TØI report 752/2004
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Summary:

Financial framework and development of the public transport sector in six Norwegian cities

The Norwegian Ministry of Transport and Communications has set up a programme – called POT – for primary transport research. Support has been given within this programme to the project ”Alternative urban transport funding – socio-economic evaluations of alternative forms of shared funding for Oslo, Stavanger, Bergen and Trondheim”[1]. The aim of the programme is to analyse the benefits of setting up different forms of shared funding *(“transport funds”)* in Norwegian cities, based on a combination of different national and local financial packages. We want to assess the extent to which the benefits of the programmes depend on the constraints which are imposed on their use. This requires a good knowledge of local transport markets, of the players' ability to adapt to different incentives, and of the significance of constraints and degrees of freedom which apply to the local decision making process.

Objectives and methodology

In order to evaluate the benefits of *alternative* forms of funding, one needs a good description of the current funding arrangements and of how these have developed in recent years. In this study we analyse the consequences of changes in funding framework conditions for public transport, i.e.

1. Which factors can explain differences and changes in the level of subsidies?
2. How will changes in the subsidy level affect service provision?
3. How have changes in provision affected the demand for public transport?
4. To what extent have different cities adapted differently and can the framework conditions in each city explain any of these differences?

The aim of these analyses is to chart the internal connections between funding, service provision and demand for public transport. In this context, fares will play a central role both because they affect demand and because they contribute to the funding.

In order to analyse the effects of changes in the framework conditions for public transport, we need to include all the direct and indirect effects of these changes. We have therefore chosen to carry out a simultaneous analysis of all the variables which can be affected by these altered framework conditions (figure S.1). In this figure the effects on car ownership and public transport journeys will form the *passengers’ adaptation* to changed framework conditions, while the effects on costs, public transport provision and fares will form the *authorities’ and operators’ adaptations* to the same changes.· It may

[1] The project has the acronym ALTFIN

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therefore be appropriate to discuss the results from these analyses based on two different market-related effects:

1. **Demand effects** (journeys by public transport and car ownership).
   These are analyses of how passengers adapt to the changed framework conditions.
2. **Public transport provision effects** (service provision, fares and cost effectiveness).
   These are analyses of how the authorities and operators adapt to changes in framework conditions.

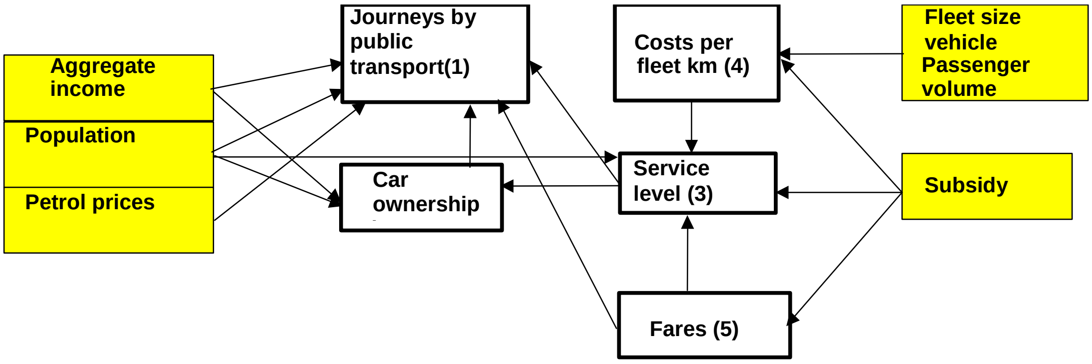

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Figure S.1: Illustration of the internal connections between funding, public transport provision and demand for public transport. The internal/dependent variables in the analysis are illustrated by (1)-(5) and the external explanatory variables are shown in yellow boxes.

These analyses are based on a time series analysis of the passenger numbers for public transport in the four cities covered in the project. In addition we have included data for Tromsø and Kristiansand in order to have a broader data set as the basis for the analyses.

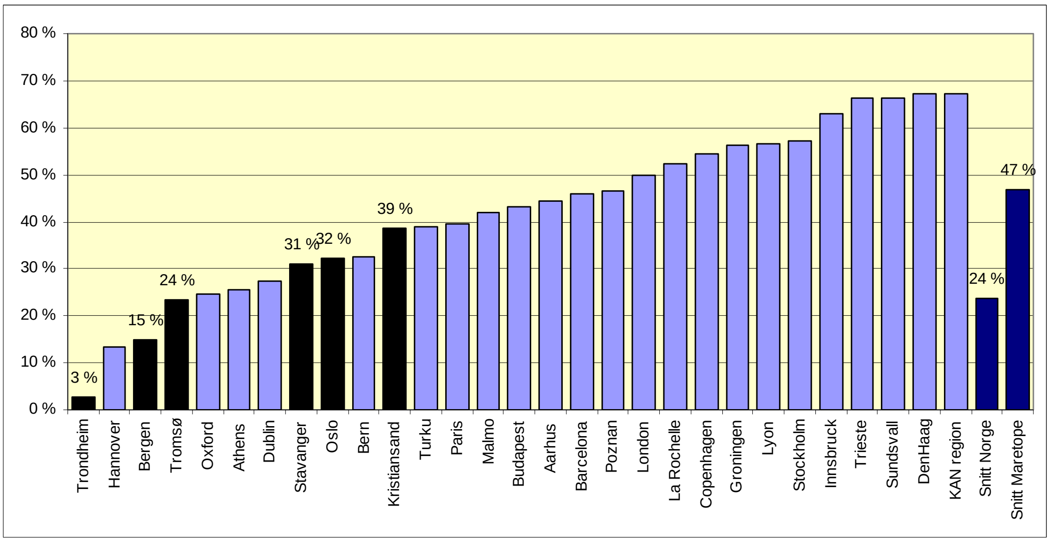
Subsidy and levels for public transport in Norway are amongst the lowest in Europe

Public transport needs subsidies in order to be able to develop a socially optimal service. One of the main problems with the current organisation and funding of public transport is that ”good economics" for society can often be “bad economics” for public transport companies. One example is increased frequency; a profit maximising firm will only increase frequency if the increased revenue exceeds the costs. A welfare maximising form will also include the benefit for the existing passengers in the calculations. A profit maximising public transport system can therefore lead to a socio-economically ineffective use of the capacity within the system.

At the same time, high public subsidies are no guarantee of socio-economically effective operation and increased subsidies do not automatically result in socio-economic benefits. For example, subsidies for public transport in European cities are far higher that in Norway and many of the cities have a great potential to cut subsidies without this affecting public transport provision or fares (figure S1). A comparison of 29 European cities was carried out as part of the EU's MARETOPE[2] project. Here we can see that the

[2] MARETOPE: *Managing and Assessing Regulatory Evolution in local public Transport Operations in Europe.*

six Norwegian cities which were included in our analyses are situated towards the lower end of the scale.



Sources: MARETOPE and TØI unpublished material

Figure S.1: Public purchase as proportion of total costs for a number of European cities in 1999 and for the six Norwegian cities.

All comparisons of this type will be subject to uncertainty because they will depend on how the subsidies for public transport are calculated. Firstly, there are a number of indirect subsidies, which to varying degrees have been taken into account in the subsidy figure. The most common are different forms of rebates on taxes, fees or credit subsidies. In the MARETOPE project the emphasis was on correcting for as many of these indirect subsidies as possible. Among the cities in the MARETOPE project which had decomposed the subsidies in this way, the average subsidy proportion was 43 per cent, while the direct subsidies comprised 32 per cent. This means that indirect subsidies made up around one quarter of the total subsidies in these cities.

Public transport services in many Norwegian cities today are run with ever smaller subsidies from the central or local government. This is partly a result of tighter county government finances, increased use of effectiveness agreements, and the actual or potential use of tendering. For the six city areas overall the subsidies have been reduced by around NOK 400 million (2002-kroner) from 1986 to 2002, which corresponds to a 30 per cent reduction in real terms (figure S.2).

However, we also see that the downturn is reversed around 1997, when subsidies were only half as large as in 1986. Since 1986 subsidies have increased in the majority of cities, the average increase being around 60 per cent as compared to the lowest level in 1997.

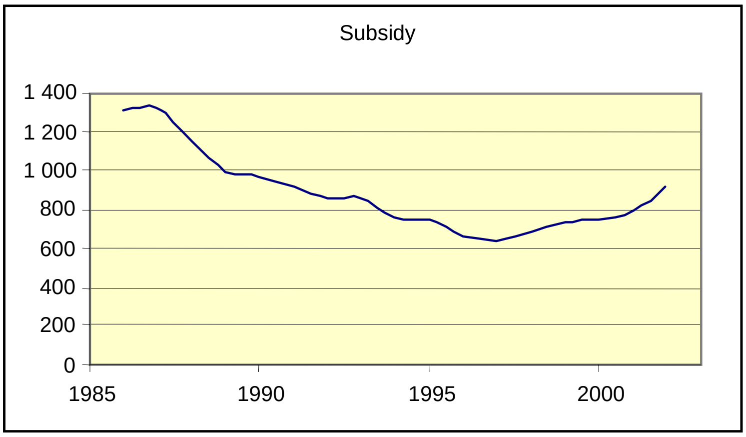


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Figure S.2: Development in total subsidies for public transport in the six cities. Figures shown in million 2002-NOK per year.

Fares have increased but not more than fuel prices

The major reduction in subsidies in these cities has had an effect on fares. When the subsidies are reduced, then either costs must also be reduced or fares must increase to compensate for the loss of revenue. On average, the prices for public transport have increased by about 15 per cent in this period, as measured in real terms (figure S.3).

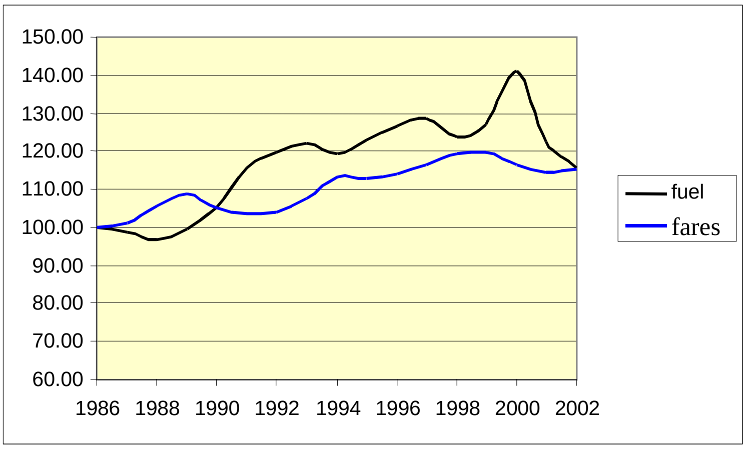

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Figure S.3: Relative development in fares and fuel prices, as measured in real terms.

These reached a peak around 1998/99 prior to an actual decrease in more recent years. Fuel prices have increased similarly in this period but much more unevenly. In fact the relative price development has favoured public transport for most of this period. In 2000, the relative price of fuel was 40 per cent above the 1986 level, while the increase for public transport fares was only half as large.

This means that the reduced subsidies have led to increased fares, but since fuel prices have increased by at least as much in this period, the demand effects of the increased fares have been dampened.

Even though the average fares have increased at least as much as fuel prices, there are major differences between the cities. Bergen has clearly shown the largest increase in fares of all the cities in our study, with increases of more than 50 per cent from 1986 to 2002, while Kristiansand is the only city with reduced fares for this period (figure S.4).

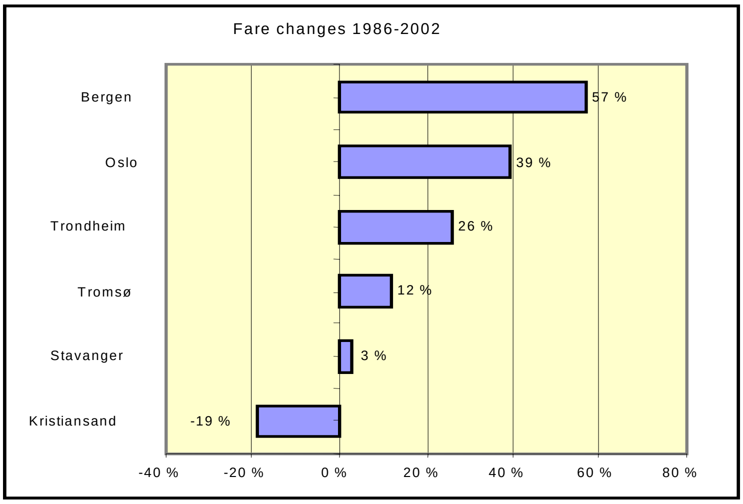

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Figure S.4: Average changes in real fares for the six cities 1986-2002.

There is a clear association between the level of subsidy and fares. The cities which have the lowest level of subsidies also have the highest fares and the strongest fare increase. The exception is Oslo, which has a high level of subsidies and a strong increase in fares.

More effective operation

Important cost effectiveness measures have been implemented between 1986 and 2002 (figure S.5). From 1986 to 1999 the cost per fleet km was reduced by 15 per cent. However, after 1999 the costs increased relatively strongly so that the relative cost level today is just about 5 per cent below the 1986 level. The powerful increase in recent years is largely due to Oslo, where there has been a significant escalation of investment and maintenance. If we look at the development in the other five cities, we see that cost rationalisation has continued, but somewhat more unevenly. Taken together, these five cities have costs per fleet km which are almost 30 per cent lower than they were in 1986.

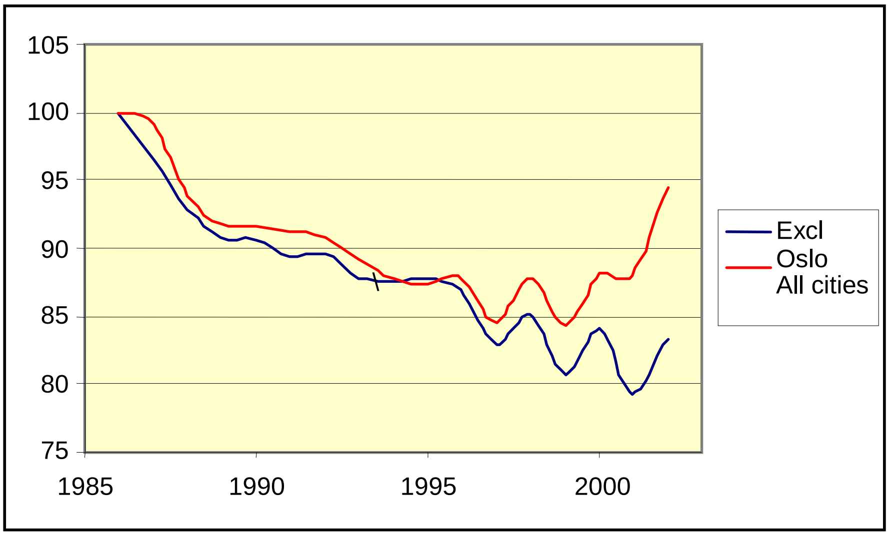

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Figure S.5:Relative development in costs per fleet km for the six cities measured in real terms. All six cities, and all expect Oslo. Index 1986=100.

The number of journeys by public transport per inhabitant has gone down from 136 per year in 1986 to 124 per year in 2000. This is a 10 per cent reduction, where the entire decrease occurred before 1990, while the period after 1990 has shown some increase. Oslo is one of the cities which have seen a market growth in the number of journeys by public transport in the 1990s (figure S.6).

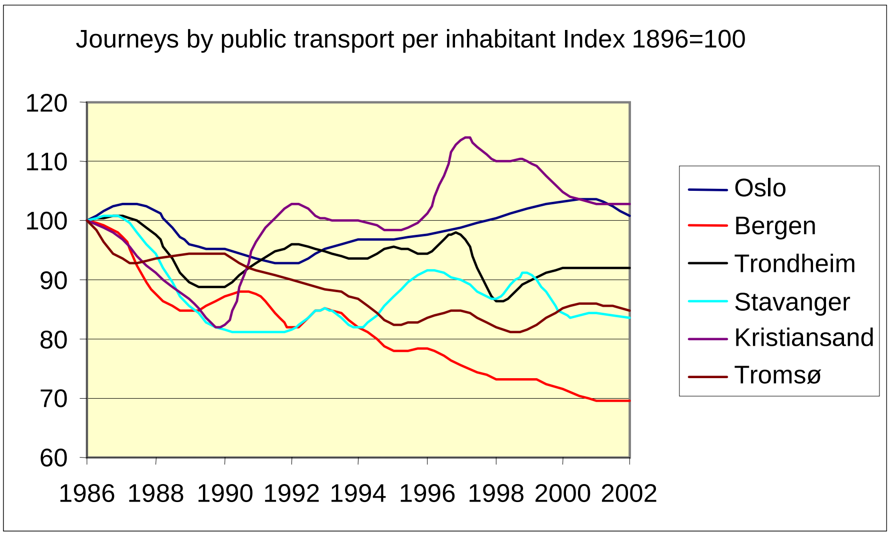

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Figure S.6: Relative development in the number of journeys by public transport per inhabitant. Index: 1986=100.

How public transport companies have adapted to changes in framework conditions

The main purpose of our analyses was to assess how public transport in the different cities adapted to changes in the funding framework conditions, and particularly with regard to altered subsidy frameworks. These analyses show that a 10 per cent reduction in the subsidy frameworks, measured by subsidy per inhabitant, will result in a 1.4 per cent reduction in routes, a 0.6 per cent cost reduction and 0.9 per cent increase in fares (table S.1). These analyses show that a 10 per cent increase in either fares or subsidies will have about the same isolated effect on routes, with an increase of around 1.5 per cent.

At the same time these effects show that an increase in cost effectiveness will have a large effect on route provision, in that the entire cost effectiveness improvement appears to come from increased route provision. 10 per cent increase in cost effectiveness, according to our analyses, will result in an 11.7 per cent increase in service provision. This effect tends to reduce the negative effects of the subsidy cuts mentioned above.

Table S.1: Final model for the partial and simultaneous analyses. Elasticities.

Effect wrt	Factor	Elasticity
Fleet km per capita	Subsidy per inhabitant	0.14
	Fares per journey	0.15
	Costs per fleet km	-1.17
Cost per fleet km	Subsidy per inhabitant	0.06
	Fleet size	0.92
	Load factor	0.61
Fares per journey	Subsidy per inhabitant	-0.09

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Cities have chosen varying financial strategies

The subsidies are an important part of the funding basis for public transport in these cities. Changes in the funding framework could therefore affect service provision, fares or the cost effectiveness of the service. In this analysis, we found that the cities had adopted varying strategies depending on whether they were cutting or increasing the subsidies (table S.2):

- ✓ *Kristiansand* has used the increased subsidies to increase route provision and, to a lesser extent, to reduce fares. *Stavanger* has also emphasised financing increased services rather than lower fares, but the effects are not as clear as they are in Kristiansand.
- ✓ *Oslo* stands out from the other cities in this study in that there is a very strong connection between changes in subsidies and adaptations in the service provision. A 10 per cent reduction in subsidies has led to a 3.4 per cent increase in fares and a 5.1 per cent reduction in costs. This latter effect is partly linked with a powerful increase in the costs of rail modes in recent years, which has been followed up by increased subsidies. When we look at the period before the cost increases in Oslo, i.e. before 1998, the effect sinks to 0.15, i.e. only just above the level for the other cities.
- ✓ Among the other cities which have cut subsidies, *Tromsø* has taken a relatively large part of the cuts in both fares and service provision, compared with the other cities. Only *Bergen* has a similarly large relative ”fare funding” of the subsidy cuts while Trondheim has a relatively large effect on cost effectiveness. This means that

the major subsidy cuts in Trondheim have been a contributory cause of the major cost reductions in this city.

Table S.2: The effect of changed subsidy frameworks on service provision, fares and cost levels. Percentage change in service provision, cost effectiveness or prices per percentage change in subsidy per inhabitant. Results from local models partial models.

	Cities with cuts in subsidies				Cities with increased subsidies		
	Oslo	Bergen	Trondheim	Tromsø	Stavanger	Kristiansand	Average
Fleet km/inhabitant	(-)	0.02	0.02*	0.12	0.10	0.44	0.11
Costs/fleet km	0.513	0.027	0.059	(-)	0.106	(-)	0.06
Price per journey	-0.34	-0.15	-0.06	-0.16	(-)	(-)	-0.09

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How passengers adapt to changes in service provision

The simultaneous analysis means that we can analyse the ways in which the public transport companies can adapt to reductions in subsidy frameworks in the form of changed service provision and fares, and the demand effects of these changes. When we concentrate our attention on the demand effects (table S.3) these simultaneous analyses show that:

1. *Reduced fares result in more passengers*
These analyses give an isolated fare elasticity of around –0.5, i.e. a 10 per cent fare reduction will result in a 5 per cent increase in demand for public transport. This is a higher price sensitivity than we have found in previous studies and in the partial analysis. This is partly due to the fact that we have taken account of the indirect effects of fare changes, not least as a tool for financing a better service.

2. *Increased service provision results in more passengers*
The effects of increased service provision are lower than we have found in previous studies, with a service elasticity of 0.09 for all the cities taken together. This means that a 10 per cent increase in service production will result in a 0.9 per cent increase in the number of journeys by public transport.

3. *More cars mean a reduction in demand for public transport*
Increased car ownership results in fewer journeys by public transport. A 10 per cent increase in car ownership results in around 3.8 per cent fewer journeys by public transport. However, this effect is lower than we found in the partial analyses. Nonetheless these effects are powerful, not least in view of a situation where income, and hence car ownership, is expected to rise.

4. *Better economy results in more travel and more journeys by public transport*
When people have more money, travel will increase and hence the demand for public transport will also increase. In all, this gives an income elasticity of 0.34, i.e. a 10 per cent increase in income results in 3.4 per cent more journeys by public transport. This is a relative high elasticity and might be related to the “income effect” on social life in the city centre and related public transport demand.

5. *There is an underlying negative trend*
There has been a general downward trend in the demand for public transport of 1 per cent per annum. This means that even if fares, service provision and level of income remain unchanged, public transport will steadily lose market shares. Hence, continuous, targeted product development must take place in order for public transport to maintain its market share.

6. *Increased economic growth results in increased car density*
   Thie income development in the cities is the most important factor in explaining the development in car ownership. A 10 per cent increase in income levels will result in an approximate 2.3 per cent increase in car density.

Table S.3: Final model and simultaneous analyses. Demand effects

Effect wrt	Factor	Elasticity
Public transport journeys per inhabitant	Fares	-0.53
	Fleet km/inhabitant	0.09
	Fuel price	(-)
	Car density	-0.38
	Income	0.34
	Trend	-0.01
Car density	Income	0.23
	Fleet km/inhabitant	(-)

(-) Not significant at 10 per cent level
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The demand effects are greatest in the smallest cities

We have also carried out partial analyses of the demand in each individual city in order to study whether there is any difference in the demand effects (table S.4). On the whole, the local models for demand for public transport show two clearly significant effects with regard to fares and service provision:

1. *Price sensitivity* varies strongly between cities. Passengers in Bergen, Kristiansand and Tromsø have the greatest price sensitivity, around 60%, higher than the average for the cities. Price sensitivity is around half the average for Oslo and Stavanger. In Trondheim no significant price sensitivity has been observed amongst passengers.

2. The effects of *changes in service provision* vary even more in the local analyses. Here, Trondheim, Stavanger and Kristiansand have the highest service elasticity of around 0.6, versus about 0.2 in Bergen and Tromsø and 0.1 in Oslo.

Table S.4: Demand for public transport per inhabitant according to local models. Total result files in appendix 3.

	Oslo	Bergen	Trondheim	Stavanger	Kristiansand	Tromsø	Average
Fares	-0.22	-0.52	(-)	-0.32	-0.59	-0.52	-0.32
Service provision	(-)	(-)	0.60	0.63	0.61	(-)	0.35

(-) Not significant at 10 per cent level
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Long term effects of subsidy cuts

Within this project it has been of particular interest to study the long term effects of reduced subsidy levels. Thus, we have attempted to calculate the multiplicator effects of the subsidy cuts which were put into effect for the six cities as a whole. Between 1986 and 2002 the total subsidies per inhabitant were reduced by 40 per cent as measured in real terms. As an illustration, we will now look at the consequences of a similar cut in subsidies in 2000.

The direct effects of this type of subsidy cut will be reduced service provision, cost reduction and increased fares. Table S.5 shows the direct effects of this type of subsidy cut, which can be financed by a 3.6 per cent increase in fares, 5.6 per cent reduced service provision and 2.4 per cent cost reduction. In total this will result in a saving of NOK 306 million3, i.e. around NOK 30 million less than the finance requirement. This lies within the range of uncertainty in these analyses and will depend on the time horizon we are looking at.

Table S.5: The direct multiplicator effects of 40 per cent reduced subsidy. Percentage and economic effects (in million NOK 2000).

	Relative ch-ange	Change (mill NOK)
Reduced subsidy	**-40.0 %**	**-335.2**
First order effect		
Fares	3.6 %	73.3
Costs	-2.4 %	69.8
Fleet km/pop	-5.6 %	162.8
Total		**305.8**

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When cuts in subsidies are financed through reduced service provision or increased fares, the multiplicator effects will be reduced demand and hence reduced revenue within public transport. This will act as an ordinary cut in subsidies for the public transport companies, necessitating further measures to cut costs or boost revenues. These multiplicator effects will be described as second order effects of reduced subsidies. In addition we will take into account the shortfall of around NOK 30 million, which was discussed above.

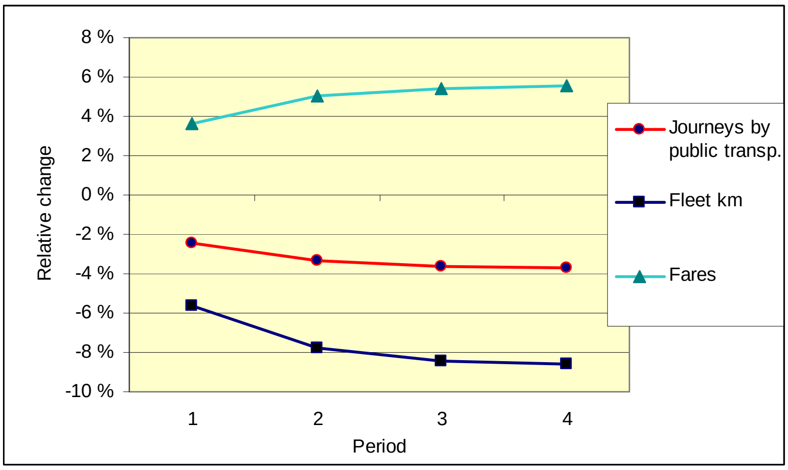

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Figure S.8: Short and long term effects of a 40 per cent cut in subsidies to public transport in the six largest cities. Model calculations based on the simultaneous analysis.

These multiplicator effects illustrated in figure S.8. Following a 40 per cent subsidy cut, we see that the fare increase, which was 3.6 per cent in the first stage, increases to almost 6 per cent in order to cover the multiplicator effects of a further drop in passenger numbers. At the same time the decrease in passenger numbers will reach almost 4 per cent and service provision will be reduced by over 8 per cent. In total this gives a long term effect of the subsidy cuts which is about 50 per cent higher than in the short term.

[3] In these simple calculations we have assumed a fixed average cost per fleet km as a basis for calculating the savings from reduced service provision

Simultaneous analyses provide new knowledge

In this project we have carried out a simultaneous statistical analysis of the public transport market, where we have looked at both the direct and the indirect effects of changed framework conditions. An important element in this analysis has been how the cities adapt to the changes in the subsidy frameworks.

We have also seen that changes in fares have an effect on both demand and subsidy, i.e. that lower fares will have a direct effect in the form of increased demand and an indirect effect in the form of less revenue and lower service provision.

These indirect effects mean that the factors which are included in the demand analyses - service provision and fares in particular - are not independent. A simultaneous analysis will therefore give completely different results from a partial demand analysis. This is the first time we have undertaken this type of analysis of the public transport market and it is therefore difficult to say how robust our results are. However, the strong association between fares and service provision suggests that simultaneous analyses are needed in order to avoid bias in the demand effects. A broader data set, with longer time periods and a broader cross-sections of cities would probably provide a better understanding of the differences between simultaneous and partial analyses of public transport demand.