastructure and access to services of general interests (SGI). We supplement these data with data on commuting from the latest Norwegian travel survey. Our research draws on insights from a project conducted by the authors for the Norwegian National Transport Plan.

The paper concludes by pointing at critical sizes and distances a typical labour market must reach in order to be sustainable in terms of population growth. We also point at the implications this gives for different kind of infrastructure investments. In particular, we discuss the threshold limit, suggesting that regions with more than 10 000 employees achieve positive population development. We also find that the qualitative improvements in the attractiveness of a region, in terms of variety of services, improves markedly for region sizes between 5 000 and 10 000 employees. This suggests that; if the objective is to maintain the population in a region or to achieve population growth; it is more important to invest in infrastructure, which increases the size of small regions rather than increasing the size of mid-sized and large regions. This results in different priorities from those usually reached by using cost benefit analyses. Which typically give higher priority to infrastructure projects in the largest regions.

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1. Introduction

There is a well-developed academic literature on prioritising between different transport infrastructure projects. The economic literature on this topic has traditionally focused on cost benefit analyses, and the use of such analyses. From the 1990s onwards wider economic benefit has gained much attention. In the Nordic countries, prominent contributions on the use of CBA in prioritising between different infrastructure projects include recent contributions such as, (Eliasson et al. 2015, Eliasson and Lundberg, 2012 and Odeck, 2010). Earlier contributions include Nilsson (1991) who based his study on Swedish road data and Odeck (1991, 1996) using data from Norwegian road investments. This dataset was also used by Fridstrøm and Elvik (1997) who focused on the internal priorities within the Norwegian National Road Authority including the use of CBA. A different approach was used by Nyborg and Spangen (1996) who focused on the use, understanding and perception of CBA by members of the Norwegian parliament. A common feature of all these earlier studies is that they all utilize data from the road sector. Looking more generally at decision-making processes in major investments Olsson (2006) utilizes examples from Norwegian railway investments together with public investments in other sectors.

In recent years, this literature has increasingly changed focus to the concept of wider economic benefits, in particular the benefits of agglomeration. There is now a substantial literature on how to calculate these benefits and the merits of the concept. Hovold and Preston (2005) give a review of how wider economic benefits can occur. Graham (2007) illustrated that these impacts can be substantial for the service sector in particular. The contribution of Hagen et al. (2010) is important in recognising the validity of the concept, in a Norwegian setting.

Looking at the Norwegian debate on infrastructure investments, economic appreciation of a project is only one of the justifications used for investing in infrastructure. Creation sustainable regions is another, and this is mentioned in the Norwegian National Transport Plan (NTP) (Regjeringen 2013, p 16), as a main objective of transport policy. In the NTP a sustainable region is defined as a region with positive population growth. In this paper we focus on the relation between the size of the region and population developments. Further we discuss the implications for selecting infrastructure investments.

Both the use of CBA and wider economic benefits, as methods aim at maximising social welfare through choosing the best infrastructure project. However, looking at the political discussion around such decisions. Investment decisions have different motivations. The link between infrastructure investments and sustainable regions goes through economic growth, and the correlation between economic growth and population growth. Infrastructure creates accessibility which can be defined as potential for interaction (Hansen, 1959). This potential for interaction is related to the services available at a given location as well as the quality of the transport system and geographical distances. Given that places have different potential for interaction, they will also have different possibilities for economic development (Straatemeier, 2008).

This paper focuses on the relation between the size of a region and population developments. In particular, we look into the relation between labour market size and population growth. We also discuss other characteristics sustainable regions have. We further utilize this in discussing implications for selecting infrastructure investments when the objective is to stimulate sustainable regions.

1.1 Definition and data

By *sustainable regions* we understand regions that are able to maintain or increase its population

In this paper we use “regions” referring to *labour market regions*. These are defined using a set of parameters described in Gundersen and Jukvam (2013). Labour market regions are constructed by aggregating municipalities to functional regions based on the level of commuting and travel time. Urban areas are used points of departure. A region is created by adding surrounding municipalities to a central urban area as long as at least 10 per cent of the working force in those municipalities commute to the central area. Some exceptions are made; 1) if a surrounding municipality constitutes its own commuting centre, 2) if the travel time to the city exceeds 75 minutes, and 3) there are also some municipalities that do not have a central city/town and are also not connected to other municipalities by commuting. These municipalities are defined as independent labour markets. Given these definitions, Norway consists of 160 labour market regions. The borders and size of these regions are illustrated in figure 1.

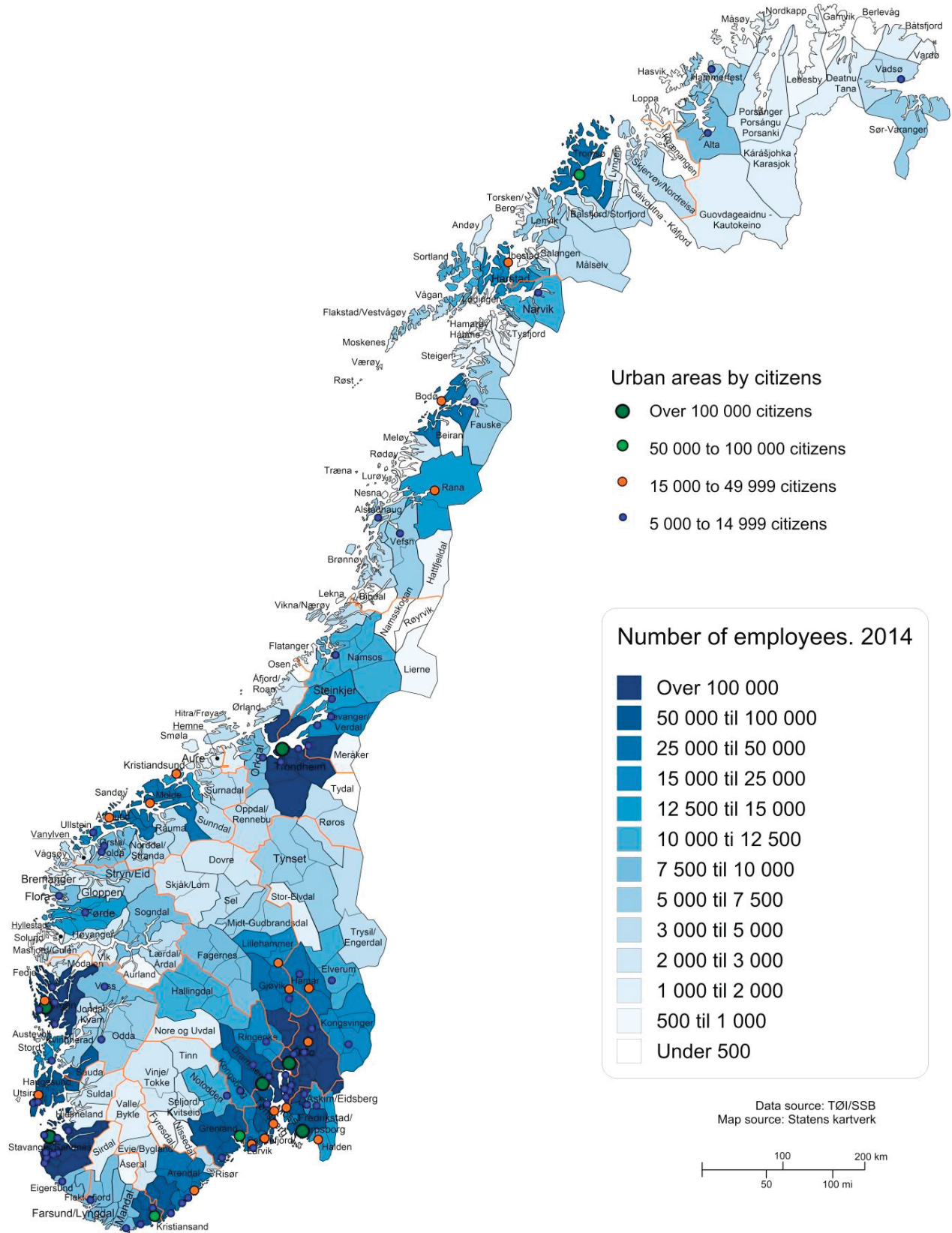


Figure 1: Labour market regions in Norway, by number of employees (Gundersen and Aarhaug, 2014).

The geographical limits of the Norwegian labour market regions are shown in figure 1, (in black). The labour markets' sizes, in terms of number of employees, are shown in different shades of blue, with darker shades representing higher number of employees. Key regional centres are marked by dots, with colouring reflecting their size. Administrative boundaries (county level) are shown with red lines. Figure 1 illustrate that the larger labour market regions (in terms of number of employees) are located around the major cities. We can also see that the labour market regions are smaller, in terms of number of employees the further away from a regional centre they are.

The potential geographical extent of labour market regions is limited by the time each individual has available for commuting. We also recognise, in line with Engebretsen and Gjerdåker (2012), that there is a correlation between distance between home and place of employment and the probability for commuting. Longer distance, or longer travel times, are associated with lower probability for commuting. However, we observe that this is a continuous function with no absolute thresholds.

We also observe that employees have longer commutes to larger cities compared with smaller regional centres. There can be three main explanations of this. First, that larger cities have a more attractive or specialized jobs, resulting in people being willing to travel longer to go to these places of employment (Sandow 2008, Gregersen & Gundersen 2016). Second, that the housing market pushes people out over a large catchment area (Groot, De Groot, and Veneri 2012). In other words, that housing cost prevents better matches between place of residence and employment. Third, that better infrastructure, in particular railways, but also dual carriageways, allow people to commute for longer distance in comfort to the largest cities, reducing the disutility of transport (Julrud & Langset 2013; Cassel et al. 2013).

To look at the qualitative differences between labour market regions, we use the Norwegian Central Register of Establishments and Enterprises (CRE). This is the main database for Statistics Norway for all units in Norway with economic activity. The register covers basic variables, such as number of employees, industry code (NACE), localisation and sector, for both enterprises and local activity units.

2. Infrastructure and sustainable regions – logic

In this argument, we assume that regional development, and population development is correlated. There is a large literature on the complicated relationship between transport infrastructure and regional development. However, the literature also illustrates that, although there are theoretical analyses which indicate significant effects, it is difficult to measure the relationship between transport infrastructure and regional development (OECD, 2002). Looking at ex post studies, conducted in Norway such as Skogstrøm et al. (2013), Lian and Rønnevik (2010), Engebretsen and Gjerdåker (2010) and Aarhaug et al. (2014) we see that the picture is complex, with some investment projects apparently paving the way for substantial regional development, while others have minor or negligible effects.

In principle, we can divide the effects of transport infrastructure on economic development and sustainable regions in two. First, the direct effects which are to improve the travel experience for the population, reducing the disutility associated with traveling and increasing the volume of transport. Second, indirect effects, which is to create more travel opportunities, thereby increasing accessibility. On labour markets transport infrastructure can have effects both in increasing the regional demand, and thereby creating new places of employment, or relocation of jobs. For a given region, these effects can be both positive and negative.

Regional development is often discussed using economic terms such as changes in productivity, employment, access to labour and markets, and establishment of new enterprises. All of these can be assumed correlated with developments in population. The linkage between transport infrastructure and economic development, is due to the fact that economic activity has a spatial dimension. Simplified, the demand for transport can be deduced from the demand for goods and services. Transport can be seen as an input factor in the production of goods and services. Transport infrastructure is then an input in the production of transport services. The expectation is that improved transport infrastructure results in lower cost, or disutility, in the production of transport services. In economic theory it is assumed that changes in relative prices results in increased consumption of the good that becomes "cheaper", in our case, improved transport infrastructure will increase the use of transport.

Investing in transport infrastructure as a tool for promoting economic development is central in transport policy. Looking at transport investments and economic development on a regional level. A regions economic growth can

come in one of two ways, either as a transfer of economic activity from one region to another or as generated growth, resulting from better utilisation of resources and increased productivity.

2.1 City and region size and population developments

By placing register data on population in a geographical context we observe that the population growth observed in Norway is mostly located relatively close to major urban centres. Sorting regions by size of the population in the central city we observe that there on average is population growth in areas close to the regional centres. But, more importantly, that the distance from city centres where we observe positive population developments is correlated with the size of the city centre.

A similar pattern is observed by using regions as a unit. There is a strong correlation between size and population growth (Figure 2).

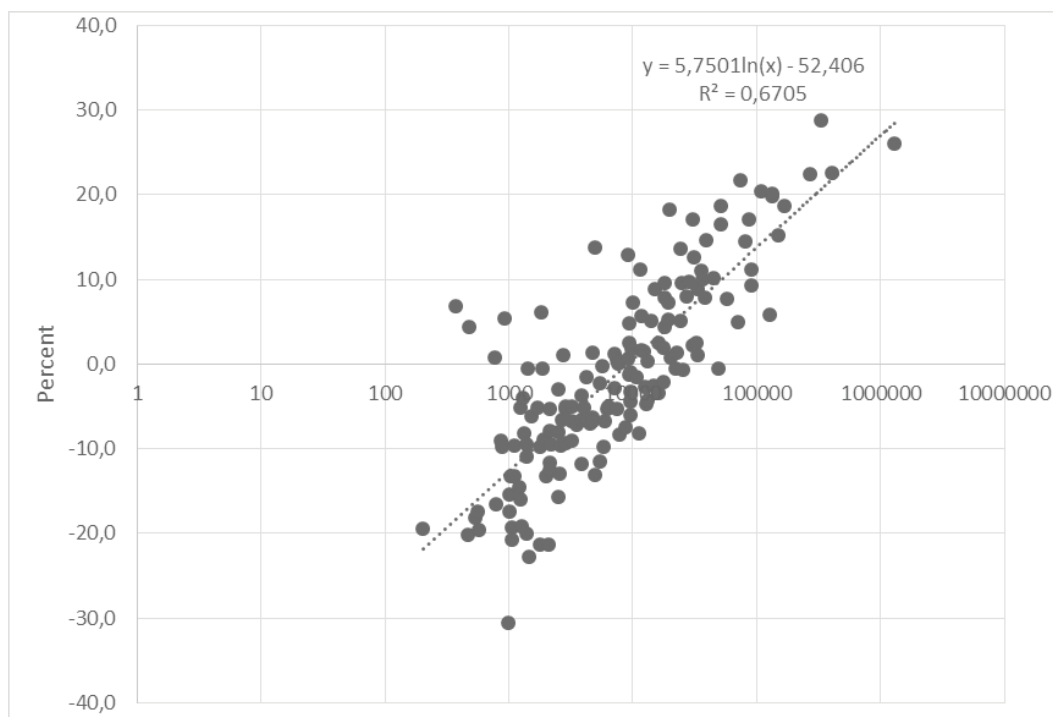


Figure 2: population change (2000-2015) in percent and size of the labour market region in total population (log scale).

Figure 2 shows the correlation between population growth and number of inhabitants in the Norwegian labour market regions, with a log linear trend line. The intersection point of the trend line is at just below 10 000 inhabitants, which is similar in size to about 5 000 employees. Above 20 000 inhabitants, 10 000 employees, there are only three regions that have experienced a negative population development in the time period. We observe a similar relation between population development and average income (Figure 3).

The correlation between average income and population development is similar to the correlation based upon regional size, but that it is less strong. In line with agglomeration theory, the larger labour market regions have higher average income. From these correlations, we propose that the size of the labour market region, in terms of population is a better indicator than average income to predict its sustainability. This could be due to smaller regions having fewer different industries and thus becoming more vulnerable to market fluctuations in specific markets. For smaller regions in Norway, this can be illustrated with small, specialized yards producing and doing repairs for the offshore industry.

In order to investigate this further we use data on registered industries in each region.

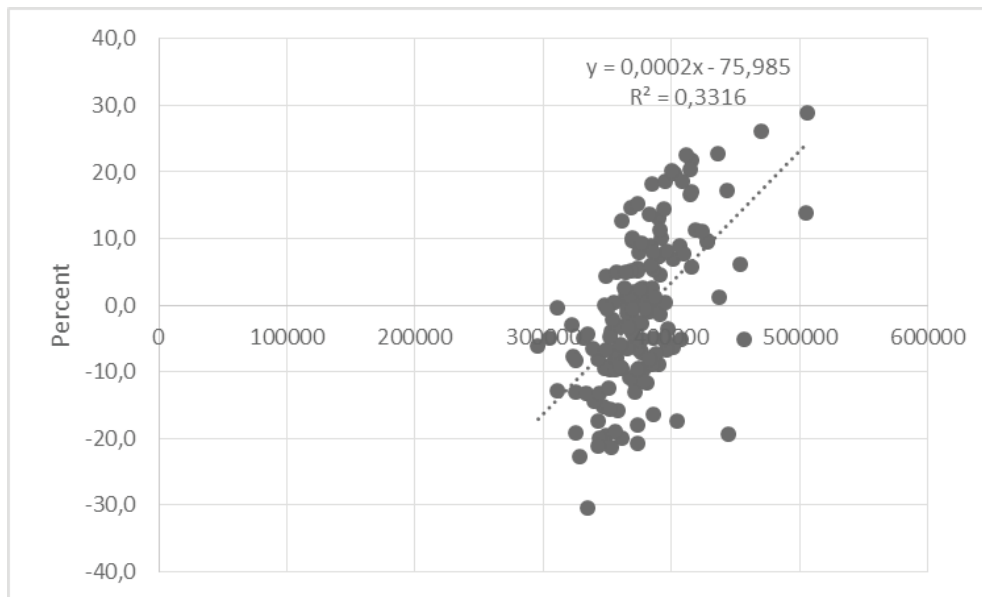


Figure 3 Population development (2000-2015) and average income in NOK (2015).

3. Identifying thresholds

By using the CRE, we map how different regions have different functions. We observe that local government constitute a large part of the labour market for small labour market regions, which for the most part is labour markets in the periphery. For labour markets with fewer than 10 000 employees we observe the share of local government employees, as a share of total employees, of 20 – 70 percent with the majority being above 30 percent. In larger regions this drops to less than 20 percent. Among regions above 100 000 employees no regions have a higher share than about 18 percent. We observe similar relationships in other sectors.

We also observe that the number of different services available, in particular targeted at private consumption, increase rapidly with size from the smallest labour market regions (figure 4).

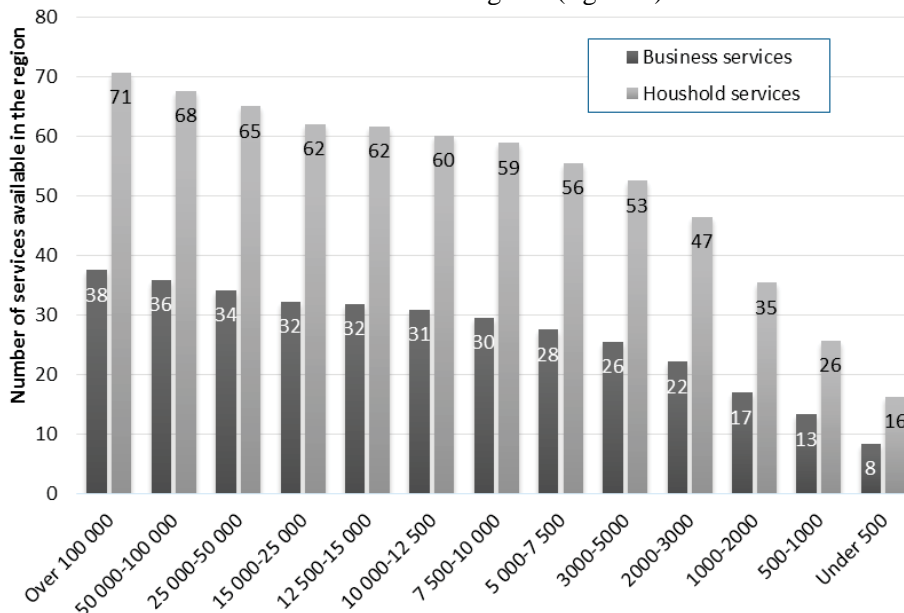


Figure 4 Number of different services available to businesses (dark) and private (light) consumers, related to the size of the labour market in 2014. (number of different NACE codes)

The rate of increase however is diminishing for mid-sized regions. The number of services targeted at businesses follow a similar path, but the differences are not as apparent.

4. Discussion

As shown in this paper, there is a correlation between the size and the function of a labour market region. Increasing the size of a labour market region does not only increase the size of the labour pool, it also creates a foundation for new services and sectors within a region. In the Norwegian data, this correlation occurs in all levels of labour market size, but the strength of the relation varies. This correlation does not describe the whole relation between functionality and size. Individual regions have characteristics that vary, in terms of which functions it has and which services are offered, and its relation to other regions, but it shows that there are clear correlations in the data.

Inhabitants in regions with less than 10 000 employees, have access to fewer services. Within this group of smaller regions, there is also a clear correlation between the number of employees and the number of different services offered in the region. For regions larger than 10 000 employees, there is less variation of the number of different services available in each region, although the composition of services still changes with regional size.

We identify four different ways a region can be affected by an infrastructure project. For simplicity we draw a line with regions smaller than 10 000 employees are termed small, and larger than 10 000 employees large. For the discussion we also assume that the cost of infrastructure is paid by some external entity (such as the central government or Norwegian Public Roads Administration).

1. An increase in mobility (and commuting) within the region.
2. A large region is enlarged in the direction of a smaller region.
3. A region (small or large), is expanded so much, that it absorbs or is absorbed into another region (they become fully integrated labour markets).

A large region is expanded towards another large region. In the first case, infrastructure investment increases mobility. This is positive and will result in reduced disutility from transport. However, it does not increase the size of the labour market region. Rather it reduces the cost of commuting, for those who already have the option to commute. An example of such a project is the Lørenbane metro link in Oslo. This type of project will typically receive a high benefit to cost ratio in a CBA, from high transport volume. But, as it only improves the connectivity within a given labour market region, its contribution to creating sustainable regions is insignificant. As the region is already above a critical size for sustainability.

The second case, where a large region is enlarged in the direction of a smaller region, is very interesting. If the large region is already above the “critical size”, there is not much to gain, in terms of new services. Although increased size will in itself create an opportunity for growth. However, the smaller region can end up losing as people in the area which are mostly affected by the infrastructure investment, instead turn to the larger region. They choose to work there, shop there and so on. Using a Norwegian example, if the Bodø region is expanded towards Fauske, which is a smaller neighbouring region. We expect that the number of employees in the remaining Fauske region will fall. Consequentially Fauske will have poorer prospects for future growth. Bodø, the county capital region, well above the threshold, will hardly be affected. The positive effect of a few thousand employees from Fauske, will in percentage terms be a relatively minor expansion of the region. Although it will be positive, we will not expect that it will result in new sectors appearing in Bodø. In a CBA such a project will most likely get a benefit cost ration of less than one. There is a limited number of persons affected, and often substantial cost.

The third case could be that the Risør region becomes a fully integrated part of Arendal region, or that the Beiar region become fully integrated with Bodø. In these instances, there will be a mutual gain situation, where all inhabitants become part of a larger, and more differentiated labour market. However, there are a few factors that can make this difficult to achieve. First the geographical factors often make it difficult to integrate whole regions. There may be physical barriers, such as fjords or mountains, that has contributed to the excising shape and size of the regions, and an infrastructure project may only end up overcoming one such obstacle not the second. That is what happens in case 2, where only parts of the region become integrated. The second is that this type of regional

enlargement require substantial investments, not a few patches on an existing network. In a CBA analyses this type of projects will have similar properties as in case two. However, as the investment to achieve this is typically higher, we will expect the benefit cost ration to be smaller. In most cases achieving full integration of two labour market regions will require a major investment as a bridge, a tunnel or a dual carriageway replacing a smaller road, cutting relevant travel times with 30 minutes or more. Also, as Norway already has an extensive infrastructure network, there are few projects with region merging possibilities left.

The forth case will only result in a redistribution of the work force. As long as both labour markets are not affected qualitatively. In terms of volume there is a zero-sum game, or close to a zero-sum game. One cannot totally dismiss the effects of enlarging large regions, as changes in the size and composition of the labour markets can have effects on niche services or industries, but on an aggregate level these are small. An example of such an infrastructure project is a connection between Ålesund and Molde or between Gjøvik and Hamar. In a CBA analyses this type of project will normally do relatively well, of course depending on the cost of the project and the location, but the number of persons affected will be large, compared with smaller labour market regions, contributing to a high benefit side in the cost benefit analyses. But, these projects will contribute little in terms of creating a more differentiated service market for the residents.

5. Conclusion

We conclude that focusing on creating sustainable regions will create different priorities in choosing infrastructure incitements, compared with the use of CBA. If infrastructure is to be used to create sustainable regions investment projects that can increase the size of small and mid-sized regions, should be given priority above investment projects that benefit a larger number of people, but are located in regions that are already above the sustainability threshold. This is in contrast to the expected results from a cost benefit analyses, where affecting many help increase the benefit.

This is not to say that cost benefit analyses are superfluous or wrong. Rather it is to say that if keeping regions alive is the main objective of investment decisions, this should result in different projects compared with a situation where optimizing social welfare is the objective. In ‘real world’ policies it is unlikely that maintaining population in as many regions as possible or optimizing social welfare will be the single major policy objective. Rather, both are likely to be one of many such objectives.

The above discussion also points toward the fact that infrastructure is an insufficient measure to create sustainability in the smallest regions. These regions will lose out, without investments targeted directly at the regions challenges, and infrastructure is a blunt instrument to do this. Further it raises the question on the desirability of maintaining the smallest regions, as these will require substantial investments or subsidies (and not infrastructure), to maintain a differentiated labour market and sustain a differentiated set of services.

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