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Halse, Askill Harkjerr and Fridstrøm, Lasse

Institute of Transport Economics (TØI), Oslo, Norway

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**Askill Harkjerr Halse, Lasse Fridstrøm**

Institute of Transport Economics, Oslo, Norway. Email ash@toi.no, phone +47 97178580

# Explaining low economic return on road investments. New evidence from Norway[1]

Is regional policy to blame for the negative economic return on many road projects, or can road investments give value for money also in remote areas? In Norway, a large majority of planned road projects have negative net present value according to cost-benefit analysis (CBA). In this paper, we point at geographic characteristics that can explain this, comparing Norway with its neighbors Sweden and Denmark. We then show econometric evidence that such factors also explain a substantial part of the variation in the benefit-cost ratio within Norway. Projects in areas that are far from the largest cities or have difficult topography have lower net present value. This implies that there is a trade-off between economic efficiency and investing in roads in rural areas with difficult topography. We also discuss the role of road design requirements, decision-making processes and the electoral system for road investment policy.

*JEL classification:* R42, D61, D72

*Keywords: Cost-benefit analysis, road investments, regional policy, distributive politics*

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# 1 Introduction

Cost-benefit analysis (CBA) is used in many countries as input to decision-making about investments in transportation, but the outcomes of these decisions often differ significantly from recommendations based on CBA. This suggests that choosing projects based on the net benefit-cost ratio (BCR) conflicts with other goals for transport policy, but the tradeoff between the BCR and such other concerns is seldom made explicit. Instead, the arguments made in favor of investing in a project are often project-specific (Mackie et al 2014) and not comparable across projects.

In this paper, we shed more light on the dilemmas that policy-makers face by identifying which characteristics of road projects contribute to low BCRs. Our country of interest is Norway, where a large share of national road and transportation projects have negative estimated net benefits (BCR < 0). At the same time, public investments in transportation are higher than in most other Western countries (OECD 2018). This might explain why Norwegian policy-makers question the relevance of CBA for transportation policy (Nyborg 1998).

Our paper is related to the growing literature on whether the results of cost-benefit analysis matter for project selection (McFadden 1976, Nilsson 1991, Odeck 1996, Fridstrøm and Elvik 1997, Odeck 2010, Eliasson et al. 2015). However, while these studies are concerned with whether the BCR affects decisions, we investigate whether the BCR varies so much in the first place, and why so many projects have a low BCR.

Low net benefits of road projects in Norway can be the result both of unfavorable characteristics of the country and the characteristics of the projects in terms of design and implementation. We have gathered statistics showing that the conditions are indeed unfavorable. Compared to its neighbors Sweden and Denmark, Norway has lower population density and more difficult topography. This implies lower net benefits from road investments, ceteris paribus. Norway also has a dispersed population and a large network of public roads to which investments are allocated.

We also conduct a brief review of current requirements for road design in the three countries. This shows some examples of stricter requirements in Norway, but we cannot conclude that this results in higher construction costs. The construction cost index shows a similar development in Norway and Denmark.

Our main contribution is an analysis revealing what geographic factors impact the BCR of individual road projects. Since Norway is large in area and diverse in terms of geographic characteristics, Norwegian data are highly suitable for this purpose. Our data consist of 267 and 220 projects that were candidates for the ten-year national investment plan in 2010 and 2014, respectively. We combine this with geographic characteristics measured at the municipality level, including topography, climate and to what extent the road is adjacent to a densely populated, central area.

The results are consistent across the two datasets and show that such characteristics do impact the estimated BCR of a road project. The effects go in the expected directions and are also quantitatively important. This implies that there is indeed a trade-off between economic efficiency and investing in many rural and remote areas, at least given current practice with respect to planning and road design.

Furthermore, we discuss the impact of characteristics of the decision-making processes and the electoral system on Norwegian transport policies. Bottom-up decision-making, equity concerns in the distribution of investment and low emphasis on measured performance could all contribute to less emphasis on CBA in planning and selection of road projects.

We also point out a misrepresentation of the Norwegian electoral system in the existing literature and public debate. In Norway, several rural districts are over-represented in Parliament in terms of seats per vote. However, after adjustment seats were introduced in 1989, these districts are not more decisive for the electoral results and therefore not 'worth more' to the parties running for election. In fact, data on highway investments per district show that the over-represented districts have received lower investments after adjustment seats were introduced, suggesting that they have lost their strategic advantage.

The paper is organized as follows: In Section 2, we compare Norway, Sweden and Denmark in terms of geographic characteristics and review the requirements for road design. Section 3 contains our empirical analysis of how geographic characteristics determine the BCRs of individual road projects. In section 4 we discuss the role of Norwegian institutions in road planning and project selection. Section 5 concludes.

# 2 Norway in a comparative perspective

In this section, we compare Norway with its Scandinavian neighbors Sweden and Denmark. While these countries share many similarities with respect to culture and institutions, they are geographically quite different, as shown in section 2.1. In light of this, we discuss the role of differences in road design requirements for construction costs and economic efficiency in section 2.2.

## 2.1 Country characteristics

Table 1 shows some key statistics for the three countries that may have a bearing on the return on road investments. In particular, we note the following:

- Population density and kilometers travelled per road kilometer are lower in Norway, which imply lower traffic volumes and hence lower benefits from road investments.
- Norway has more mountains, a longer and more furrowed coastline and a colder climate, which could imply higher construction costs.

- GDP per capita is higher in Norway, something which might imply higher willingness to pay for transport improvements (Börjesson et al. 2012). It could also explain why traffic volumes per inhabitant are slightly higher.

*Table 1. Characteristics of Norway, Sweden and Denmark*

| | Norway | Sweden | Denmark |
|---|---|---|---|
| Area (km$^2$) | 324 000 | 447 000 | 43 000 |
| Area > 900 m above sea level | 20,5 % | | 0 % |
| Mountains > 2000 m above sea level | ≈ 300 | 11 | 0 |
| Coastline (km) | 53 000 | 26 000 | 5000 |
| Mean annual temperature in capital | 5,7 °C | 6,6 °C | 8,0 °C |
| Population per km$^2$ | 17,3 | 24,5 | 133,8 |
| GDP per capita (NOK 2016) | 595 291 | 494 735 | 498 757 |
| Public roads (km) | 94 000 | 148 000 | 75 000 |
| km travelled per inhabitant | 13 000 | 12 000 | 12 000 |
| km traveled per road km | 0,74 mill. | 0,83 mill. | 0,91 mill. |

*Sources: Statistisk sentralbyrå, Statistiska centralbyrån, Danmarks statistik, Statens vegvesen, Trafikverket, Vejdirektoratet, Nordisk statistikkbank, Eurostat, OECD, World Resources Institute, Svenska turistföreningen, www.nfo200m.no*

With the exception of GDP per capita, all factors point towards lower return on road investments in Norway. Furthermore, higher income also implies higher labor costs, which could drive up construction costs, as seen in the next section.

One factor that is not covered here is the quality of existing roads and other transport infrastructure. If this is lower in Norway, it could imply higher return on new investments. However, road investments have been high in Norway at least for the last decade, which could result in decreasing returns.

## 2.2 Road design and construction costs

To what extent unfavorable geographic characteristics result in low return on road investments depends on the requirements for and practice concerning road design. We have conducted a brief review of road design requirements in the three countries. (See Halse and Fridstrøm 2018 for details.) This shows the following:

- The requirements for stopping sight distance are stricter in Norway.
- The requirements for highway lighting are less strict in Norway.
- Traffic volumes (AADT numbers) play a more important role in determining the type of road to be built in Norway.

To sum up, there is no clear evidence that requirements are stricter in Norway. However, the finding that AADT numbers play a more prominent role in Norway is interesting. For instance, ADT = 12 000 is normally required to build a four-lane divided highway.

From an economic point of view, AADT limits could be used as a rule-of-thumb, but they should not be decisive. Whether the type of road fits the local traffic situation should be captured by the CBA, without additional constraints. In fact, the Norwegian Public Roads Administration (NPRA) recently announced that they would lower the AADT required for four-lane divided highways.[2]

There has been increasing debate about road type and road design after the government established the state enterprise Nye Veier AS, which is now responsible for road construction and maintenance on selected highway corridors. The policy of Nye Veier is to build four-lane divided highways to a larger extent, but to cut costs by reducing the standard (without violating the requirements), innovative contracts and close co-operation with local governments. A report by McKinsey written for Nye Veier shows that different practices with respect to project implementation and road design partly explain why construction costs are higher in Norway. However, this report is not publicly available.

Another important factor is the general price level. Figure 1 shows changes over time in Norway and Demark in construction costs (left panel) and GDP per capita (right panel). Over the whole period, construction costs have increased about 30 percent more in Norway. This is almost the same as the difference in the increase in GDP per capita. This implies that the direct positive impact of higher income on the benefits of road investment (through higher willingness-to-pay) is netted out by higher costs.

[2] VG, December 14, 2018: *«Vegvesenet åpner for flere motorveier i Norge – 2000 kilometer vei er aktuell for utbygging.»*

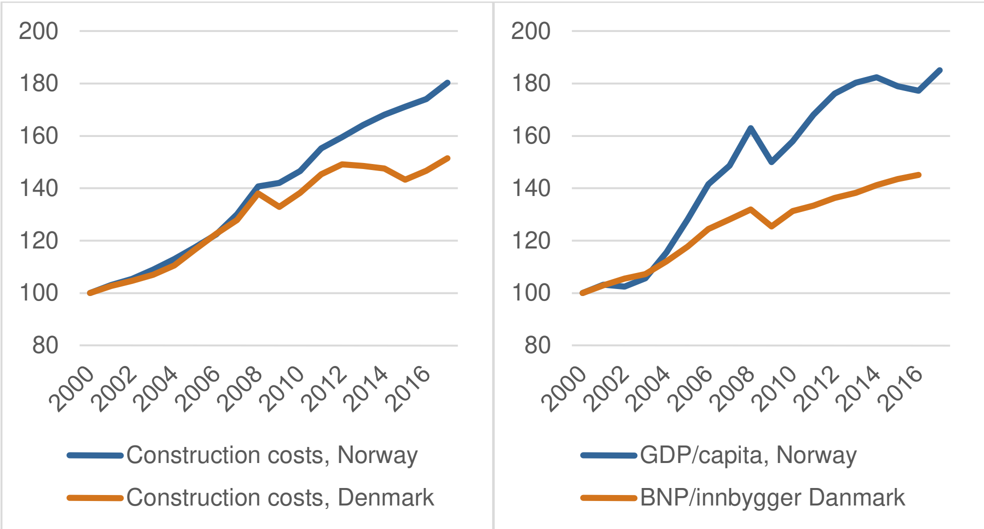


*Figure 1. Construction costs and income level in Norway and Denmark.*

# 3 Evidence from Norwegian road projects

In this section, we show how the economic return on Norwegian road projects depends on the characteristics of the area in which they are located, and discuss the implications for transport policy.

## 3.1 Data and identification strategy

We use data on projects that were candidates for being included in the national transport plans for 2010-2019 and 2014-2023. This data set contains 267 and 220 projects, respectively. We do not combine the two data sets, since some projects appear in both data sets under different names.

Our purpose is to identify how the geographic characteristics of an area affect the costs and benefits of road projects in that area. However, estimated costs and benefits (in monetary terms) also reflect the scale and scope of a project – larger or more ambitious projects typically have both higher costs and higher benefits. Since we do not have an objective measure of scale or scope, we instead focus on *relative* net benefits, measured by the net benefit-cost ratio (BCR):

$$BCR_i = \frac{NPV_i}{C_i} = \frac{B_i - C_i}{C_i}$$

where $B_i$ are the 'benefits' of the project, both positive and negative, and $C_i$ is construction cost. We follow Norwegian practice and use net benefits in the numerator (cf. Minken, 2016). However, we depart from standard practice and use $C_i$ as the denominator instead of budget cost. This is because we are not interested in the variation in the BCR that reflects differences in the funding scheme.[3] Appendix Figure 3 shows how the outcome variable is distributed across projects.

We estimate a simple linear regression model using this as the outcome variable and geographic characteristics $\boldsymbol{X}_i$ as explanatory variables:

$$BCR_i = \alpha + \boldsymbol{\beta X}_i + \varepsilon_i$$

Hence, we can assess whether a certain characteristic influences the BCR, but not whether this effect comes through benefits or costs (or both). We expect some characteristics to mainly affect the benefit side and others to mainly affect the cost side (see next section).

The identifying assumption is that there are no unobserved project characteristics that are correlated with both $\boldsymbol{X}_i$ and $BCR_i$. To evaluate the robustness of our results, we compare models with and without additional control variables: Dummies for the five road regions and dummies for the planning stage of the project.

## 3.2 Explanatory variables

We combine this data with data on geographic characteristics that might influence the net return on road investments, more precisely characteristics of the *municipality* in which each project is located.[4] Since Norway has relatively many municipalities, this gives large variation and fairly precise information. An alternative would be to use GIS data with a higher resolution, but this would also require assumptions about which parts of an area explain the net return on a road investment located in it.

The municipality characteristics are:

- Altitude difference: Measured in 100 meters. Difference between the highest and the lowest altitude interval, based on area statistics from Statistics Norway. For instance, if a municipality has some area in the interval 0-60 m above sea level (MASL) and some in the interval 900-1199 MASL, this variable takes the value 9 (900 meters).
- Coastal area: A dummy equal to one if the municipality has some coastline, zero otherwise.
- Island share: The share (from 0 to 1) of the coastline that is part of an island. (If no coastline, this variable is equal to zero.)
- Temperature: Measured in degrees Celsius. Average temperature, from statistics gathered by Andersen et al. (2014).
- Precipitation: Measured in 1000 millimeters. Annual precipitation, from the same source.

[3] Replacing our outcome variable with BCR based on budget cost as the denominator gives similar results, but slightly lower precision and model fit (Halse and Fridstrøm 2018).

[4] If more municipalities are listed in the database, we use the first one. In some cases, no municipality is listed. In this case, we use the municipality to which most of the project belongs.

- Centrality: The centrality index (from 0 to 1) from Statistics Norway (Høydahl 2017).[5]
- Population density: Measured in 1000 inhabitants per square kilometer
- Income: Measured in 100 000 NOK. Median household income after taxes, in the relevant year (2010 or 2014, respectively).

The advantage of the centrality index is that it captures not only whether the municipality itself is a major city or a densely populated area, but also whether it is close to such areas. This is important because a large share of the traffic generating benefits from a road projects could be traffic passing through the municipality.

We also include population density, because building in more populated areas could be more expensive and therefore give lower net benefits (other things equal). Appendix Figure 4 shows that centrality and population density is correlated, but this correlation is driven by the 10-15 most central municipalities in our data. And also among these, population density varies substantially.

## 3.3 Results

The regression results are shown in Table 1. The results are quite stable across the two national transport plans (columns 1-3 and 4-6, respectively) and different model specifications. The following conclusions can be made:

- Projects in areas with large differences in altitude have lower BCRs. An increase in altitude differences of 100 meters is associated with a decrease in the BCR of about 0.03-0.05 (keeping other characteristics constant).
- Projects along the coast have lower BCRs. The difference is about 0.22-0.40.
- Projects in areas with higher temperature have higher BCRs. One degree Celsius higher temperature is associated with an increase in the BCR of about 0.04-0.08.
- Projects in more central areas have higher BCRs. An increase in the centrality index of 0.1 is associated with an increase in the BCR of about 0.15-0.24.

All these findings are in line with our expectations. There is also some evidence that population density negatively affects the BCR, but this effect is only statistically significant in the dataset from the NTP for 2014-2023. The effect of islands is also negative in all specifications, but never statistically significant.

The effect of precipitation, which we would expect to be negative, differs between specifications and is in most cases not statistically significant. The same goes for the effect of the income level. This might not be surprising, since the unit values used in CBA are national values that do not reflect regional differences in willingness to pay (Østli et al. 2012). However, regional differences in income could still affect the traffic volumes.

[5] The original index goes from 1 to 1000, but we divide the variable by 1000.

*Table 2. The relationship between the benefit cost ratio (BCR) and geographic characteristics*

| | NTP 2010-2019 | | | NTP 2014-2023 | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Altitude diff. | -0.028*** | -0.040*** | -0.040*** | -0.036*** | -0.051*** | -0.047*** |
| | (0.010) | (0.011) | (0.011) | (0.011) | (0.012) | (0.013) |
| Coastal area | -0.219* | -0.368*** | -0.368*** | -0.216* | -0.401*** | -0.398*** |
| | (0.115) | (0.134) | (0.134) | (0.118) | (0.140) | (0.141) |
| Island share | -0.110 | -0.094 | -0.061 | -0.090 | -0.113 | -0.110 |
| | (0.209) | (0.224) | (0.220) | (0.226) | (0.234) | (0.233) |
| Temperature | 0.064*** | 0.075*** | 0.074** | 0.040* | 0.061** | 0.062** |
| | (0.024) | (0.028) | (0.029) | (0.021) | (0.025) | (0.025) |
| Precipitation | 0.024 | -0.083 | -0.096 | 0.387*** | 0.193 | 0.195 |
| | (0.087) | (0.085) | (0.086) | (0.119) | (0.132) | (0.133) |
| Centrality | 1.547*** | 2.052*** | 1.948*** | 1.487*** | 2.327*** | 2.385*** |
| | (0.430) | (0.559) | (0.502) | (0.431) | (0.518) | (0.508) |
| Pop. density | -0.208 | -0.387 | -0.374 | -0.496*** | -0.732*** | -0.702*** |
| | (0.251) | (0.250) | (0.247) | (0.133) | (0.149) | (0.158) |
| Median income | 0.134 | -0.136 | -0.108 | 0.015 | -0.252* | -0.217 |
| | (0.174) | (0.231) | (0.225) | (0.112) | (0.151) | (0.153) |
| Observations | 267 | 267 | 267 | 219 | 219 | 219 |
| R-squared | 0.18 | 0.20 | 0.20 | 0.28 | 0.32 | 0.32 |
| Region fixed effects | No | Yes | Yes | No | Yes | Yes |
| Planning stage controls | No | No | Yes | No | No | Yes |

** $p<0.1$, ** $p<0.05$, *** $p<0.01$. Standard errors are robust to heteroscedasticity and autocorrelation.*

## 3.4 Implications

The results clearly suggest that there is a tradeoff between choosing road projects based on economic net benefits and investing in areas with certain characteristics. In Norway, centrality is positively correlated with temperature and negatively correlated with altitude differences. Hence, prioritizing based on the BCR would imply investing more in central areas, with the possible exception of some very central areas with high population density.

To illustrate the implications, we show how the distribution of investments and economic benefits would have been if all projects with BCR > 0 had been implemented. The distributional impact is illustrated by dividing the population into five percentiles (quintiles) based on (1) centrality and (2) income.

The distribution of investments with respect to centrality is shown in the left panels of Figure 1. As we can see, choosing projects with positive BCRs imply low investments both in the most central areas[6] (which have high population density) and least central areas. In the NTP for 2010, those in the 3rd centrality quintile would receive the highest investment. In 2014-2023, those in the 2nd quintile would receive the most, followed by those in the 3rd. (As there are more large projects with positive BCR in the NTP for 2014-2023, total investments are higher in the middle panel.) Due to positive correlation between centrality and BCR also within those projects that have BCR > 0, benefits (right panels) are somewhat more centralized than investments.

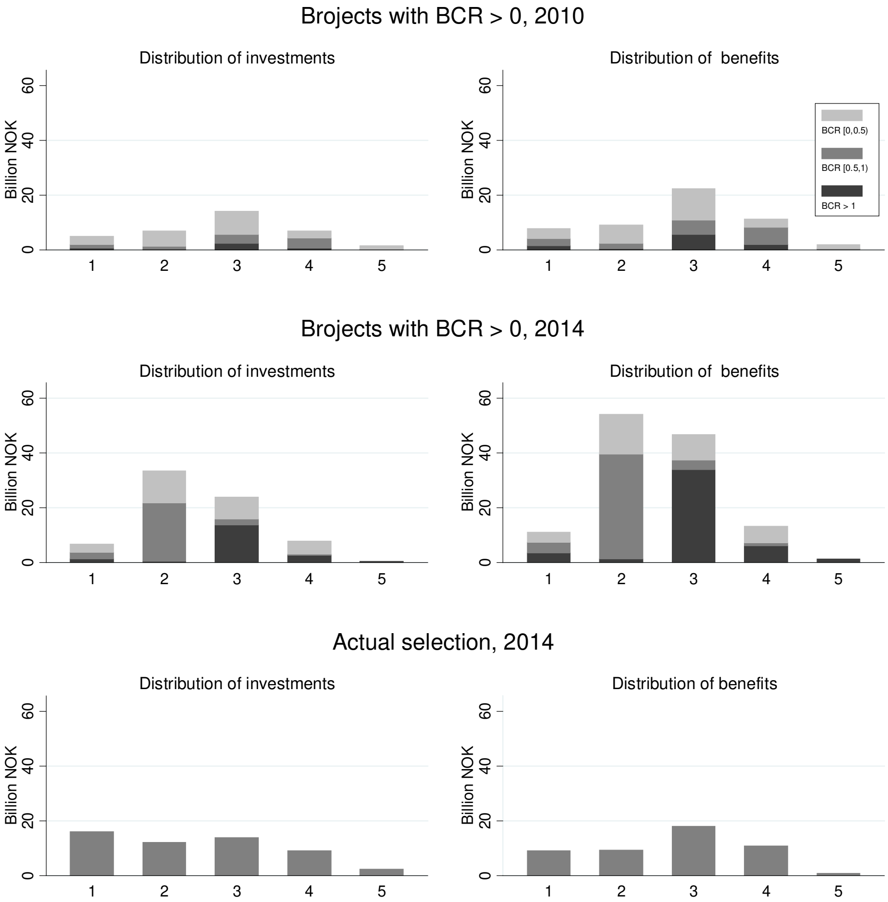


*Figure 2. Distribution of road projects by centrality quintile (1-5). Note: 'Actual selection' refers to the recommendations to the government by the transport authorities (cf. Eliasson et al, 2015), which is not necessarily the same as the projects eventually appearing in the National Transport Plan.*

Although this distribution does not dramatically favor central areas, it clearly contrasts with actual policy. The bottom panel shows the distribution proposed by the transport agencies in the planning stage of the NTP for 2014-2023 (the outcome

[6] The 5th quintile includes those living in Oslo, six neighboring municipalities, and Drammen.

studied by Eliasson et al. 2015). In this distribution, those in the 1st quintile receive the highest investments. We do not have data on the selection of projects in the final plan presented to parliament, but we have no reason to believe that central areas are favored more there.

Figure 2 shows a somewhat similar picture for distribution with respect to income level. Choosing projects with BCR > 0 would imply low investments in the poorest areas, and in the NTP for 2014-2023, high investments in the richest areas. This clearly contrasts with the distribution proposed by the transport agencies. This suggests that decision-makers take distributional concerns into account.[7]

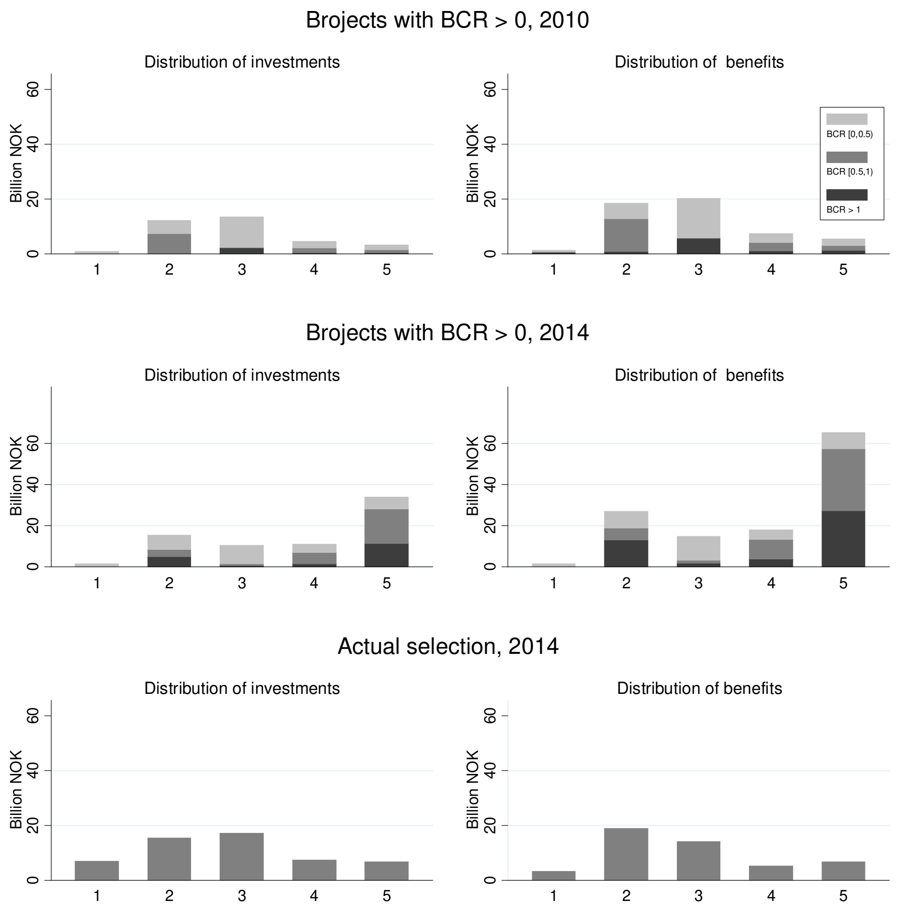


*Figure 3. Distribution of road projects by income quintile (1-5). Note: 'Actual selection' refers to the recommendations to the government by the transport authorities (cf. Eliasson et al. 2015), which is not necessarily the same as the projects eventually appearing in the National Transport plan presented to parliament.*

[7] According to the results in section 3.3, the relationship with income level might not reflect income in itself, but characteristics correlated with income, like altitude differences and temperature.

# 4 The role of institutions

In Norway, there are many road projects with low net benefits, both among projects in the planning stage and those that have been implemented. When CBA results do not matter in the final selection of projects, this could result in less emphasis on economic return also in earlier stages (Eliasson and Lundberg 2012, Mackie et al. 2014). Alternatively, it could be that the same factors that result in low emphasis on economic return in the final selection also influence planning practices.

In any case, institutional features are likely to be important. In this chapter, we discuss how administrative institutions (section 4.1) and electoral institutions (section 4.2) could influence how CBA is used in decision-making.

## 4.1 Administrative institutions

One issue commonly addressed is that national road projects often have a long history that involves initiatives from local interests (Haanes 2006, Strand 2015, Sager 2016). This means that the expectations about and support for a project could be high before precise estimates of costs and benefits are available, giving projects with low net benefits enough momentum to eventually be implemented. To what extent this happens to a larger extent in Norway is an open question.

There is also some evidence indicating that decision-makers prefer an even/and or stable distribution of investments across geographic areas. Strand (1983, 1993) and Ravlum and Sørensen (2005) find that the distribution of investment across counties has been relatively stable over time. Fridstrøm and Elvik (1997) find that two projects are less likely to be selected if they are located in the same municipality.

One feature that might be characteristic for Norway is the administrative culture or tradition. According to Christensen et al. (2002), Norway differs from its neighbor Sweden in two respects:

1. In Norway, each minister answers to the Parliament for decisions within his or her sector, while in Sweden, the whole cabinet is responsible. This could result in decision-making being more fragmented and less top-down.
2. Sweden has a more 'rationalistic' administrative culture with more tradition for measuring and evaluating the quality of publicly provided goods and services. (See also Olson and Sahlin-Andersson 1998.)

This feature is not specific to the transport sector, but it could be a part of the explanation why CBA seems to be less important for decisions in Norway than in Sweden (Eliasson et al. 2015).

## 4.2 Electoral institutions

Building new infrastructure is a visible form of public investment. Several studies show that the geographic allocation of such investments is affected by the strategic interests of politicians in office or running for election (Elvik 1996, Knight 2004, Knight 2008, Helland and Sørensen 2009, Halse 2016, Hammes and Nilsson 2016). Can this also explain the allocation of road investments to less populated areas in Norway?

One particular feature of the Norwegian electoral system that has caught attention is the relatively large differences in parliamentary representation between electoral districts (counties). While the capital Oslo has more than 24,000 voters per seat in Parliament, the far north county of Finnmark has less than 11,000.

If all MPs were elected based on district votes, this would have implied that a vote cast in Finnmark or another over-represented district would be more decisive for the party composition in Parliament. This again would have given parties incentives to allocate (or promise to allocate) more public investments to the over-represented districts in order to win the next election.

However, since 1989, some of the seats in Parliament are so-called adjustment seats.[8] These seats were introduced to ensure that the party composition reflects the popular vote. If a party is 'unlucky' and loses a seat in several districts by a close margin, it will instead be granted adjustment seats, provided that it has more than four percent support on the national level. According to Aardal (2011), this implies that differences in district representation have virtually no impact on party composition.

Hence, parties now have no incentive to favor a particular district in order to win the election. If such incentives are important, we would expect over-represented districts do receive lower investments after 1989. Using the data from Helland and Sørensen (2009), Figure 4 shows that this is also the case, at least up until year 2000. (The relationship with over-representation in each district is shown in appendix Figure 7.) However, we cannot conclude that this is the explanation.

Over-represented districts still have the advantage that they have more representatives that can act as their spokesmen in Parliament, giving more bargaining power (Knight 2008). This is however something different than the electoral incentives of parties. The importance of adjustment seats for this seems to have gone un-noticed in the discussions of Hansen and Jørgensen (2015) and Sager (2016) of the Norwegian system and in the comparative study of proportional election systems by Kedar et al. (2015).

In general, proportional election systems are expected to give less room for geographic special interests and deliver more welfare services for the broader population than systems with single-member districts (Persson and Tabellini 1999, Lizzeri and Persico 2001, Milesi-Ferreti et al. 2002, Stratmann and Baur 2002, Gagliarducci et al. 2011, Funk and Gathmann 2011). This should also be kept in mind when discussing the role of the electoral system in transport politics in Norway.

[8] In the elctions from 1989 to 2001, there were eight adjustment seats. Since 2005, there has been 19, one for each district (county).

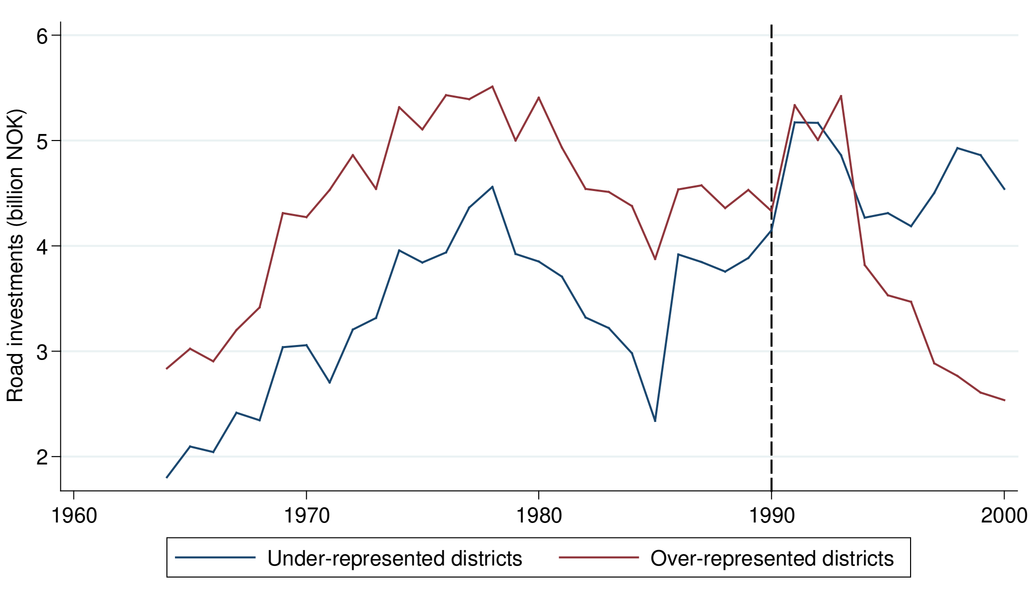


*Figure 4. National road investments over time in districts that are under- and over-represented in Parliament.*

# 5 Conclusion

Our study shows that allocating road investments based only on economic return could conflict with equity concerns with respect to geography and possibly also income. If such concerns are taken into account in decision-making, this could explain why so many road projects showing low economic return are planned and eventually carried out.

The economic textbook solution would be to choose the projects yielding the highest value for money, and then use other policies to compensate those not benefitting. This raises the question about whether such other policies exist in practice. More research should be done on the effectiveness of different policy measures for regional redistribution.

Even if distributional concerns are legitimate, the fact that these concerns are not transparent in the assessment and selection of projects is problematic. A possible solution would be to quantify to what extent a project gives benefits to an area that for instance is far from the largest cities, has low population growth or low income. This would also enable planners to identify projects that *neither* give positive economic return *nor* stimulate development in disadvantaged areas.

Distributional concerns have received relatively little attention in the transport economics literature compared to other fields of economics. Given the challenges that economic inequality poses to the economy and the political system (see e.g. Fetzer 2018), these issues should be taken seriously also by those who favor cost-effectiveness in public decision-making.

The focus of this paper has been on factors that explain low economic return on road projects as shown in the CBA conducted in the planning phase. If costs are under-estimated at this stage (Welde and Odeck 2017), net benefits will be even lower when the project is implemented. Some projects also end up giving lower benefits due to user charges. Although our results are robust to controlling for planning stage, this also calls for more studies based on ex-post CBA.

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# Appendix: Supplementary figures

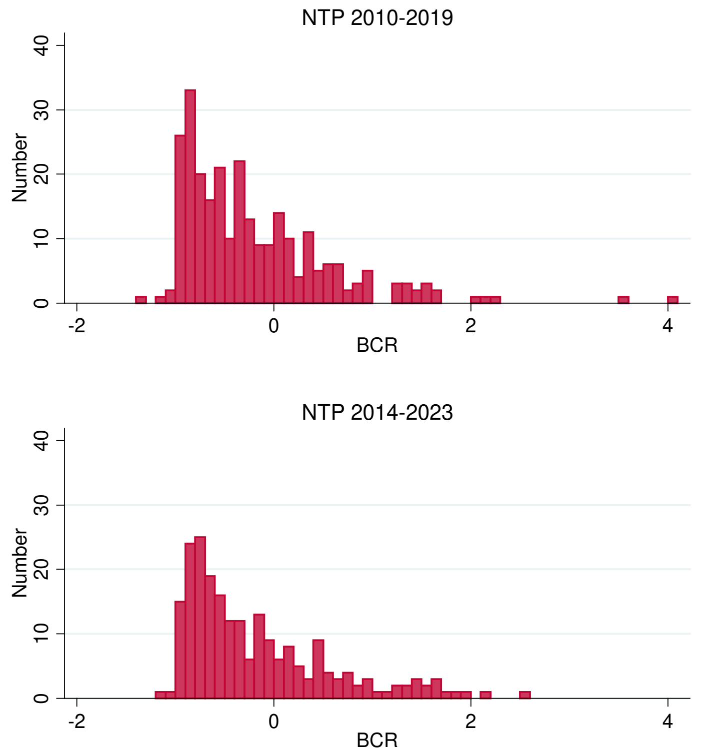


*Figure 5. The distribution of the benefit-cost ratio among road projects in our data.*

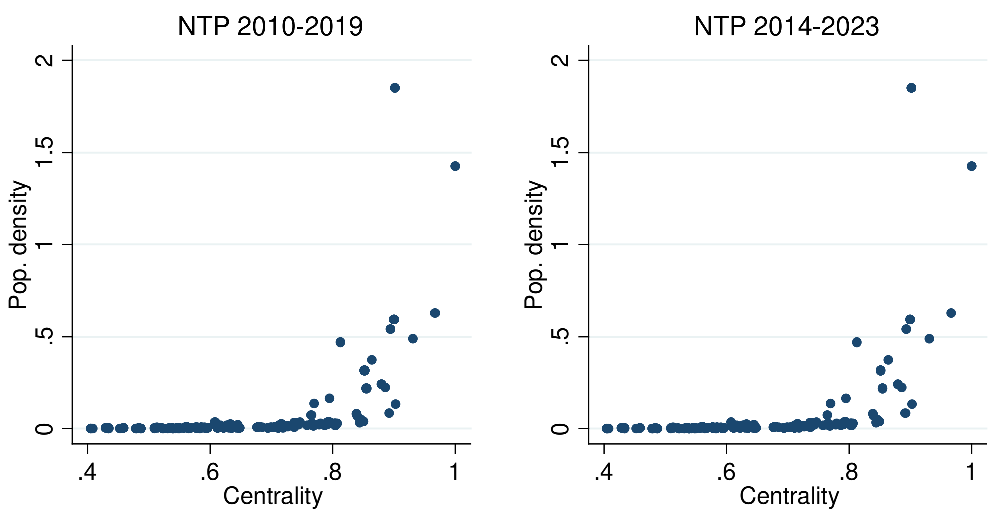


*Figure 6. The relationship between the population density and centrality level of municipalities in our data.*

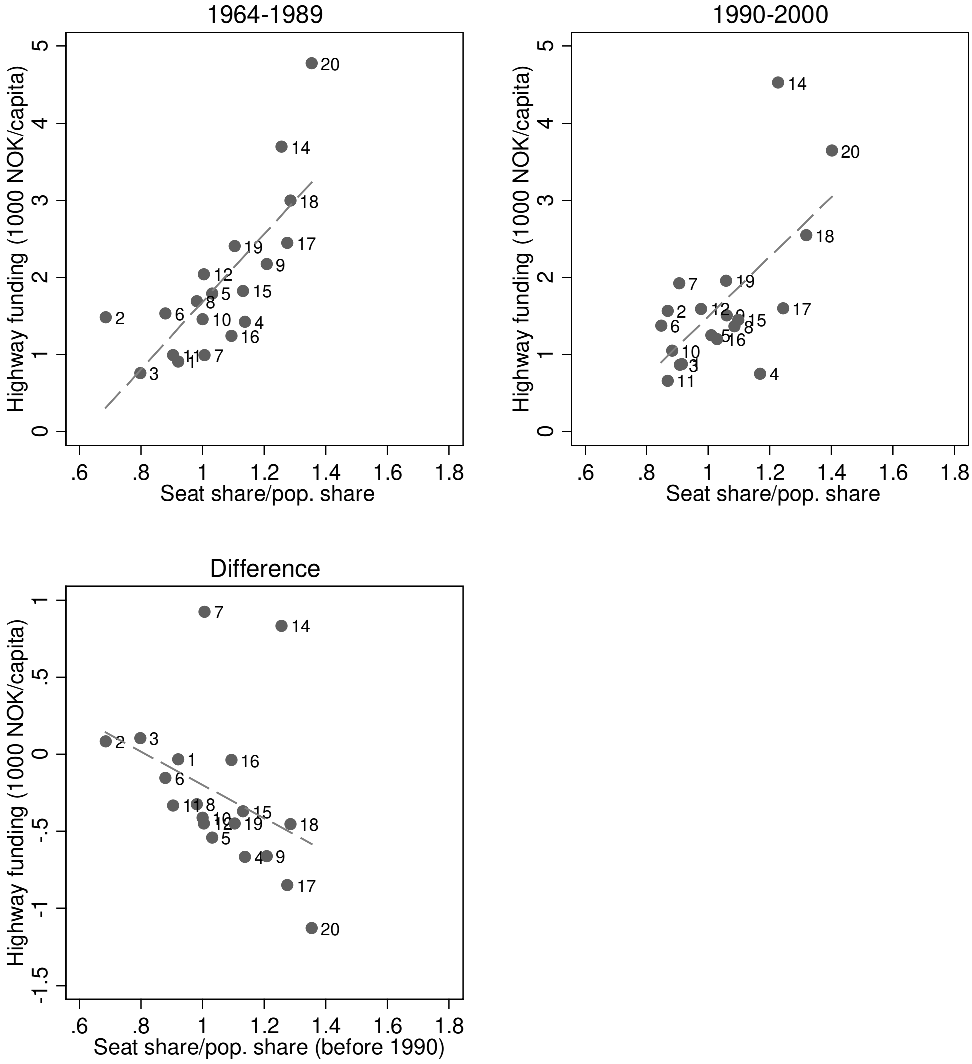


*Figure 7. Central government road funding in the electoral district vs. overrepresentation in Parliament in 1964-1989 and 1990-2000, not including user charges and regional co-financing.*