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Use and efficiency of public transport: the effects of price and service measures

Abstract
Like in many other countries in the Netherlands, , the government of the Nethertlands assigns public transport an important role in its transport policy. However, the costs of public transport do exceed the revenues of it. Price may be an important variable to both increase the use of public transport and to improve the costs/benefits ratio. Unfortunately, little knowledge is available with regard to the effects of price measures. In the paper two questions are answered. First, the influence of price measures on the use of public transport, the costs/benefits ration and the modal split is discussed. Then, the change of structure in the Netherlands and its implications on the probability that price measures will be taken is described and discussed. It is concluded, that price does influence the demand for public transport. Besides, because of the financing system it seems less unlikely than desirable that regional/local authorities will implement price measures.

THE USE AND EFFICIENCY OF PUBLIC TRANSPORT : THE EFFECTS OF PRICE AND SERVICE MEASURES

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1 INTRODUCTION

In transport policy in the Netherlands, like in many other countries, the government assigns public transport an important role. At the moment, however, only few travellers use public transport. Goal of the policy is to increase the use of public transport while reducing the use of car. Unfortunately, this aim seems to conflict with financial arguments. From a financial point of view, the supply of public transport is expensive. The costs of public transport exceed the financial revenues of it to a great extent. The income generated by selling tickets only covers approximately 35 % of the costs of public transport. As a result, in the Netherlands in many regions the supply of public transport is threatened. Public transport connections between cities or villages are closed because of the unacceptable cost/benefits ratio. A consequence of closing these connections may be that the attractiveness of public transport gets worse. Less people will use public transport, reducing the costs/benefits ratio of other connections as well. A negative spiral might be the result. And hence, the policy goal to increase the use of public transport may not be attained at all.

This negative spiral in the Netherlands is partially the result of the way public transport is financed and organised. Regional authorities are responsible for the supply of public transport in their region. On the other hand, it is the central government that supplements every sold ticket in the region with a grant. Till the end of the year 2000, the central government made two important demands on the regional authorities. The first demand was that regional authorities are not authorised to change fares considerably. The central government sets the fares and regional governments may on average not diverge from these fares by more than 10 percent. The second demand was that all through the country uniform tickets can be used to pay the fare.

Nevertheless, although a number of measures have been taken tot increase the attractiveness of public transport, price seems to be an important variable as well. Considering the fact that the administrative structure made it very difficult or even impossible to use price measures in public transport policy, the central government realised that changing the administrative structure might be necessary. Changing the rules might lead to a more perfect public transport market in which price is a more important variable. Changing the rules may have a positive influence on the attainability of the goals. Therefore, the law has been changed. Since the beginning of 2001 the new Wet Personenvervoer (law regarding public transport) is effective.

In this paper two main questions will be answered:

- what influence does price have on the use of public transport, the cost/benefits ratio and the modal split?
- will the change of structure in the Netherlands lead to an increase of the use of price measures in public transport policy**?**

To answer the first question apart from literature study a number of cases have been studied. To answer the second question in the first place the situation before 2001 and the situation

after 2001 have been studied and compared. Comparing and analysing the new Law, conclusions will be drawn with respect to the probability that price measures will be used in public transport policy.

In the following paragraph the first question will be answered. In paragraph 3 the situation till 2001 will be described, in paragraph 4 the new situation. Finally, some conclusions will be drawn and recommendations will be given.

2. THE INFLUENCE OF PRICE

2.1 Introduction

To answer the first question both literature and several cases have been studied. Theoretically, the law of demand states that a price change will have an inverse effect on the quantity of the good purchased. Relatively little research has been carried out on the elasticity of the demand for public transport. Whether the demand for public transport is relatively inelastic or relatively elastic is uncertain. Nevertheless, it may be expected that an increase of the prices in public transport will result in a decrease in the demand for public transport.

To gain more insight into the effects of price measures in public transport, a number of financing methods and effects of implemented measures within these systems on the use and level of service of public transport and car mobility on the one hand and the benefits and the costs/benefits ratio on the other hand have been studied.

The financing systems of Apeldoorn (Netherlands), Dordrecht (Netherlands), Twente (Netherlands), Hasselt (Belgium), England, Basel (Switzerland) and Freiburg (Germany), Trenton (USA), Denver (USA), Atlanta (USA) and Los Angeles (USA) have been studied. In all of these cities/regions specific measures have been implemented. These varied from a reduction of the fare to introduction of free competition and an increase of the frequency of public transport. In the following paragraphs the mentioned regions/cities and their measures and effects will be described shortly.

2.2 Apeldoorn

In Apeldoorn (150.000 inhabitants), subjected to the Dutch financing system, in 1991 the local government decreased the fare and increase the frequency at peak moments (Saturday, Thursday-evening, special Sundays). These measures influenced traveller behaviour. Effects were both positive and negative.

A significant increase of the use of public transport and a slight decrease of car mobility were attained. There were some negative effects as well. In the first place, the measures resulted in an increase of the financial expenditures for the local government. The increase in

the use was not sufficient to compensate for the loss of income per passenger. As a consequence, the costs/benefits ratio worsened. Besides, the increase of the use resulted in fully occupied busses. In general, passengers experience this to be negative. Another negative effect is, that the increase of the use led to a decreasing reliability of public transport. Busses could not hold their schedule. The city of Apeldoorn tried to cope with these problems by increasing the number of busses, what subsequently caused another cost increase.

2.3 Dordrecht (NL)

Dordrecht (110.000 inhabitants) faced a very low costs/benefits ratio. To increase this ratio and to increase the attractiveness of public transport, the city of Dordrecht implemented a number of measures since 1995. These measures were a decrease of the fare in the centre of the city, a considerable increase of the frequency, product differentiation and a kind of fare increase outside the centre.

At first these measures seemed to be very successful, but at the end, the measures turned out to be disastrous from a financial point of view. Although the level of service increased, the use of public transport did not increase. Car mobility did not decrease. While traveller behaviour was not influenced, the costs for the local government increased incredibly and the costs/benefits ratio worsened considerably. In 1998 the Dordrecht system turned out to be a financial disaster, costing the city of Dordecht millions of guilders. In trying to deal with the problems, several measures, like decreasing frequencies and skipping services, were taken in 1998 and 1999. Unfortunately, these measures did not suffice and the whole system had to be abandoned.

2.4 Twente (NL)

In Twente (600.000 inhabitants), in 1994 a modest fare decrease has been introduced. This fare decrease was effective after 9 AM. Starting with the fare decrease in two cities, in 1997 it was effective in the whole region of Twente.

In 1998 the fare decrease seemed to have resulted in both a (modest) increase of the use of public transport and a slight improvement of the costs/benefits ratio. With respect to the effect on car mobility no conclusions could be drawn. Probably there will not have been a significant effect.

In 2000, however, from a financial point of view the results showed out to be not as positive as expected. Therefore, the experiment was ended.

2.5 England

In England, free competition in public transport by bus has been introduced in 1986. This free competition has resulted in different effects.

In general, the deregulation resulted in a decrease of the operational costs of public transport and an increase of the supply of public transport. On the other hand, the fares increased as well, especially in the big cities. Whereas fares increased by approximately 8% really at the countryside (outside the big cities), in the big cities the fares increased by 40%. And although frequencies increased, a higher quality of public transport was not effected. On the contrary, as a consequence of higher uncertainty, less information and more instability of the public transport network, consumers trust in public transport decreased. This resulted in a decrease of public transport travellers. Between 1984 and 1993/94 the number of passengers decreased by more than 20%.

2.6 Hasselt (B)

In the city of Hasselt (70.000 inhabitants), in Belgium, the municipality faced a deterioration of the accessibility of the inner city. More than forty percent of the car drivers in the inner city did not have their origin or destination in the inner city. On the other hand, the costs/benefits ratio of public transport was extremely low (14%). The municipality decided not to invest in extra car infrastructure (including parking area) but to use the financial means to pay for public transport totally. Since July 1997, the use of public transport in Hasselt by inhabitants of Hasselt is free. Besides, the frequency of buses has quadrupled and the number of bus stops has doubled.

Both traveller behaviour and costs/benefits ratio changed significantly. Whereas a quadrupling of the number of bus passengers in 2001 was foreseen, in November 1997 the number of users of the buses had already been increased by a factor eight (compared to November 1996). Approximately half of the bus passengers claimed to visit the city of Hasselt more frequently. One third of the bus trips is a new trip. Of the other trips, a quarter has been made before by car. So, the decrease of the fare resulted in a reduction of the car mobility. On the other hand, due to the free bus transport, a lot of pedestrians and cyclists choose to use the bus. As a consequence, the share of walking and bicycling in the modal split have decreased.

The costs/benefits ratio has been deteriorated. Benefits have been reduced to zero, costs have been risen due to the increased service level and the extra busses.

2.7 Freiburg (D) and Basel (CH)

Both Freiburg (the region counts 600.000 inhabitants) and Basel faced a low and even deteriorating costs/benefits ratio. Besides, an increasing pollution and a decreasing traffic safety forced these cities to take measures.

In the 1980s the cities decided to take measures to increase the share of public transport and bicycle in the modal split. Parking fees were increased and the public transport fare has been reduced.

Season-tickets are provided. Very characteristic is that these tickets are not personal; at different times different persons can use the ticket to travel. Another variant of the ticket is a ticket, valid during peak hours for only one person and otherwise valid for more persons travelling together.

This system resulted in a substantial increase of sold tickets. Research in Basel showed that the introduction of the season-ticket in 1984 resulted in an increase by 68% of the number of sold tickets. More than half of the buyers stated that the attractive price of the ticket was an important reason to buy the ticket.

In both Basel and Freiburg the strong growth of car mobility was stopped and turned into a decrease. The use of public transport increased, the use of car decreased. In Freiburg the number of car trips in 1998 appeared to be as high/low as in 1978. In Basel the number of car trips in 1985 decreased by 4%.

And, important as well, the costs/benefits ratio improved significantly. As a result of the growth of the amount of sold tickets the benefits increased considerable. On the other hand, as a consequence of the steady level of service, the costs did not increase.

It may be concluded, that this system can be valued very positively.

2.8 Trenton (USA)

In Trenton during the period March 1978-March 1979 in off-peak hours public transport was free (decrease of the fare). Purpose of this experiment was to investigate the effects of free public transport.

The decrease of the fare resulted in an overall increase of the use of public transport of 24%. In off-peak hours the use increased by 46%. However, in off-peak hours the attractiveness of public transport was negatively influenced because of provoking and rioting behaviour of, in general, younger people. The costs/benefits ratio decreased. Benefits decreased by 25%, whereas costs increased.

2.9 Denver (USA)

In the 1970s Denver was facing increasing pollution and energy problems. The local authorities decided to investigate the behaviour and opinion of the citizens and started an experiment. In this experiment, the fare of public transport in off-peak hours was reduced to zero and the level of service was increased.

The use of public transport increased considerably. Overall, this increase was 49%. 15% was due to the increase of the level 34% the result of the zero-tariff. In off-peak hours the increase in the number of passengers amounted between 74% and 155%. In Denver, the number of aggressive and provoking passengers in the busses, increased during the experiment.

The costs of the experiment amounted $7 million. The annual loss of benefits as a result of the zero-tariff has been estimated at $3.7 million. Not surprisingly, the costs/benefits ratio deteriorated.

2.10 Atlanta (USA)

In 1972, in Atlanta the Metropolitan Rapid Transit Authority (MARTA) implemented a short-range transit improvement program. The fares were decreased considerably. The fare was decreased from $0.40 to $0.15 per trip, being a reduction by 60%. Besides, the level of service was improved. Among these improvement were new busses, new and changed bus routes and an improvement of the service schedule.

The decrease of the fare resulted in a growth of the number of bus passengers by 19%. Furthermore, among the new bus passengers were former car drivers. Hence, the modal split may have been changed.

2.11 Los Angeles (USA)

In July 1982 in Los Angeles a three-year program started. Goal of this program was to increase the use of public transport. To reach these goals the fares were reduced and the service was increased (more busses). With regard to the fares, both the prices of one-way tickets and the prices of month-tickets were reduced (dependent on the kind of ticket by 40-85%).

These measures resulted in an increase of the sale of tickets and month-tickets. The sale of month-tickets grew by 70%. After three years the number of travellers appeared to have been increased by 40%. Although the number of users increased, this increase did not suffice to meet the loss of benefit per user. As a consequence, the benefits decreased. On the other hand the operational costs increased. Hence, the costs/benefits ratio decreased.

2.12 The effects of price measures summarised

From the described cases it may be concluded, that a decrease of the fare may have positive effects on the amount of travellers using public transport. As the cases of Freiburg and Basel show, using season-tickets can commit travellers to public transport. These positive effects on the costs/benefits ratio may be larger than the direct negative effects of lower fares per traveller. In most cases where the prices of public transport have been decreased, the number

of users increased and the costs/benefits ratio deteriorated. In table 1 a general overview is given of the in the preceding paragraphs described cases.

Table 1: Price measures and systems compared

City/region	Measures	Effects* use of public transport	level of service	revenue of travellers	costs for regional authority	cost/benefit ratio	use of cart
Apeldoorn	• decrease of fare (at certain moments) • Increase of frequency	+	+	-	+	-	-
Dordrecht	• Product differentiation • decrease of fare in centre • Increase of frequency • global increase of fare	0	+	+	+	-	0
Twente	• decrease of fare	+	0	0	0	0	(-)****
Engeland	• concurrency • market (in general increase of fare) • Increase of frequency	-	0**	nvt	-	nvt	?
Hasselt (Belgie)	• decrease of fare (free transport for inhabitants Hasselt) • Increase of frequency	+	0***	-	+	-	-
Basel/Freiburg (Duitsland)	• decrease of fare (environment-card)	+	0	+	0	+	-
Trenton (VS)	• decrease of fare (free in off-peak hours)	+	0	-	?	?	?
Denver (VS)	• Gratis daluren	+	+	-	+	-	?
Atlanta (VS)	• decrease of fare	+	+	-	+	-	?
Los Angeles (VS)	• decrease of fare	+	+	-	+	-	?

* "+"means an increase or an improvement;
"-"means a decrease or a deterioration.
Service level is related with measures with regard to frequency, comfort etcetera.

** on the one hand the increased frequency resulted in an improved level of service, on the other hand the growing uncertainty and reliability, the increasing lack of information and the increased instability of the provision resulted in a deteriorated service level.

*** a higher frequency may be rewarded to be positive, (over-)crowded busses will be valued negative by travellers.

**** Car mobility decreased among incidental travellers.

As could be expected from theory, price changes have an inverse effect on the quantity of the good purchased (the use of public transport). However, the price elasticity of demand appears not be constant, but influence by a number of variables:

- the transport market. If the demand for public transport is maximal (100%), another price decrease will not result in an increase. It may be expected that the smaller the share of public transport in the modal split and the bigger the (latent) demand (that has not been supplied with), the larger the price elasticity of demand will be.

- the starting price. If the starting price is relatively low, price elasticity (of a decrease) will be smaller than if the starting price is relatively high.
- the size of the price change. It may be expected that a big price change will have a larger elasticity of demand than a small price change.
- the group of travellers. Users that do not have an alternative are less likely to be influenced by price changes than users that do have an alternative.
- the length of the trip. The elasticity of demand for long-length trips will be smaller than the elasticity of demand for short-term trips, because with regard to short-term trips usually more alternatives are available (like bicycle).
- time of the day. In off-peak hours the elasticity of demand will be larger than in peak-hours.
- time. Price elasticity of demand on the short-term will differ (be larger than) from the elasticity on the long-term.

3. THE ROLE OF PRICE IN THE 20TH CENTURY

Since the 1960s in the Netherlands public transport is not able to cover its costs. Because the central government assigned public transport important functions, the government decided to subsidise public transport. The possibility for people to travel and to increase the accessibility of cities and to substitute for car mobility are some of these important functions. The system of subsidising public transport has been changed a couple of times. In 1998 the present system was introduced. According to this system, the central authorities subsidise public transport using two main criteria :

1. the use of public transport. The number of sold tickets is used to define the use of public transport;
2. some other characteristics of the regions/cities like the social function of public transport in the specific regions and the existent infrastructure. The central authorities state that more rural areas should have some form of public transport that would not exist if only subsidies were given using the first criteria. Besides, according to the central authorities regions/cities possessing rail infrastructure need more money to maintain their (specific) infrastructure than regions/cities possessing road infrastructure (used by cars as well).

Whereas the first criterion is dependent on the use of public transport, the second is not. In general, the subsidy is dependent on the first criterion for approximately 80%.

Till the 1970s fares were set by local government. However, the central authorities got an increasing role in financing public transport. As a consequence, the central government claimed that :

- the Secretary of State should set the fares;
- the tickets should be uniform. Buying a ticket in Amsterdam and travelling with it in The Hague became possible.

Hence, local governments had to conform to the centrally set fares. Only to a very small extent the local governments could vary the prices. If they would like to change prices to a

larger extent, they needed permission of the central authorities. In practice, experiments with price measures were rare (and marginal).

4. THE ROLE OF PRICE IN THE 21ST CENTURY

4.1 Introduction

In the 1980s public policy changed. The central government aimed at reducing the deficits in public transport. Discussions were held about the introduction of more competition and finally two main developments took place. In the first place, competition was introduced. And in the second place, competencies were shifted. In the next two paragraphs these two developments will be described. In paragraph 4.4 the probability that price measures will be taken in public transport policy by the regional/local authorities is discussed.

4.2 Competition

Theoretically, in competition may be defined as a process by which market participants (transport companies), in pursuing their own interests, attempt to outdo, outprice, outproduce and outmanoeuvre each other. In the market, price is an important competitive tool. Theoretically, the market system maximises output.

Bearing the above mentioned notions in mind, the central authorities stated that in public transport, competition might lead to a higher costs/benefits ratio. To realise this, they introduced tendering in public transport. In every region, the regional authority should have to tender public transport. The way of competition differs from the English system in which many bus companies may compete on the same roads. In the Netherlands one company, having gained the tendered contract, takes care of the supply of public transport in that specific region.

4.3 Decentralisation and tariffs

The second main change is the decentralisation. In the 1990s the central authorities realised that not all regions were alike. The situation with respect to public transport and the role public transport could play differed in kind and degree between regions. To tune the public transport policy to the region-specific situation, it therefore seemed appropriate to formulate and implement the public transport policy on a regional level. To enable this, since 1998 regional authorities have the competencies with respect to public transport. It is the regional authority that decides where and how often bus services are provided. It is the public transport company that takes care of the supply. With the tendering procedure the relation between regional authority and transport company changes into a more formal one.

Another change that has been realised concerns the competencies with respect to the setting of prices. Whereas till the end of the 2000 the central government set the prices, since 2001 regional/local authorities may change them and do not need permission of the central government. Although the regional/local authorities have the competency to change prices, it depends on the contract a regional/local authority concludes with a public transport company if price changes can be effected very easily. The contract party bearing the risks of price changes has to agree on any change of the prices. In general, three kinds of contract may be concluded :

- a cost contract. The public transport company receives an amount of money. Price changes do not affect this amount, and therefore, it will be the local/regional authority bearing the risk.
- a benefit contract. The public transport company receives an amount of money that is dependent on the amount of income derived from the users of public transport. In this contract, it is the company that bears the risk and therefore, it will have to agree on any price change.
- a mixed contract. Like in the benefit contract, the company bears a risk and will have to agree on price changes.

4.4 Price measures : some obstacles

The decentralisation and the introduction of competition seem to offer regional authorities possibilities to implement price measures in transport policy. However, two aspects severely limit this freedom.

In the first place the financing system limits the probability that price measures will be taken. The national ticket system and the prices set for it will function as an upper limit for the prices. Hence, because of the national ticket system it is less likely that the market system will operate efficiently, and a situation with different prices in different regions in different situations will emerge.

Besides, the way subsidies are given by the central authorities will limit the implementation of price measures. Because the system of subsidising public transport has not been changed since 1998, the central authorities still subsidise public transport using the two main criteria mentioned in section 3. One of these criteria is the generated income as a result of the use of public transport (the number of sold tickets multiplied by the price per ticket). As a consequence of this system, central authorities do not bear any risk. In case a regional authority decides to cut prices, the risk will be born by that regional authority. If the total income (sold tickets multiplied by the price per ticket) decreases, the central authority will decrease its subsidy to the regional authority as well. Then, the regional authority will have to pay twice and probably even more, since it is very likely that the costs will increase (more passengers, more busses).

As a result of these two aspects, it is not as probable as would be expected from the changes that have taken place in the Netherlands, that the number of price measures will increase. Regional authorities bear the risk of any experiment. Therefore, they consider it unattractive

to implement price measures. It is very likely that increasing the costs/benefits ratio will be considered to be more important than increasing the share of public transport in the modal split.

5. CONCLUSIONS AND RECOMMENDATIONS

It may be concluded that the use of price measures may be an important tool in the aiming for public transport policy goals. These goals are increasing the share of public transport in the modal split and increasing the costs/benefits ratio.

In theory, in the Netherlands the possibilities to implement price policy in public transport policy appear to have been increased since 2001. Unfortunately, the national ticket system and the financing system will limit the probability that price measures will be taken. Although regional authorities obtain the tasks and competencies with respect to public transport, the central authorities disposes the means. Hence, with regard to the financing of public transport, the regional authorities are dependent on the central authorities. In case the regional authority decides to implement a price measure, they will have to bear the risks totally.

It may be recommended to transfer the means to the regional authorities as well. Decentralising the tasks and competencies may be considered to be the first step into a process in which regional authorities have the opportunity to deal with their (regional) problems their own way without being dependent on the central authorities.

Besides, it may be recommended to transfer the competence to fix the price to the public transport provider (company). In case public transport providers may set the prices, it is very likely that market will operate more efficiently. The use of chipcards may enable market forces by making price-changes in time and by place within the reach. The national ticket system, although its advantages, bears some disadvantages as well.

Finally, the role of the central government may be discussed. Although it may be recommended that apart from competencies and tasks the means have to be decentralised, the central authorities do have a role. Their role is the information of regional/local governments, dispersion of knowledge and expertise. And because of the lack of knowledge with regard to price elasticity's and the effects of price on costs/benefits ratio and the share of public transport in the modal split, they should be very stimulating in the implementation of experiments.

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