

Road pricing in urban areas



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Författare: Jonas Eliasson och Mattias Lundberg, Transek AB

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vagverket.butiken@vv.se

T&E Preface

Road pricing has been promoted by transport economists for decades as a means of solving congestion problems in big cities. Congestion causes enormous costs to society in a number of ways; for example, overall transport costs rise, polluting emissions increase, the demand for infrastructure is artificially driven up. The social benefits of solving the congestion problem would therefore be enormous.

And yet, despite repeated recommendations from experts and strong verbal support from the European Institutions, few politicians have so far had the courage to introduce urban road pricing (London being the recent, inspiring, exception).

One major obstacle to introducing rational tools in urban transport policies is a lack of knowledge. This leads to the many pervasive misunderstandings and prejudices which influence the public debate on urban road pricing.

One reason for this obstacle has been the lack of a comprehensive, easily accessible, introduction to the present knowledge on the issue. T&E therefore very much welcomes the initiative taken by the Swedish National Road Administration to produce just such a report.

"Urban road pricing" was originally produced in Swedish by the Swedish National Road Administration, for a Swedish audience. Still, the content is of general interest and certainly fills a gap in the international debate. It has been designed to present the information in an unbiased way. As co-publisher of the English translation, T&E is proud to contribute to the dissemination of the report.

While we support the report's findings, T&E does not necessarily share any opinions expressed therein. Any errors remain the responsibility of the authors.

Beatrice Schell

T&E Director

SNRA Preface

Parliament's decision on continued development of the transportation system emphasizes adaptation to provide a sustainable transportation system. The planning is based on sub-goals of the transportation policy and parliament's vision of what they desire to achieve. The planning has to satisfy both the need of transportation and the ambition to accomplish sustainable solutions. New effective combinations of established, as well as new and untried policy measures and inputs must be considered and used in order to attain stipulated goals. In this respect, the National Road Administration has made use of a method involving the so-called four-step principle, with focus on gradual testing of measures, starting with "soft" measures that affect the need of transportation, choice of mode, and efficiency. It is not until such measures have been found insufficient for solving a problem that other measures such as new road constructions or improvements are taken into consideration.

Considering this background, road pricing in urban areas is an interesting measure. Parliament has also opened an opportunity for implementation of road pricing in interested municipalities and regions. The government has asserted that this issue will be dealt with if there is a proposal to implement road pricing as part of a strategy to solve congestion and environmental problems. The Stockholm Transport Commission has also been appointed by the Swedish Government to investigate the issue.

Road pricing in urban areas is still an untried measure in Sweden. However, when the issue is debated there are many opinions on its suitability. With this review the National Road Administration wishes to establish a joint basis for the continued debate on road pricing.

This review is an English translation of a report written in Swedish, in some parts it therefore has a Swedish perspective but we still believe it can be of interest also to readers outside of Sweden. Since the original report was written in the fall of 2002 the report is not entirely up to date with the latest developments – such as experiences from the start of the road pricing in London.

Christer Rydmell

The National Road Administration, Commercial Transport Department

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1 Introduction

Assignment and purpose

The National Road Administration has assigned Transek AB to assemble a review of research and practical experience from road pricing in urban areas. The objective was to produce an accessible and independent review of relevant knowledge. The review is written for a wide target group, and is mainly intended to be read by planners, politicians, journalists, scientists and the public and others that need a lucid description of possibilities and problems with road pricing in urban areas. We hope that this report will provide a common basis for the continued debate on this issue.

It is the nature of a review that many difficult and important questions have to be treated in a brief and sometimes simplified manner. This synthesis report summarizes the most important results from available analyses and scientific projects.

The objective of this review is to give a neutral report on what research on the issue has yielded. Road pricing is, however, a research field where many strong opinions are to be found. In many cases, the experts themselves have pronounced opinions. Since it is a fact that scientists and experts within the field of transportation economics and road pricing are positive to the idea to impose a charge on congested roads, even a neutral abstract might give the wrong impression. Perhaps this impression in some cases depends on how the research has been defined from the start. Nevertheless, we have tried to report both possibilities and problems with road pricing, and leave it to the reader to decide what weighs the most.

The report was prepared by Jonas Eliasson and Mattias Lundberg. Johanna Lindqvist Dillén was the project manager

Terminology

In this report we use the term *road pricing* for all kinds of charges on a vehicle for the right to use a certain road or driving in a certain area. There are many other terms and the terminology is not always consequent, partly because opponents and intercessors sometimes tend to choose a term by its negative or positive value in itself. Many terms and expressions overlap one another.

Road pricing is normally used for systems with the main objective to reduce congestion by allocating the traffic to other less congested alternative routes and hours. *Urban road pricing* is synonymous but is used to emphasize that refers to fees in urban areas. In this report however, we give these terms a somewhat broader definition.

When we want to emphasise that the fees are designed to reduce congestion we sometimes use the term *congestion pricing*. This is a charge according to the traffic load

and hence the congestion, emissions and incidents etc for a certain road link. Charges in such systems will vary according to the traffic load, time of day etc. Thus it is clear that a system with "[full] road pricing" is mostly a theoretical construction, but is useful when analysing external costs or constructing practicable proposals of solutions.

"*Environmental pricing*" is in the same fashion constructed to reduce the environmental impact from road traffic. A sub goal is then also often to reduce congestion (like with congestion pricing), but in addition the fee is differentiated by the vehicles environmental qualities. These fees can also differ according to the sensitivity of a geographical area.

The expressions *road tolls*, *car tolls* and *road [user] charges* refer to a charge for entering a certain area or a passing a certain point of a road. In the United States (especially in California) the term *value pricing* is used for the possibility to pay for driving in a special lane with less traffic ("HOT lane" - see end of chapter 3.1).

Restrictions and disposition

The report focuses on road pricing in urban areas, thus on a more or less joint system of charges on certain roads or areas within or around a city. Toll roads that are common in many countries are peripheral to the main theme of this report. Aspects concerning financing, construction and operation of the roads by commercial operators (private or public) are important issues, but are only dealt with incidentally in this report.

In chapter 3 we briefly describe a few international experiences of systems that are already, or shortly will be, in operation, and a few that have been close to realization. In chapter 4, we describe the effects of a road pricing system on traffic, environment, business, settlement and localization, together with distributive effects and socio-economic consequences. We report on principal reasoning, calculations of concrete proposals and practical experiences. In some cases, in particular when it comes to distributive effects, scientists do not agree. Then we give an account of different points of view in a progressive discussion rather than a summarized conclusion of the research.

Chapter 5 deals with different technical and administrative solutions. The topic of chapter 6 is "acceptance", a word that has come to describe the research on support or lack of support for road pricing shown by the general public, and the factors that affect this support in different directions. Chapter 7 describes institutional prerequisites for road pricing in different countries, for example how differences in the legal and political systems have affected the process.

Chapter 8 deals with another comprehensive topic, namely how the revenue can be used. The chapter provides both a review of how revenue is used in existing systems and an abstract of the animated discussion about how the revenue should be used, which is a strongly debated issue.

2 The purpose of road pricing

Road pricing may have two main purposes: financing or managing the traffic. Fees with managing purposes can then in turn have the purpose to improve the environment or accessibility. These goals are not in conflict, and most systems are designed to fulfil all functions to some extent. No matter the design of the system, it will have both a financing function – since it returns revenue – and a controlling function – as the revenue will affect the traffic. However, usually one of the purposes is superior, and this will determine the system that finally will be chosen.

Road pricing can be used for financing

Road pricing can be implemented with the main purpose to raise money. The money can then be used in road construction or to improve public transport, but of course the money can also be used in other areas than the transportation system. The need for financing is often the incentive for implementing road pricing. The most common cases are the toll roads (expressways) that are to be found in many countries.

When financing is the main purpose of road pricing, the aim is to design a system that provides steady and reliable revenues. It is sometimes perceived as fair to put a charge on what is financed by the revenue, for example a new road.

Charges can be used to improve the environment

Road pricing can also be implemented as environmental measures, for example to reduce emissions, noise and other disturbances caused by traffic. In some cases the objective is to reduce the total traffic load, but in other cases the intention is to protect a certain area, for example a city center. Few or no road pricing systems have been implemented with environmental measures as the main purpose, but many are designed with this in mind by reducing the traffic in sensitive areas.

If the main purpose is to reduce traffic, simple measures such as levy tax on fuel or per kilometre will work just as well, whereas various types of area fees are more suitable to reduce traffic in certain areas. If the intention is to reduce emissions, it is possible to differentiate the charges according to the environmental qualities (combustion system, type of fuel and fuel consumption) of the vehicle.

Charges can also be used to improve accessibility

Finally the purpose of road pricing may be to reduce congestion on certain roads or at certain hours - and thus increase accessibility in the road network. Among the majority of those in favour of road pricing, this is believed to be the main advantage. A smaller number of road pricing systems have been constructed with this as the main purpose.

If mobility management to improve accessibility is the main purpose, the design should be to charge just where and when the traffic load is high, thereby achieving a maximum redistribution of traffic to other times, places and mode of transportation.

3 Some international experiences

In this chapter we provide a brief review of road pricing systems throughout the world, those in use or those close to having been realized. We have chosen only to include those systems that directly affect the traffic in urban areas, and consequently we do not describe toll expressways that are common in many countries.

3.1 Systems in operation

Singapore – the only system with the main purpose to regulate traffic

Already in 1975 Singapore¹ implemented a type of area-based system, which is considered to be the first modern road pricing system in the world. In the fall of 1998 it was made a totally automatic system, the ERP system (Electronic Road Pricing System). The background for implementing road pricing was the high exploitation of land and rather high standard of living, and these factors made traffic restrictions necessary.

The purpose of the system is to regulate traffic in order to increase accessibility. The basis for the charge is to achieve a target-speed that gives improved accessibility. If the average speed drops the fees increase and vice versa. The fees are revised every third month and specified on electronic billboards at every gate. From year 2001, the charges also have environmental measures as a purpose, and electric- and hybrid vehicles pay a lower fee. The charge varies for different places, types of vehicles and hours. The fee is at its highest about €1.5 per gate at peak time.

The revenue goes into the national account and is not distinguished from other state revenues. The state, region and municipality being one and the same facilitates the political process.

Oslo and Bergen – financing tolls

Apart from Singapore, Oslo is the only large city that has introduced a system with proportionately full coverage. The Oslo electronic road toll system was launched in 1990. The background reason was increasing road congestion during the 1980's. Accordingly an investment package for Oslo was worked out.

The purpose of the toll system was to finance new investments, that otherwise would take too long to realize. The Norwegian parliament took a resolution to contribute with half the financing. The remainder was to be covered by the road toll revenue. For the

¹ Gorpe (2000, 2001); May (1992); www.lta.gov.sg.

period 1990 to 1997, the investments were estimated to about 15 billion NOK². The emphasis was on new road constructions. The purpose of the new roads and passages was a transfer of traffic and thus alleviation of the situation in central parts of the city³.

A ring of 19 toll stations was set on all roads leading into central Oslo. The payment was either electronic, manual or through coin-drops. Most vehicles now pay electronically. At present (year 2002) the fee is 15 NOK. There is charge for all 24 hours and all vehicles (except emergency vehicles, scheduled buses and motorcycles). The cost for a monthly pass is 400 NOK. Heavy trucks pay a double fee⁴.

The tolls are to be revoked in 2007, but now a second period is being discussed and will include more investments in public transport. This means that the tolls might remain for a longer period. In the discussions, one reason to prolong the period of toll system is that there is not enough time to finish the investments stated in the first package, and that new investments are now being discussed.

In 1986 Bergen was the first city in Norway to charge on existing roads to finance new infrastructure. 80 percent of the revenue was used to extend the road network and the remainder to improve the city bus system⁵. The tolls apply weekdays (daytime), and the initially low fees were doubled in 1999 to 10 NOK for cars and 20 NOK for trucks. A monthly pass costs 200 NOK. Initially, the system was totally manual. Now, there is however a possibility for electronic payment, which facilitates passage without stops. The Bergen agreement was initially planned to last until the turn of year 2001/2002⁶ but has now been prolonged for another ten years, with the possibility of an additional ten later on. Some of the changes are that new technology will be introduced (transponders from year 2004), a new toll station has been introduced, and the charge has been raised and will apply for more hours of the day⁷.

Trondheim – the world’s first electronic road pricing system for entering a city

In 1988 Trondheim introduced its first toll road, a new road parallel to an old highway. In 1991 an electronic road pricing system for entering the inner city was implemented, consisting of 7 toll zones (extended to 8 in the fall of 2002). This system came to be called the Trondheim Ring. The purpose is to finance new infrastructure – mainly roads, but also public transport, environmental measures and passages for pedestrians and bicycles.

80 % of those using the system have a transponder, but there are also payment machines and a few manned stations. At present, the charge is 15 NOK per gate passage. A subscription is discounted by 20–50%. There is no extra charge for additional passages

² 1 NOK is approx. €0.12 (5/03 2003).

³ Gorpe (2001).

⁴ www.fjellinjen.no.

⁵ Naturvårdsverket (2002).

⁶ www.brotunnel.no.

⁷ Bro & Tunnelselskapet AS (2002).

within the same hour. Fees apply between the hours of 6 a.m. and 6 p.m. The charge is lower during off-peak hours than in the morning peak⁸.

At present there are ongoing trials with time-differentiated fees to control the traffic level, although this is limited by existing legislation. The aim in Trondheim is to achieve a transition to a road pricing system that controls the traffic when the present agreement expires within a few years.

Toll roads with fees corresponding to the congestion situation

There are many examples of toll roads that have other purposes than just generating revenue. Even though this does not really refer to systems in urban areas, it is still interesting since the charges adapt to the congestion situation and the technical solutions also provide practicable experiences.

In California in 1995, an expressway (SR91) with central charge lanes was constructed. The owner was a private corporation. The tolls are automatically obtained by a transponder on the windshield. The aim is to set the level of charge so that free flow speed is a steady 65 mph. The revenue goes to the company constructing the road, but any surplus becomes part of the state finance⁹. The purpose of the toll was to finance infrastructure, but with a business concept based on fees at a level that limits congestion, i.e. congestion pricing. The expressway concept in California has recently been followed by other roads with congestion charges throughout the United States. Many, but not all, are privately operated.

Other accessibility solutions are the so-called HOT-lanes (HOT stands for High Occupancy Toll). HOT-lanes are parallel to existing roads, and only to be used by buses, co-riders (i.e. highly occupied vehicles) and by those paying the special fee. The level of charge is adjusted so that the speed does not drop appreciably at free flow.

In Toronto and Melbourne there are other examples of toll roads where the level of charge is set to improve accessibility. In Toronto, road 407 is the world's first toll road for free flow passage with solely electronic payment. The road, which was opened in stages starting in 1997, is about 65 miles long and located in the fringe of Toronto¹⁰. Since year 2000 in Melbourne, there is a fee to use a newly constructed road stretch connecting three of the radial motorways leading into the city centre. The fees are changed every third month. The technique used is pre-paid transponders, placed on the windshield and registered at passage by a toll station. Cameras automatically identify vehicles that have not paid¹¹.

Manual checks at entrance gates in Rome

Since 1992 Italian cities have had the possibility to introduce entrance checks and levy a fee to protect the cultural and historical values of a city. For example in Rome, the so-

⁸ www.bomringen.no.

⁹ Richardson and Bae (1996).

¹⁰ www.407etr.com.

¹¹ www.citylink.vic.gov.au.

called blue zone has existed since 1989 as a means to protect parts of the city core. Between 6.30 am and 6 p.m. Monday through Friday and between 2 and 6 p.m. on Saturdays, a part of the city centre is closed for all vehicles not having a special permit. In an additional area (Trastevere) the access is limited in the morning and evening. Similar systems are to be found in Bologna and Genoa.

In Rome, everyone living or working within the zone and certain others (visiting clients, medical doctors, etc.), can get permission to drive in the zone. Since 1988, however, everyone but the residents has to pay for permission that costs a bit more than €300 per year, which corresponds to the cost for an annual public transport pass. The check is today done manually at 26 entrance gates. Cheating is reported to be widespread: about 36 % of all cars crossing the area lack permission. Still, the traffic in the area is reduced during the toll-periods and the number of people using public transport has increased. More modern technology is however being developed. The basic idea is to implement an automatic system that, in a longer perspective, also can manage differentiated charges¹².

3.2 Systems expected soon to be implemented

London – a controlling and financing system

In London the plan is to launch a road pricing system in February of 2003. The background is that the London mayor Ken Livingstone considered the traffic situation to be the most important issue in the elections. In the election campaign he supported a proposal to levy a charge for the inner city of London to reduce traffic and to finance transport investments. Road pricing has, however, been discussed for many years. A previous government established the legal possibility for road pricing. Londoners consider congestion to be the most urgent traffic issue – motorists in central London spend about 50 % of their travel time in queues¹³.

The purpose is thus primarily to reduce congestion in the road network but also to obtain revenue. The revenues will subsidize traffic investments in both road network and public transport, at least for the first ten years.

The charge is to be levied on trips in central London (an area about the same size as the inner city of Stockholm) between 7 a.m. and 6.30 p.m. in weekdays. The charge is proposed to be £5 per day for cars and £15 for trucks. The fee is per day and remains the same no matter how much you drive during one day. Residents of central London have the opportunity to buy a discounted weekly pass. Buses, taxis, motorcycles and emergency vehicles are exempted. There are also other types of exemptions, for example a low annual or onetime fee for the disabled and for environmentally adapted cars.

There will not be any toll stations, instead the technique is to photo all vehicles travelling the zone. There is no need for a vehicle to stop. The number on the registration plate is then compared with a register of vehicles having paid in advance. Cameras will be placed at the boundary as well as within the zone.

¹² Naturvårdsverket (2002).

¹³ www.tfl.gov.uk/streets.

More or less advanced plans of implementing road pricing are to be found in a number of places throughout the world. An additional number of British cities are close to finalizing their plans, namely Bristol, Leeds and Edinburgh. Most likely the experiences from London will be of great importance in the decision to launch a road pricing system or not. Other cities discussing road-pricing implementation are, for example, Dublin, Auckland (New Zealand) and Tokyo¹⁴.

3.3 Systems considered but abandoned

There are also examples of proposals well in progress and politically sanctioned, but where the plans have been abandoned. Studies of acceptance, etc., often refer to such cases, thus this section is a short abstract of three of the systems having been closest to becoming realized.

Hong Kong – fell on the matter of integrity

The first attempt to introduce an automatic system with an electronic charge to control traffic was made in Hong Kong already in the 1980's. An experiment including 2500 vehicles was initiated in 1983, a system of three zones and different fees for five periods of the day. The idea was then a full-scale implementation in 1985. However, anxiety that the system would reveal a person's identity led to a public opinion against it, and the resolution was revoked. One reason that this issue became so important was probably the agreement that Hong Kong should be reunited with China, which may have led to a fear for a system that would be possible to use for supervision. Another reason for the negative opinion was the technology which, at the time, was rather undeveloped, and thus with doubtful functionality¹⁵.

New studies and proposals are still being presented. In 2001 a proposal of a zonal and time differentiated electronic road pricing system was made, but again the question of acceptance was still very sensitive, and it is now considered that road pricing will not be necessary until the year 2006¹⁶, at the earliest.

Stockholm – fell on a difficult political situation

The so-called Dennis Agreement of the early 1990's involved considerable investments in both public transport and roads in Stockholm. The package also included road tolls both to finance part of the infrastructure and as a means of controlling traffic. The tolls were constructed as a ring around an inner circular passage for traffic going into central Stockholm. The fee was to be obtained electronically through a transponder placed on the vehicle's windshield. Alternative designs and constructions were analysed. In what later became the main alternative, there would be a charge of a bit more than €1 for passing the ring around the inner city. The revenue was estimated to a bit more than €0.2 billion per year. Calculations indicated that the inner city traffic would be reduced by a bit more than 20%, which was an effect of both the toll ring and the beltways.

¹⁴ See further Naturvårdsverket (2002).

¹⁵ Hau (1990); Borins (1988).

¹⁶ Naturvårdsverket (2002).

The Dennis Agreement was abandoned in 1997. There were many reasons for this, but one of the main reasons was the matter of road tolls. It was a politically explosive issue already from start with a strong opposing opinion. There were several reasons for the negative opinion. Residents of some municipalities feared that they would be excluded from the road network, and there were also apprehensions that the tolls would strike the low-income residents the most. There was also anxiety that anonymity could not be guaranteed. Concurrently, another opinion grew, for example, among the environmental movements, that the system was not designed as an effective means of regulating traffic but rather as a financing method. Thus, opposition by the politicians and the public finally became too strong. Above all, it was the issue of acceptance that was found to be insurmountable.

The Netherlands – fell on a new political majority

In The Netherlands they have had, until recently, plans to introduce distance-based road charges to regulate traffic. The idea was kilometre-based charge replacing part of the vehicle excises from the year 2004 and on. However, the election brought about a new political majority in July of 2002, with a policy that such a system would not be introduced until accessibility to both road network and public transport had been considerably improved. Thus the budget will not include any financing of a road pricing system in the Netherlands¹⁷. In practice it thus seems that there will be no kilometre charge within the near future.

The background to the proposed system was a desire to transfer the cost of owning a car to a cost for actually using it. Therefore, all cars were to be equipped with a “mobimeter”, registering the distance travelled and computing the amount of tax to pay. There were also plans that from year 2006, the charge would be differentiated according to time and place. The level of the charge would then imply that those driving less than 18 000 kilometres per year would get a positive net effect compared with the previous vehicle excise, and vice versa. Calculations indicated that the number of vehicle kilometres and emissions would be reduced by about 10 %, and the number of hours spent in queues would be reduced by 25 % by year 2020 compared with a situation with no kilometre charge¹⁸.

¹⁷ www.roadpricing.nl.

¹⁸ Progress report (2001).

4 Effects of different road pricing system

In this chapter we describe the effects of road pricing on traffic, environment, business, housing and localization together with the charge's distributive effects and socio-economic consequences. We report on principal reasoning, calculations of concrete proposals and practical experiences. In some cases, in particular when it comes to distributive effects, scientists do not agree. Then we return different points of view in a progressive discussion rather than a summarized conclusion of the research.

There are a large number of studies concerning calculated effects of proposed road pricing systems. It is important to note that most proposed systems have never been realized, so there are a significantly larger number of model-based studies than studies of existing systems. When it has been possible to compare modelled forecasts with the real outcome, the forecasts have often proved to be reasonably correct. The importance and experiences of being able to model traffic in road pricing systems have increased in pace with commercial roads becoming more common, i.e. roads for which a commercial operator determines the fee and usually also is in charge of construction and maintenance of the roads.

One problem with many existing models is that they don't model changes in time for travel, for example time of departure. If the charge does not vary over the hours of day this is no big issue, but in cases where a shift in time for travel is expected to be the dominating effect, this of course is a serious defect. The consequence is (probably) a bigger reduction of congestion in reality than in the forecast, but a smaller reduction in the total number of vehicle kilometres is less than forecasted.

4.1 Traffic effects

The effects of road pricing of course depend on the design and construction of the system. For example in Oslo, the fees were expressively designed not to change the traffic pattern, whereas in Singapore the level of charge is regularly changed to keep traffic flowing. Hence it is difficult to say something in general about how road pricing affects the traffic. It is crucial where and when the charge is obtained.

The charge might affect car trips in five aspects: They can take place at a different time, by a different route, to a different place, with other types of mode, or not take place at all. Depending on how the charge is designed – when and where they are obtained – they will affect the car travelling in different ways. The easiest to influence is the choice time for travelling and what roads to be used. Destinations and types of transportation mode are somewhat harder to change, but the changes can be significant if the alternative is

attractive. The effects on the total number of trips, finally, are usually rather modest with those constructions of systems that are most common in the discussions.

Small traffic reductions provide big queue reductions

It is a well-known fact that small changes in traffic volume might accomplish big changes in the queue situation¹⁹. An illustrative example is that the traffic in Stockholm is reduced by 10 % during the school winter holidays, which is enough to bring about a noticeable reduction of queues. If part of the peak traffic were to shift to other times of the day, other roads or means of travel, it would convey a relatively large alleviation in congestion.

A computation for Stockholm showed that a theoretic road pricing system eliminating 95% of the queues would only reduce the total peak traffic in the county by a modest 10%. The reductions would, however, be bigger in the more congested places and times of day²⁰. In other words, it does not take very dramatic reductions of the total traffic volume to eliminate queues.

The influence on the total traffic is rather small

Most proposed or realized road pricing systems have relatively small effects on the total number of car trips in a region²¹. The explanation is either the lack of (attractive) free alternatives (free hours of day, free roads or public transport), or that the charge is only made where there is congestion (example for passages through the city centre during peak hours), which usually represent a fraction of the total number of car trips in a region. In the previous case, the effects on the total traffic are, on the whole, very small (which expressively is the point in for example Oslo²²). In the latter case considerable reductions of queues might be accomplished, but as pointed out above, a dramatic reduction of traffic is not needed to achieve a significant alleviation of the queue situation. This becomes very clear if the charge is made only during certain hours of the day, since the effect then is that the choice of time for travel is affected while the total number of vehicle kilometres stays almost the same.

Studying systems including a charge for trips to and through the city center during peak hours it is clear that this charge reduces the total number of vehicle kilometres by a few percent – a common figure is 2-3%. Whereas the actual peak hour traffic in the city centre might be reduced by 20-30%.²³

Charges that controls the traffic might bring considerable effects

The purpose of using charges that controls the traffic is generally to improve traffic flow and eliminate bottlenecks (even though other purposes are mentioned, for example, to

¹⁹ See for example CAPRI, Schiller (1998).

²⁰ SIKA (1999), Transek (1999).

²¹ See for example CAPRI, Naturvårdsverket (2001), Tretvik (2002).

²² Vold et al, 2001.

²³ Naturvårdsverket (2001), Mattsson (1995).

reduce emissions). It is most common to levy charges during peak hours in or around a city core, or on certain stretches of an expressway.

Since the charge is levied during peak hours, the greatest effect is a change of time for travelling²⁴. Some trips that should have occurred during peak hours, instead take place before or after the peak. If possible there is also a transfer of trips to alternative roads, modes of transportation and destinations. These effects are, however, smaller than the effects in time for travel. The supply of free alternatives – other types of mode, other roads or departure time are of great importance and determine whether the charges will be a success or not.

The charges in Singapore have evident effects

Singapore has an extensive public transport system and also alternative routes through the country. When the inner city charge was introduced in 1975, the daily traffic in this area dropped by 44 %, and by 75% during peak hours. During the afternoon, which was free, the level of traffic remained the same. Since then the morning peak hour traffic has slowly increased, but is still 31% below the level before the charges were introduced. This has occurred in spite of increased employment (about 1/3) and increased number of cars (by 77%).²⁵ In 1988 there was an introduction of a charge for traffic during the afternoon as well, which led to a drop of 40%²⁶. When the electronic system was launched in 1998, the daily number of trips was reduced by 10-15% and by 20% during peak²⁷.

The effects of the charges in Singapore are evident. Now there is also a charge on certain expressways and other roads with heavy congestion. The charge varies in time and space, and is adjusted every third month to keep the average speed at a previously determined level²⁸. At present, the charge to enter the city core equals about €1.5.

The total traffic volume is held back by restrictions in car ownership. Car ownership permits are auctioned regularly. The road pricing revenue alone would hardly be enough to reduce the traffic as a total, but on the other hand the restricted car ownership and the efficient public transport system are not enough to eliminate queues in the city centre and other congested areas. Hence, it is the combination of attractive alternatives, charges, city planning and restricted car ownership that, in the Singapore case, have provided the significant and long-term effects.

London charges are expected to reduce traffic in the city center

In February 2003, London will introduce a charge for driving in the inner city. The charges do not vary during a day, and the traffic in the city core is calculated to drop by 15%²⁹. Many categories are exempted from a charge and it is possible to subscribe for a

²⁴ CAPRI, Schiller (1998).

²⁵ Chin (2002)

²⁶ The Economist (1997), May (1992).

²⁷ Chin (2002), Gorpe (2000).

²⁸ Gorpe (2001).

²⁹ Gorpe (2001).

long-term pass, and that will reduce the effects³⁰. The purpose of the charge is both to reduce the inner city traffic and to finance investments in the transport system.

In Norway, charges have little effect

Most Norwegian road pricing systems are expressively designed not to affect the traffic³¹. Their purpose is solely to finance infrastructure investments. Some systems, for example in Trondheim, have however been adjusted to navigate traffic away from the city core during peak hour, but have still revenue as the main purpose.

Especially in Oslo the system is constructed not to affect the traffic. The toll ring is located rather far from the city core, and fees are also levied on the major arteries and remain constant. This means that there is hardly any way of avoiding a charge if the trip originates outside the toll area. Traffic within the area is, on the contrary, free. The public transport is relatively poor in many areas. On the whole, the result is that the Oslo charge of 10 NOK (the charge has varied somewhat since the start) has hardly any measurable traffic effects³². The reduction in traffic during the morning peak in the whole Oslo/Akershus region was estimated to some 10%, while the traffic within the toll ring was reduced by almost 20%³³.

Bergen introduced a charge of 5 NOK to enter the city core, which reduced the inner city traffic by 7%³⁴. There are no figures of the traffic effects for the whole region, but they ought to be negligible.

Trondheim introduced a charge of 11 NOK in 1991, and it was only obtained when entering the city core during morning peak, which reduced the number of vehicles by 10% during the first period of charge³⁵. The change in choice of time for travelling stood for the larger part of this effect.

Norway's financing charges are similar to those on internationally very common toll roads. The difference is that the charge is obtained on existing roads whereas, for example, France only allows a charge on newly constructed roads, and there has to be a free alternative. Hence, in France, a problem has been that the expressways are not being used to the extent expected. A large share of the traffic, especially the heavy traffic, use smaller parallel roads that often go through towns and villages³⁶.

Road pricing in Stockholm

Several systems have been proposed for Stockholm. The Dennis Agreement, including for example the West and East passages, and the North and Southern Links and a toll

³⁰ Jones (2002).

³¹ Vold et al (2001), May (1992).

³² Ramjerdi (1994); Vold et al (2001).

³³ Larsen and Hamre (2000).

³⁴ Larsen (1988), May (1992).

³⁵ Langmyhr, 1997.

³⁶ Andersson, 1995.

ring, was calculated to reduce the inner city traffic by a bit more than 20%³⁷. Contributing to this effect were also the beltways, since the toll ring was located outside the beltways and at some distance from the city centre. The tolls were more important for accomplishing the reduction of the traffic in the inner city than were the West and East passages³⁸. An alternative design of system with tolls inside the beltways was calculated to reduce the inner city traffic by twice as much.

The Swedish Society for Nature Conservation (SSNC) has proposed several systems based on 5-10 zones in the inner city, with a charge for passages between zones³⁹. One proposal in 1995 was calculated to convey a traffic reduction of about 33% during the period of charge (daytime weekdays), and a reduction in the total number of vehicle kilometres in the region of about 3%⁴⁰. A later system proposed in 1999 with fewer zones and thus a somewhat higher charge (about €1–2 for passing the toll ring or certain city bridges during peak) was calculated to reduce the inner city traffic by 12% and in the region by 3%. Both systems were estimated to eliminate most of the queues.

In 1999, the Swedish Institute for Transport and Communications Analysis (SIKA) presented a report discussing possible measures to solve the congestion problems in the major cities of Sweden⁴¹. An example calculated for Stockholm showed that road pricing that fully correspond to the external costs⁴², would nearly eliminate all congestion. These hypothetical charges would be €0–0.9 per vehicle kilometre and the revenue about €0.5 billion per year.

In 2001 the Swedish Environmental Protection Agency (EPA), (who commissioned Transek AB for construction and calculations), proposed a road pricing system in two versions. The computations showed that a charge of a bit more than €0.2/km in the inner city and half of that outside the city and in the closest municipalities during peak hour would eliminate most bottlenecks in Stockholm. The traffic in the inner city during peak hours would be reduced by 21%, and the number of vehicle kilometres in the county reduced by 3%. Trips through the inner city during peak hours would be considerably faster, with a gain in travel time of about 10 minutes for a trip that formerly took 30 minutes. The average travel time effects would, on the contrary, be small, less than 2 minutes per trip on an average. This is explained by the fact that only a small part of the total trips pass the bottlenecks.

Increased accessibility for bus traffic

Charges that reduce congestion in the road system also increase the accessibility for bus traffic. By enabling the buses to move faster and become more punctual, the costs for bus traffic can be reduced. According to a calculation by SIKA of one of the SSNC

³⁷ Transek, 1995.

³⁸ The County Administration (1993)

³⁹ The SSNC has presented similar proposals. Many of which also consist of some sort of supplement for the traffic over the Saltsjö-Mälaren borderline, for example The Bromma passage of the Essinge beltway in order to manage the traffic transferred from the inner city.

⁴⁰ Naturskyddsföreningen (2000), Mattsson (1995).

⁴¹ SIKA (1999)

⁴² External costs refer to costs that motorists cause and do not pay for, e.g., emissions, noise, congestion and time loss and traffic incidents.

proposals, the existing bus traffic could manage with 13% fewer drivers and vehicles⁴³. Alternatively, the existing buses and drivers could increase the traffic supply.

4.2 Environmental effects

Environmental effects depend on how the charges are constructed

Road pricing sometimes is proposed as a means to reduce the environmental burden of road traffic. As for all other impacts, the effects depend on how the charges are constructed. The main purpose of most systems is to reduce congestion in the road network or to finance investments in the transportation systems. In some cases, e.g., in the Netherlands and in London, it has been suggested to design the charges to also include environmental measures additional to the environmental gain of reduced congestion. Mainly this refers to differentiated fees corresponding to the level of emissions of the vehicles. Many countries already have the vehicle fleet categorized by environmental qualities in order to, for example, levy differentiated vehicle excise.

No such systems have yet been implemented, except for Singapore where electrical vehicles from year 2001 pay a fee 20% lower and hybrids a 10% lower fee⁴⁴. Some cities, e.g., Oslo and Toronto, have different charges for different types of vehicles, for instance trucks, motorcycles and private cars. There are no major technical obstacles to differentiate charges by environmental category in the same fashion. On the other hand, there are practical problems in, for example, determining what environmental quality the differentiation should apply to, and how to check compliance. No studies on the effects of such a differentiated system have yet been made.

The reduction of total emissions is relatively small

Considering the systems usually proposed or implemented, the impact on the total number of vehicle kilometres is relatively small. The local effects in terms of emissions and air contamination may, on the contrary, be relatively considerable. Inner city charges may, for example, reduce the traffic in this area by 20-30% or more. Since the emissions of hydrocarbons and particles dramatically diminish when the traffic flows, it may be of great importance for the most affected streets. The total effects for a whole region are, however, relatively small. Here a reduction of 2-3% is typical⁴⁵. Thus the total emissions at a regional level remain almost the same.

The design of the road pricing system also plays a role. If the charges are constructed in such a way that the main effect is a change in time for travel, there is no major change in total number of vehicle kilometres. If the system, on the other hand, is designed so that the major effect is a change in type of travelling mode, the emissions can be considerably reduced, at least on local level.

⁴³ SIKA (1996)

⁴⁴ www.lta.gov.sg.

⁴⁵ Naturvårdsverket (2001, 2002), Trafikministeriet Köpenhamn (2000), EUROPRICE, Naturskyddsföreningen (2000), Mattsson (1995).

Better flow in traffic provides little reduction of emissions

The reduction of emissions is, in reality, somewhat higher than the reduction in number of vehicle kilometres. This is due to the fact that better traffic flow causes less emissions per kilometre driven. Emissions such as volatile organic compounds (VOC) and carbon monoxide (CO) - both are main components in smog - are 250% higher at congestion than when the traffic flows⁴⁶. Hence the quality of air is directly linked with the congestion situation. The magnitude of the reduction of emissions depends on the size of the share of the reduced traffic in queues or not in queues. Calculations, however, indicate that additional reduction of emissions due to better traffic flow is usually small. The EPA proposal from 2001 would e.g. reduce the inner city traffic by ca. 20% and almost eliminate the queues. If calculating the additional reduction of emissions from inner city traffic due to improved flow in traffic, this means improvements of a few percent⁴⁷. The calculations are, however, vacillating since the models are insufficient in certain aspects. Still, the indication is that the effects of improved flow of traffic are small in this context; the major reduction of emissions occurs with reduced number of vehicle kilometres.

“The big environmental gain is that new roads can be avoided”

The effect on emissions is thus fairly small on the whole. Instead, the big environmental gain is that the need for new roads diminishes, as is claimed by many⁴⁸, who consider that new roads primarily lead to an increase in number of car trips⁴⁹. This is due to the generation of new trips, a modal shift from public transport and more long-term effects such as localization of business, shops and housing and a more car dependent society. Secondly, they advocate that new roads through unexploited areas imply destruction of valuable natural and cultural environments. The big environmental gain, they claim finally, is not primarily the direct effects of the charges, but that the negative long- and short-term effects of new road constructions can be stopped or reduced.

Probably rather small effects on traffic safety

Available studies indicate that the risk of an incident (in terms of number of incidents per vehicle kilometre) does not seem to increase when congestion is reduced and the speed thereby increases⁵⁰. However, the consequences of incidents can be worse at higher speeds. The expected increase of speed is, however, relatively limited, and it is doubtful if this effect has any practical significance. Consequently, this implies that reduced congestion caused by road pricing would not have any significant effects on traffic safety.

⁴⁶ Schiller (1998).

⁴⁷ Transek (2002a).

⁴⁸ For example the Swedish Society for Nature Conservation, see for example the website www.snf.se/om/villovagar/sajten/start1.htm.

⁴⁹ In order to explain: the existence of this effect is not controversial in itself. There are however very distinct opinions whether this permits a conclusion that continued road constructions ought to be stopped or avoided.

⁵⁰ According to a review by Satterthwaite (1981).

On the other hand, a possible effect is that the number of incidents at low speed is reduced, which should have significant effects on whiplash injuries. However, we have been unable to find any study that confirms this.

Another safety aspect is that road pricing can contribute to reduce queues in tunnels. The occurrence of queues can be very significant for the possibility to evacuate smoke fumes using impulse fans in cases of fire⁵¹.

4.3 Distributive effects

The distributive effects that may be expected from a road pricing system are a complicated matter. Primarily they depend on how the charges are designed, how revenue is used and which groups and areas are affected by the charges. Secondly, it is very complicated to calculate the effects for different socio-economic groups and geographical areas. Even among experts there are divergent opinions of what distributive effects can be expected and to what extent they can be calculated.

The distributive effects depend on how revenue is used

The groups that will benefit from redistribution depend on how revenue is used⁵². If revenue is used for road investments this is a case of redistribution between different groups of motorists, if used for public transportation it is a redistribution of money from motorists to those using public transport. If they are used to lower taxes then it depends on the type of taxes it applies to, and so on. It is, however, difficult to speak of redistributions between groups as if “groups” was something static and well defined. Most people do not belong to one “group” only. Most people sometimes go by car and some times by public transport. Different routes are used on different occasions and different members of a household may be affected differently but, on the other hand, they distribute their time and money between themselves.

Distributive effects can be very large

Distributive effects of road pricing are usually very large. Many of the systems proposed or implemented provide several hundreds of millions euros in revenue per year, which may be compared with, for example, the total municipality budget of Stockholm; approx. €3 billion per year.

The redistribution effects between various groups in society can also be very large compared with the gain obtained by the system⁵³. This has made some experts doubtful of the whole idea of charges⁵⁴.

⁵¹ Kågeson (2001)

⁵² Morrison (1986); Small (1983); Segal and Steinmeier (1980).

⁵³ Fridström (2000); Segal and Steinmeier (1980).

⁵⁴ For example Evans (1992), Goodwin (1995).

An example is the Stockholm road pricing system proposed by EPA in 2001. This system was to provide socio-economic benefits of about € 0.2 billion per year. The revenue from the system was expected to be about the same⁵⁵. With such big revenue the redistribution effects might be large. The conclusion of the investigation was that whether you are a winner or a loser mainly depends on how the revenue is used.

A road pricing system proposed for Oslo based on congestion as an alternative to the existing system was estimated to provide socio-economic benefits of about 95 million NOK per year, whereas the revenue would be almost twice as large, about 180 million per year⁵⁶.

Today's motorists most often get a change for the worse

Most people using a road where a charge is to be implemented will experience a change for the worse. Sometimes it is claimed that motorists would gain from a charge reform since the queues would vanish. This is generally not true since the charges for most people would be larger than the gain in travel time⁵⁷.

Road users can be split into four groups⁵⁸. The first group is made up of motorists who alter their route or mode of travel when road pricing is introduced because the fee is too high. The charge then is an imposition since they are forced to switch to a worse alternative. The second group are motorists that pay a high fee and continue on the same route, but do not think the time gain (experienced when the first group leaves the road) is worth the charge. Also to them, the change is for the worse. The third group are motorists that think that the time gain is worth the charge paid. This is the only group that get a direct improvement from the charges. Finally, there is a large fourth group that are not affected by the charges, namely those using public transport and motorists using roads free of charge. They might have a change for better or worse when, due to the charge, other motorists disappear or are added when altering their route or mode of travel. In general, these impairments and improvements are very small, so most people in this group are not at all affected by the charges.

Empirical research combined with transport economic theory shows that the first two groups (motorists facing a worse situation) usually are bigger than the group getting an improvement⁵⁹. Hence, in most cases⁶⁰ the majority will suffer deterioration. Here, as always, the exact distributive effects depend on the construction of the charges and the original travel pattern, but the general principle applies in most cases. However, we want to remind the reader of the statement made earlier that the dividing of road users into "groups" is artificial – most people belong to different "groups" on different occasions.

⁵⁵ Naturvårdsverket (2001). Two different systems were proposed. The one with a higher charge and revenue of €0.3 billion per year and social economic benefits also of €0.3 billion per year. The one with lower charges provided revenue of €160 million and a social economic benefit of €190 million per year. The calculated social economic benefit is a rough estimate.

⁵⁶ Ramjerdi (1992).

⁵⁷ Giuliano (1992); Johansson and Mattsson (1994); Fridström (2000).

⁵⁸ The description follows, for example, Hau (1992), Goodwin (1995), Small (1992), Eliasson (2001).

⁵⁹ For example, Hau (1992), Goodwin (1995), Small (1992).

⁶⁰ With exemption for extreme queue situations and some very special distributions of motorists' time value.

However, it can also be proved that the revenue in theory is enough to compensate those that lose from the system yet still benefit from it⁶¹. How this is achieved in practice is a totally different and a much more difficult question⁶². Thus, the way the revenue is used is crucial for the distributive effects⁶³.

Professional traffic and business travellers are winners

Who are those in the “third group”, those who feel the time gain is worth paying for? It is those with high value of time, mainly professional traffic and those travelling for the purpose of business. The time value for these groups is typically about €20/h (in some cases much higher)⁶⁴. For them it’s very well worth the money to gain time, let’s say ten minutes for € 1.5. Since the share of professional traffic and business travellers is normally much higher in the central city areas, this means that inner city charges can provide relatively great gains for these two categories.

In addition to these groups there are other road users in a hurry that will therefore end up in a “winning” group, e.g., emergency vehicles and ordinary private people who are short of time.

The winners are many but unknown, the losers are few but obvious

As is the case with many reforms, it’s easier to identify the losers rather than the winners. In addition, usually (but not always) the losers lose quite a lot while the winners win just a little. The profits from road pricing, depending on how they are used, are spread among many groups in a somewhat diffuse manner and often in the future⁶⁵. Many of those that will profit from, let’s say, construction of a new railroad, do not even know about it when the construction is being discussed. The losers, on the other hand, are easier to find. This is a general problem with many types of reforms⁶⁶.

Redistribution in time provide relatively small distributive effects

Road pricing systems with the major effect of changed time for travel, in other words redistribution of trips over the day, usually have considerably smaller redistribution effects than systems with the major effect of redistributing road users between modes of transport or destinations. One example of the first type of system is a charge made only during peak hours, whereas the latter can be exemplified by a system with a charge around the clock in a certain area.

The reason is that many motorists can change their time for travel without any particular problem. This enables rather big reductions of congestion to be achieved at a fairly low

⁶¹ The theory is to be found in, for example, Johansson and Mattsson (1995); among empirical studies, see for example Small (1992); for a discussion of theory versus practice, see for example, Thomson (1998) and Smeed (1964).

⁶² See, for example, Goodwin (1995) and Small (1992).

⁶³ Small (1983, 1992), Naturvårdsverket (2001), Foster (1974), Arnott et al (1994).

⁶⁴ For example, Transek (1995a).

⁶⁵ Small (1983), Langmyhr (1997).

⁶⁶ Langmyhr (1995).

cost, where the “cost” can be either paying a fee or travelling at an earlier or later point of time. The reason that the redistribution effects become rather small is that the effect, so to speak, remains within the same “group” of motorists⁶⁷. In addition, it is possible, if wanted, to use the revenue in such a way that the benefit becomes clearer to those who pay by, for example, improving the road locally.

Is it those with high or low income that suffer most?

What the distribution effects will be for different income segments is probably the question most frequently discussed (in competition with redistribution between geographical areas and redistribution between motorists and others). The answer is once again that there is no general answer. It depends partly on the starting conditions – who is driving the car and where they are going, in what areas do people with most low or high incomes live. It is also a matter of how the system is constructed – where the charges are obtained and how the revenue is used. Various scientists have come up with different results due to disparities in these aspects. Results might therefore appear contradictory since they are based on different requirements.

Some arguments and results from the debate and research are listed below to provide a general view of what affects how different income groups are influenced. Obviously, the arguments are not equally relevant and true in different cities, depending on the traffic situation, travel pattern, and how the road pricing systems are designed.

Arguments that people with high incomes suffer more than those with low income;

Those with high income drive more frequently, and more often have their destination in the inner city⁶⁸. They are more likely to live within or close to the inner city and therefore cannot avoid the charges or choose alternate routes⁶⁹.

Arguments that people with low incomes suffer more than those with high income;

Those with low income have inferior possibilities to decide their time for work, and thus cannot avoid charges levied during peak hours⁷⁰. They are more likely to live far from the city core and their destination is more often located outside the inner city where the public transportation is poorer⁷¹. Those with small economic margins suffer most from the charges⁷².

⁶⁷ Bernstein and Muller (1998). The exact argument is rather complicated. The idea is that those choosing a different time for travel do not increase their generalized cost especially much (thus the total impedance of vehicle costs and travel time), since they get shorter travel time off peak. Since the effects of the charge then become rather big, those that remain during peak hours will get an improvement, charge and travel time gain put together. The possibility to construct a charge that everybody profits from “directly”, without refund, is supported by rather complicated mathematical evidence. The phenomenon itself is, however, well known, and its logic resembles the so-called Braess’ paradox, which is an example of reducing the travel time for all travellers by cutting off a road in a road network.

⁶⁸ Foster (1974).

⁶⁹ Thomson (1998)

⁷⁰ Arnott et al. (1994)

⁷¹ Transek (2002b)

⁷² Richardson (1974)

Arguments that those with high incomes gain the most from road pricing;

Those with high income have higher value of time and more often feel that the time gain is worth the charge⁷³. If road investments are not financed by charges they have to be financed by income taxes, and since those with high incomes pay more tax they would suffer more⁷⁴. At the same time, they have better chance to pay the charge since they have a higher disposable income⁷⁵.

Arguments that those with low incomes gain the most from road pricing;

Those with low income often use public transport, and are therefore not affected much by the charges, but can still profit from the revenue if it is spent to improve public transport (as is generally proposed for at least part of the revenues)⁷⁶. Road pricing also slows down the development towards a more car-dependent society, which favors those with low income who are less likely to have a car⁷⁷.

There have been attempts to compute how all these effects actually fall upon different income segments for concrete proposed road pricing systems. Some experts claim that we do not have the prerequisite requirements to perform such computations, since we lack sufficient basic material on how travel patterns and values diverge between income groups.

Most computations (e.g. for San Francisco⁷⁸, Oslo⁷⁹, Gothenburg⁸⁰ and Stockholm⁸¹) indicate that those with high incomes are affected the most since, on one hand, they more often drive a car, and on the other more likely live in areas with poor access to public transport. The net effect if all were to equally share the revenue would then be that those with low incomes gain the most. These calculations are still insecure, e.g. since the models used do not fully consider diversions in time values and effects on time for travel. There are also theoretical computations modelling only time for travel that indicate that those with high income will gain more than those with low incomes, given that they share the revenue equally⁸².

Common for these studies is that the difference between income groups is quite small. In fact, it is so small that it is more important how the revenues are used.

Is it fair to put a price on travelling?

Many experts, especially those with an economic background, claim that the major benefit of road pricing is that “urgent” trips will be faster, while “unnecessary” trips will

⁷³ Evans (1992), Small (1983).

⁷⁴ Arnott et al. (1994)

⁷⁵ Richardson (1974).

⁷⁶ Evans (1992).

⁷⁷ The Swedish Society for Nature Conservation (www.snf.se/om/villovagar/sajten/start1.htm)

⁷⁸ Schiller (1998).

⁷⁹ AFFORD; Fridström (2000).

⁸⁰ Transek (2002b)

⁸¹ Naturvårdsverket (2001).

⁸² Arnott et al (1994).

be transferred to other places, times of day and modes of travel⁸³. In this context, “unnecessary” trips are those that can be done just as easily by another type of travelling mode or at a different time or with a different destination. The opposite applies to the so-called “urgent” trips. An optimal fee would, hence, have the effect that “unnecessary” trips, for which there is an immediately available attractive alternative to car, would be transferred.

However, some experts have claimed that it’s not certain that the willingness to pay reflects how “urgent” or “unnecessary” a trip actually is. In order for this to occur, all travellers must have the same marginal benefit of money, i.e., they should have the same amount of money to spend when bills and other necessities have been paid. This is hardly true in reality. Hence, if some travellers have a lot more money to spend than others, the consequence might be that those with low incomes are in for severe impairments, while those with high incomes do not notice the charge very much. Indeed, the winners can still compensate the losers, theoretically speaking, but this compensation usually remains only as a theoretical construction. Many experts have claimed this to be a major problem⁸⁴.

4.4 Business life

Professional traffic and business travellers are winning

The effects that road pricing would have on the business in a region have been studied comparatively little. The effect most noticed is that professional traffic and business trips would be facilitated⁸⁵. The travel time obtained with road pricing (given that it is designed to reduce congestion) is well worth the charge for most professional traffic and business trips. In addition, arriving on time, as well as safety aspects of goods transports would normally increase when a charge is implemented. However, we have been unable to find any studies on this effect. In practice, most proposed systems also consist of special solutions to facilitate for professional traffic, for example by limiting the maximum charge paid during one day

Quantitative calculations of these effects are few. As an example of the time effect, the road pricing system proposed by the EPA in 2001 gave rough estimations of travel time gains for professional traffic in Stockholm⁸⁶. The total gain in travel matched about 2–3% of the total time production, and was valued to about €50 million per year. However, if the professional traffic were to pay the same charge as private motorists, the charge would correspond to, or exceed, the gain in travel time.

Apart from purely professional traffic, other parts of business life are also affected by faster deliveries and faster business trips⁸⁷. Quantitative studies are also sparse in this respect.

⁸³ Verhoef and Small (1999), Small and Yan (1999).

⁸⁴ Mayet and Hansen (2000), Minken (2000), Eliasson (2000).

⁸⁵ E.g., Goodwin (1995), Arnott et al. (1994), Naturvårdsverket (2001), Small (1992).

⁸⁶ Naturvårdsverket (2001).

⁸⁷ See, for example, DeCorla-Souza and Kane (1992).

Effects on the labor market are uncertain but probably small

Finally, business life is also affected by changed opportunities to recruit labor. Whether the long-term effect and matching on the labor market is positive or negative is hard to determine. Again, it depends on how the charges are constructed and for what the revenue is used, but there are also very few studies on this topic. Theoretically speaking, the positive effects of shifted taxes (see section 4.6) provided by a road pricing system would increase the supply of labor⁸⁸ – given that the revenue is used to lower taxes. On the other hand, the charges bring about higher travel costs and thereby reduce the matching of the labor market. Some studies and reasoning indicate that these effects probably are small - see section on localization effects (4.5).

Effects on regional economy increment are not well known

The interaction between transportation system and regional economy in developed countries is very complex. In latter decades there has been an animated debate between scientists claiming that all essential beneficiary effects for regional economy, for example of a new road, are covered in socioeconomic benefit analyses, and those claiming that there are additional, potentially big, benefits⁸⁹.

To our knowledge there are, however, no studies on what effects a road pricing system would have on the regional economy. Road pricing may imply a restraint on the growth of business traffic. The biggest economic effect, however, depends on how the revenue is used, i.e. if it is used to reduce distorted taxes or not (compare section 4.6).

4.5 Real estate prices, housing and localization

The effect of road pricing on localization and land prices is a complex interaction between travel pattern and supply and demand of land, housing and premises. There are comparatively few empirical studies on these effects, partly due to the difficulties of measuring such slow changes, and partly due to the overall lack of practical experience from road pricing. On the other hand, there is a relatively strong consensus among scientists about the main fundamentals of effects to be expected, based on theoretical studies and computations.

Road pricing should in general have a centralizing effect

Road pricing generally makes car trips more expensive. The increased transportation costs urge households as well as companies, in theory, to strive to reduce their car travelling and to avoid congested roads. This must also include reduction of the travel distance, which ought to cause a need to move closer to destinations. Families, for example, should try to localize closer to their work places and to commerce. In a city with an obvious city centre this probably means an increased demand for housing and premises in central areas. Areas with a good supply of public transportation should

⁸⁸ Mayeres (2000)

⁸⁹ SIKa (2002)

become more attractive, which in most cities also ought to contribute to an increased demand in the city centre. The increased demands for central localizations should, on one hand, result in rising prices for housing and premises, and on the other, an increased supply (through new constructions and/or increased disposal).

In summary, an increased demand is to be expected in central areas, while the demand will decline in the periphery⁹⁰. Changes in localization and transportation patterns are, however, a result of a complicated interaction between different forces, which means that the final result is dependent on, for example, the exact design of the road pricing system and the localization structure of the city prior to the implementation.

The general structure of the city plays a role

Experience from theoretical studies, simulations and modelling is unambiguous: the centralizing forces dominate over the decentralizing forces. The result is, hence, that households, commerce and workplaces are driven towards the city centre – the “city” shrinks. These experiences must, however, be considered with caution. There are two important reservations.

The first is that detailed results are dependent on the city structure. Most theoretical studies have handled the “mono-centric” cities, where all workplaces are located in the centre. Simulation studies with a more realistic city structure have shown that in some cases it is the more semi-central areas (close suburbs) that increase their attraction rather than the actual city core. These results are, however, in turn dependent on the infrastructure in the city surroundings, for example if there is a ring road or not⁹¹. Even if the major result still is that the city core in a wider aspect becomes more attractive, it requires detailed studies, where the city’s specific requirements are considered in order to more precisely determine what can be expected to happen.

The second important reservation is that most public studies deal with the consequences of “optimal” congestion pricing, i.e. charges are obtained wherever a queue situation occurs. If implementing more realistic road pricing systems, for example pay roads or toll rings, these results are not necessarily applicable. The effects of a toll ring are discussed below.

Real estates close to a toll ring should become less attractive

A toll ring should primarily have *local* effects on traffic and localization. Effects further away from the actual toll ring should be relatively small.

The effect on the demand for housing/premises should primarily be a decline in areas close to the toll ring. The effects on the city at large depend on how big an area the ring encircles. If the ring is “small”, i.e. the supply of shops and workplaces within the toll ring is small, the consequence ought to be that the demand for the area within the ring declines. In this case, it seems more attractive to remain outside the ring. If the ring, on

⁹⁰ Karlström and Mattsson (1995), Wheaton (1974, 1998), Anas and Xu (1999), Eliasson and Mattsson (2001).

⁹¹ A ring road usually adds to the attraction of the city core, since the roads are relieved from bypassing traffic and thus the accessibility is improved.

the other hand, is “big”, i.e. the supply of workplaces and shops within the ring is large (compared with the supply outside), the demand within the ring should increase⁹².

The toll ring of the so-called Dennis Agreement in Stockholm was calculated to have a centralizing effect. The infrastructure investments outside the ring were, on the other hand, so big that the total effect of the package ended up in a decentralization. Especially locations immediately outside the ring became less attractive. Localizations immediately inside the ring also became less attractive due to the ring, but this was balanced by good access to the planned beltways around the planned city core⁹³.

The city center ought to become more attractive to business in need of deliveries

For most people road pricing implies more expensive car trips, even if they are partly compensated by reduced congestion and thereby improved travel times⁹⁴. On the other hand, there are certain groups that value reduced travel time more than the charge they pay. Especially those with high time value belong to this group, which mainly applies to professional traffic, merchandise deliveries and business trips. To the extent that congestion previously prevented the localization of retailing business, this means that the inner city localizations ought to become more attractive. Likewise, certain offices with long business trips might consider the city centre more attractive than before.

Localization effects are expected to be small

So far we have only discussed in what direction the localization patterns change. But then how big are these effects? The answer is that in general they are expected to be very small, especially in comparison with the effects on traffic and the general changes in land use.

An analysis of the so-called Stockholm Dennis Agreement⁹⁵ that consisted of a toll ring encircling the central city and big infrastructural investments mainly in the periphery of the city showed that the package caused a redistribution of about 1.3% of the residents and about 2.3% of the workplaces. It was expected to take about 15 years for these effects to fully penetrate. Most of these effects originated from infrastructure investments rather than the toll ring.

A simulation study of implementing full congestion pricing in a “typical” European city⁹⁶, showed redistribution in localization of about 2% of the households and slightly more of workplaces and shops.

⁹² Eliasson and Mattsson (2001).

⁹³ Anderstig and Mattsson (1992), Johansson and Mattsson (1994).

⁹⁴ Explanation: the point with road pricing is that those losing from the actual charges can be compensated more than well by the revenue, for example by tax reductions or infrastructure investments. The reasoning here infers that certain groups might gain from the charges already *without* this compensation.

⁹⁵ Anderstig and Mattsson (1992).

⁹⁶ Eliasson and Mattsson (2001).

Road pricing is not expected to deplete the city center

A concern sometimes expressed is that road pricing will deplete the city centre by causing the retailers to leave for more peripheral localizations. As appeared above, this should hardly be a problem in reality. Primarily, the effects of charges are rather the opposite, that central localizations become more attractive. Secondly, these effects are small, in most cases not noticeable. For example, a study in Trondheim studied exactly this effect without being able to notice any measurable effects⁹⁷.

Changes in real estate prices are expected to be relatively small

Empirical studies indicate that changes in real estate prices are expected to be relatively small. A study of the effects on real estate prices in London before implementing inner city charges estimated, for example, that these effects would be very small⁹⁸. Similar studies in, for instance, Oslo have been unable to track any significant effects⁹⁹.

To explain this, we refer to a simple calculation example¹⁰⁰. In theory, one expects the price on a housing estate will increase or decline corresponding to the value of the changed accessibility (the so-called *capitalization*). Imagine, for example, a household working in the inner city and considering buying a house in a suburb. Assume that a road pricing system implies that each work trip costs €2 more per day than if no charges existed. (We might assume that this €2 represent the charge minus the value of gained travel time due to reduced congestion). With two working people in the household, 260 work trips a year and a loan at 5.5% interest rate, this equals an increased purchase sum for the house of €19 000¹⁰¹. Compared with the variation in house prices both over time and between houses in the same area this is a fairly small sum. This illustrates that the expected change in housing demand might be relatively small.

Even more important is that most real estates on the local market are affected equally. As long as potential buyers choose between houses in the same area (municipality or region) the prices will not change. It is only to the extent that there is real competition between different local markets, differently affected by road pricing, that the house prices will change.

⁹⁷ Tretvik, 2002.

⁹⁸ Chesterton's Estate Agents. Cited on <http://www.cclondon.com/WebCenterBranded/StaticPages/index.htm>

⁹⁹ Larsen (1988), Ramjerdi (1994).

¹⁰⁰ Transek (2002b).

¹⁰¹ To this should be added the increased (or reduced) costs for other trips, such as purchase- and leisure trips, so the figure is probably a little underestimated. On the other hand: in most toll systems, the maximum charges per year are much lower due to various periodic passes.

4.6 Social benefit

Social benefit analyses ignore distributive effects

In a social benefit analysis the benefits from a certain measure are compared with the cost of the measure and any possible negative consequences. The most important effects are changed travel time, traffic incidents and emissions from road traffic. There are some important effects that are not normally included in the social benefit calculations, for example intrusion effects (roads through unexploited areas disturb the surroundings, and similar effects) and long-term effects on urban development, urban planning and regional economy development. Properly used, social benefit analyses are a practical aid when discussing whether a certain measure or a certain project is “worth the money”.

An important issue to keep in mind when discussing social benefit analyses is that they only deal with *total* effects on society. A social benefit analysis totally ignores the distributive effects. A measure such as “take all properties exceeding a million and give them to the residents of a small town”, gives a social benefit result equal to nil since it’s a matter of a purely distributive character. Whether this measure is desirable or not cannot be investigated by a social benefit analysis (of standard type).

”Good” road pricing is by definition socially cost beneficial

That social benefit analyses ignore distributive effects implies that “good” road pricing systems by definition are socially cost beneficial. “Good” road pricing refers to a system where a charge is made where it is congestion, and solely there¹⁰². It can be proved that the total social benefit of the travel time gain will then always exceed the value of the total “inconvenience” to those forced to change their way of travel. How big the social benefit gain will be, depends on how severe the congestion problem was originally.

Note that it doesn’t matter to the net result of the social benefit how many that pay the charges and how high the charge is. As long as the profit is a benefit elsewhere it’s only a redistribution of money, which, as already mentioned, is ignored by social benefit analyses. Hence, we should not be surprised if road pricing systems show a social benefit surplus – if they do not, then they are clumsily designed (see below under the topic “Profit maximizing tolls” for such examples). To argue in favour of road pricing systems by saying that they generate a social benefit surplus is, of course, correct, but it doesn’t match the perhaps strongest argument against them, namely that the redistribution effects might be perceived as unfair.

The socio-economic benefits can be very big

The socio-economic benefits that road pricing might provide may, however, be very big if congestion problems are severe.

Some examples of the magnitudes are given. The AFFORD-project¹⁰³ was a study of the theoretical aspects of implementing optimal road pricing in Edinburgh, Oslo, Helsinki

¹⁰² More exactly expressed; the charges must not exceed the external costs of the car traffic. By obtaining a charge exactly equal to the external costs, most (but not all) queues will disappear.

¹⁰³ AFFORD (2001).

and Athens. For the first three cities, the value of the time gains amounted to about € 200–400 per resident, whereas for Athens the value was about €30 per resident. The system proposed by the EPA in 2001 was calculated to provide a social economic benefit surplus of ca. €0.2–0.3 billion per year, of which about half came from gains in travel time. The value of reduced congestion following the charges implemented in Oslo was estimated to only 20 million NOK per year (1992), but here one should keep in mind that the charges were designed in a way that they hardly affected congestion. Computations showed that a system designed to reduce congestion would instead provide social economic benefits of more than 140 million per year. Computations of this kind are seldom directly comparative since, for example, the models used and values of time differ.

The biggest profit is made if the charges replace “damaging” taxes

One of the major profits from road pricing is that, from an economic point of view, they are a better way of raising money for investments than through ordinary taxation. Tax on merchandise and incomes cause losses in the social economy due to reduced efficiency¹⁰⁴. If revenue from road pricing is used to replace such taxes, this will allow improved efficiency in the social economy.

The benefit of this taxation transfer may be very big. The system studied in Oslo within the AFFORD-project provided social benefits of ca. 2000 NOK per year and resident, of which about 1250 NOK originated from transferred taxes¹⁰⁵.

The point is that well-designed congestion charges are a good way of financing public expenditures. Instead of causing losses in other parts of the economy (as do ordinary taxes), they will bring about a more effective social economy system.

Socio-economic effects depend on how the revenue is used

It is an important, well-understood, requirement in social benefit analyses that the revenues are used reasonably, i.e., in a socio-economic way. If the revenues are used for unprofitable investments or projects the money will be lost.

Charges affect the need of other measures.

Road pricing affects the traffic demand and thereby the social economic profitability of other investments in the transportation system, for example new roads or rail. How the profitability is affected depends on how the road pricing system is designed but in general the profit of new public transports increase and the profit of new roads decreases. It may, therefore, be important to analyse how the benefit of new infrastructure or other measures is affected with or without charges¹⁰⁶.

¹⁰⁴ This report is limited and hence does not allow any deeper discussion, but most textbooks in socio-economics discuss these issues in detail.

¹⁰⁵ Fridström (2000).

¹⁰⁶ SIKA (2002)

Profit maximizing tolls are often worse than no tolls at all

For road pricing to be a good idea from a socio-economic point of view, the charge has to be obtained where the traffic is causing so-called external costs, thus primarily congestion. Only then are charges legitimate from a strictly socio-economic point of view. If charges are made on roads with no congestion, this represents a pure socio-economic loss.

Another situation is to introduce tolls that maximize revenue. Even if there is congestion on the road prior to the charges, it can be shown that charges designed to maximize benefits will be so high that they cause socio-economic losses¹⁰⁷. From a socio-economic point of view it would thus be better not to have any charges at all, rather than to arrange them to maximize revenue.

¹⁰⁷ Small and Yan (1999).

5 Technique and administration

In this chapter we will describe how road-pricing systems are organized in practice, covering, for example, the technical solution used to obtain the charge, but also the handling of administrative matters such as occasional visitors and fines for those not paying. We also briefly discuss how various technical and administrative solutions meet the requirements for reliability, legal security, integrity and low operative costs.

We have organized the description according to how the charges are obtained: a fee per passage (payment either by “smart cards” or by transponders connected to bank accounts), charge per distance driven (the experimental GPS based systems) and charging for the right to travel within a zone (by video photographing vehicles driving in the area).

5.1 Payment at passage

In this section, we describe systems where the payment is done when passing a toll station. The payment can be made either via prepaid transponders, manually to a cashier, through money slots or by using a card registering a pre-paid subscription withdrawn from bank account. This is by far the most common type of road pricing system.

Norway – subscription transponders based on bank accounts

Oslo has a ring of 19 toll stations on all roads leading towards the city centre. There are lanes for electronic payment, for money slots or manual payment. However, practically all cars have an electronic subscription transponder placed on the windscreen. Since it can be electronically read, the charge is immediately debited from a given bank account. There is also the possibility to pay in advance, and then the charge is debited journey-by-journey. The pictures below show examples of toll stations (examples are from Trondheim).



Picture of toll station approaching Trondheim.



Picture of toll station in central Trondheim.

The company operating the toll stations sells a subscription for electronic payment. When a car with a subscription transponder passes the gate (see picture above) the charge is withdrawn automatically. The car does not have to slow for passage. If the debiting runs smoothly the car can pass totally anonymously – which it of course also does if the charge is paid manually.

If the debiting fails, for example if there isn't enough money on the subscription account or if the subscription is not valid, the car and its registration plate are photographed. The car owner is then later contacted. Paying a fee of 35 NOK within three days of notice at a gas station is a way to avoid an additional fine of 300 NOK. There is cooperation with the Swedish car register list so that also Swedish motorists get a ticket if passing without paying.

Occasional visitors are no problem to handle since they can pay the charge manually. Since electronic payment, however, is the most common method among all cars passing,

there are hardly ever any queues at the toll stations. The process from decision to implementation took some years.

The revenue for year 2002 is expected to be about 1 billion NOK. The investment cost in 1990 was about 250 million NOK, of which 100 million went directly to the construction of toll stations. A transponder costs about 200 NOK. The operative costs amount to about 10% of the revenue, i.e., about 100 million for year 2002. Most of the cost is related to the 24-hour manning of the toll stations. The annual maintenance costs are about 10 million NOK¹⁰⁸.

Singapore – prepaid “smart cards”

The Singapore system is totally automatic. Vehicles going into Singapore city or using certain highways pay a charge. There are about forty gates where a charge is made. Each car has an electronic reader with a prepaid “smart card”, similar to a telephone card or “cash card”. The cards can be bought at, for example, service stations and can be charged at ordinary cash withdrawal machines.

The charge is debited whenever the car passes a gate. The gates are similar to the steel-framed gates in Trondheim. The card reader displays the charge debited and also the remaining balance. The charges are revised every third month and specified on electronic billboards at each gate. The charges are based on a target speed to reach reasonable accessibility. If the average speed declines, the charges are raised and vice versa.

Since the transponders are impersonal (in the same way as telephone cards) the passage is totally anonymous if the debiting runs smoothly. All debits are, however, stored at the operative central agency for a short period of time before they are erased. The reason is that there has to be a possibility to appeal against incorrect debits, incorrect fines, etc. The number of errors is, however, small. The reliability has been studied by a number of tests and claimed to be 99.99 percent¹⁰⁹.

When it comes to registry and photographing of vehicles passing without paying, the system is very similar to the one in Oslo. The fine invoiced afterwards is, however, low. There are no gates for manual payment. Visitors thus have to rent an electronic reader at the Singapore border.

It took about eight years to build the system. The total investment cost was a bit over a hundred million euros, including the distributing of electronic readers for each car¹¹⁰. Since there was no such system in operation prior to the implementation in Singapore, the development costs were high. When discussing implementation of the same system in other places, the development costs will be considerably lower.

¹⁰⁸ TFK (2002)

¹⁰⁹ www.onemotoring.com.sg.

¹¹⁰ Gorpe (2000).

The revenue equals about € 40–50 million per year¹¹¹. The costs for operation and maintenance are about €8 million per year. The cost of a new tollgate is at present about €0.7–0.8 million and an electronic reader costs about €90¹¹².

In Melbourne and Toronto there are systems similar to the one in Singapore, but only for certain routes in and around the city. An interesting feature in the Toronto road pricing system is, nevertheless, the opportunity to pay in advance and still not have a transponder in the vehicle. The car is then identified by its registration number using cameras. Each month (if at least one passage has been done) a bill is sent to the car owner. About 30 percent of the passages are done this way, although the charge is higher – i.e., an additional 2.65 Canadian dollars per passage¹¹³.

EU wants to coordinate automatic payment systems

The development of techniques for automatic payment is rapid and is pursued all over the world. The increased use of automatic payment systems has led the EU to prioritize coordination of payment routines for road pricing. The objective is to let a vehicle pass through a large number of payment systems throughout Europe only using one single electronic device for automatic debiting. In the fall of 2002 the commission proposed directives on requirements for interoperative payment systems. This is pursued on account of the European standardization committee (CEN), after many years of work, has failed to establish an agreement for a European standard.

In Norway, a successive transition to a new system for automatic road pricing payment is in progress. The system is called Autopass and will be used at all toll stations throughout the country. A contract with the operative company, however, still has to be signed. According to the plans, it will be possible to use one single subscription and get an invoice for all toll systems, at the latest by the New Year 2003/2004. The technique is claimed to be more user friendly and at the same time, more rational, efficient and reliable to the operative companies. There are plans to use the system also for other services, e.g., parking. It is also hoped to make the system more compatible with future European standards¹¹⁴. The actual situation today is, however, that the Norwegian system is not technically interoperative with the standards of the directives proposed by the EU¹¹⁵.

5.2 Payment per driven distance

In this section we describe road-pricing systems with a charge according to the distance driven. There are, however, still no such dedicated systems operating full-scale. In the Netherlands, this system was close to being finalised when the plans were shelved (August 2002), and within the EU-project PROGRESS this technology is used in field

¹¹¹ Gorpe (2000)

¹¹² TFK (2002)

¹¹³ www.407etr.com.

¹¹⁴ www.vegvesen.no/autopass.

¹¹⁵ Information from Christer Karlsson, chairman of the Swedish Technical Committee SIS/TK 255.

trials. The Toronto system is, in practice, a distance-based system since the driven distance, depending on the toll stations that are passed, determines the charge. The same applies to Singapore where the charge varies in different zones. The technique used in these cases is, nevertheless, not the equipment in the vehicle that keeps track of how far you drive, but automatic tolls. In Switzerland, a kilometre-based system was implemented a couple of years ago for heavy traffic and Germany is considering the same type of system. However, they do not specifically address traffic in urban areas and are therefore not discussed in this report.

Field trials with distance-based charges

Systems for distance-based charges are not yet in operation. Through research and field trials, knowledge of such systems is building up. It is still difficult to tell when distance-based systems can be brought into full-scale operation, but no doubt many technical problems still have to be solved.

At present, in Gothenburg, field trials are ongoing – within the EU project PROGRESS – with a system based on GPS and GSM, where the vehicle itself keeps track on its position and where it drives. This information is then used to compute the charge that varies by location and time.

The position of the vehicle is determined by satellite positioning, GPS. Information about charges is obtained from a central data unit using the GSM network, and stored in the vehicle's transponder as a digital map with charges for different zones and points of time. A small palm computer placed on the front panel is connected to a GPS navigator under the driver's seat. The computer continuously registers the vehicle's position and checks it against the price listed on the digital map. When the vehicle enters a new zone a counter starts ticking, just like the taximeter in a taxi.

After a few hours a summary is compiled and the computer sends a payment order via the GSM network to the central unit. The central unit then returns an electronic receipt of the payment. The driver does the actual payment, by choosing the operation company to supply the service and the account to be debited. The account can be an ordinary bank account, fuel account or a food account

Information sent from the vehicle to the central unit is coded and cannot be read without permission from the driver. Only the transactions are known by the central unit, not the identity of the sender nor the vehicle or its movements. There is no registering of vehicles passing without problem. All transactions are stored in the central unit for a certain time and then erased. If a problem should occur, the driver can "unlock" the payment using a personal code so that any errors can be corrected.

The cost of obtaining the charges is hard to calculate. The major part consists of a one-time investment for purchase of card readers for all vehicles and the organization and construction of the central unit. After this investment the running costs are relatively small. The GPS/GSM system already exists as a prototype. The card readers used in the Gothenburg trial are manufactured in small series and hence are relatively expensive, about €2 000 per unit. When it comes to very large production series, as is the case in a

real full-scale system, this cost will drop dramatically¹¹⁶. Experiences of the reliability of automatic systems with distance-based charges naturally do not exist. In the field trials in Gothenburg there have been certain problems with the transponder in the vehicles, which is not surprising since they are only prototypes.

In the Netherlands a similar system was planned full-scale

The technique for the Dutch system with kilometre-based charges was not finally settled when the plans were put on the shelf. The vehicle's position was to be determined either by transmitters along the roadside or through GPS within the vehicle. In other respects the technology was similar to the one used in Gothenburg

The equipment – called Mobimeter – was then to be installed in all vehicles to register the number of kilometres driven in different zones. Information about the distance as well as the actual charge was then to be transmitted to the authority administering the charges, perhaps via an operating service. Data on when and where the vehicle had been would, however, only be registered within the vehicle's equipment. Once a month an invoice was to be sent to the vehicle owner – unlike in Gothenburg where payment is made in advance. Another distinction compared with the Gothenburg field trial was the Dutch plan to also let the charge depend on the environmental qualities of the vehicle.

5.3 Payment for permission to travel within a charging zone

In this section, we describe systems where payment is made in advance for permission to travel within a certain zone at a certain time of day. Traditional road pricing systems are, instead, based on paying for a permission to pass a certain charging zone. A simple system granting the right to travel in a certain area is to be found in Italy (brief description in chapter 3). The same idea was proposed in Stockholm in the late 1980s. The idea was that a monthly pass for the Stockholm public transport system was to be displayed on the windshield in order to drive in the inner city. The focus of the description in this section is, however, the system planned in London, since this is a technologically and administratively more interesting system.

In London all vehicles will be photographed

The system planned in London is based on advance payment for the right to travel within the charging zone. The motorists pay the fee in advance, or later the same day. The payment can be made either over the phone, by post, via internet, in shops or at service stations. When the payment is made the vehicle's registration number is stored in a database. Cameras are placed in the charging zone, photographing the number plates on all moving vehicles in the area and checking against the database that they're paid for. If payment has not been made a note of this is stored, and if not paid by the end of the day a fine is sent to the owner of the vehicle. The payment can be made per day, week, month or per year.

¹¹⁶ The Swedish Environmental Protection Agency (2001)

There is no need to stop the vehicle for the photographing. If the charge is not paid, a fine is issued. The fine is planned to be relatively high (from £40-£80 depending on how fast it is paid). It is estimated that the cameras will be able to catch 80% of the cheaters. The reliability is, thus, low compared with a system with passage control.

The method is considered to be relatively quick to implement compared with a system with passage control. Necessary investments are the cameras and an extensive database system transforming pictures of number plates to digital information. The revenue is estimated to equal £ 130 million per year. Information on the operating costs has not been available.

6 Acceptance

How many are in favour of road pricing? How many are opposed? It depends on the question asked. Studies of “acceptance” refer to studying how big the support for road pricing is and the factors that affect that opinion.

In this chapter we will discuss results from some European studies investigating the public’s impression of road pricing. The summary consists of some general conclusions that are expounded through the rest of the chapter.

6.1 Introduction

Numerous studies have investigated how many that are in favour and how many are opposed to road pricing, and how this is affected by how the questions are designed, the information given to the respondents, etc. In this chapter we try to summarize the major results from a number of studies. Since the material is very extensive, we cannot account for all studies and results in detail. The purpose is, instead, to provide a general review of the results.

In section 6.2 we describe some general perceptions and opinions of the traffic situation and road pricing. In section 6.3 we summarize the most common objections against road pricing. In section 6.4 we present the requirements to get public support for a road pricing system.

6.2 Common opinions about traffic and charges

Congestion considered a big problem

The congestion in the road system is considered one of the worst traffic related problems in most large cities¹¹⁷. Most studies show that the majority feel that something must be done to improve accessibility on the roads. When people rank which traffic problem is the most urgent to solve, congestion and queues usually come first, along with emissions and lack of parking space. Congestion is considered a bigger problem than, for instance, traffic incidents and noise. The acceptance for road pricing is also higher in large cities with severe congestion problems.

¹¹⁷ AFFORD. Naturvårdsverket (2002).

Improved public transport has most support

The most popular measure to reduce queues is to improve the public transport system¹¹⁸. A support of about 80% is typical for this measure. This is also the measure that most people believe to be the most effective. Raised parking fees in the inner city and various types of restrictions (for example, a ban for cars in the city centre) are the second most supported measures, and also believed to be the second most effective. About 60% are typically in support of these measures. Then comes road pricing, typically supported by about 30%. Some of the opponents claim that road pricing is not an effective measure to reduce queues. Other opponents believe that charges are likely to reduce queues, but function unfairly.

Charges are easier accepted for financing purposes

If the question “Should road pricing be implemented?” is rephrased as “How should improved public transport be financed?” charges to drive in the inner city are by far the most supported measure¹¹⁹. Similar results have been presented for other popular traffic improvements¹²⁰. The support for charges that controls the traffic, e.g., a fee for driving in the inner city during peak hours, also gets significantly more support than general automobile fees (e.g., higher vehicle excise and taxes).

Regulations easier to accept than pricing

Many people are opposed to the whole idea of pricing public assets, e.g., roads. Some studies have pointed out that the most common ways to handle restricted resources within the public sector (such as roads) are different regulations, rations or bans, not charges¹²¹. This diverges from the handling of common stock in a market, where it's fully accepted that more desirable merchandise is more expensive. The same approach applied on public assets such as roads is difficult to accept for many people. Many, for example, find it easier to accept a total ban for car traffic in the inner city than a charge to drive there, an opinion that may appear a paradox to some.

Support for road pricing depends on how the question is phrased

How many that claim to support a road pricing system fully depends on how the question is phrased. The lowest support is returned when asking about road pricing as an isolated measure, not mentioning what the revenue is meant for, how the charges will be constructed, etc. The support usually increases if it is declared that the revenue is supplemented by other measures (e.g., improvement roads and public transport) and that the revenue is needed (i.e. the other measures are not sufficient), specifying where the money goes and make it plausible that the charges have effect¹²².

We will present two examples. In a study by the SSNC in Gothenburg in 2002, one question was posed: “If new investments in improved roads and public transport are

¹¹⁸ Jones (1995), (Jones 2002), Schade (2002).

¹¹⁹ Jones (2002).

¹²⁰ Jones (1995).

¹²¹ PATS (2001), PRIMA (2000), Frey (2002).

¹²² Jones (1995), (Jones 2002), PRIMA (2000).

insufficient to reduce queues in Gothenburg, would you then approve of introducing a special charge during peak hours as a supplement, if this reduces the queues?" . A total of 38% of the respondents answered "Yes, absolutely" or "Yes, maybe". Most likely phrasings such as "... as a supplement..." and "... if this reduces queues..." made the positive share increase. Probably even bigger support would have been found if it had been specified that the revenue would be used for a purpose favoured by the respondents (e.g., better schools, lower taxes or improved public transport).

Another study was done within the PROGRESS project in Gothenburg in 2000. There were many questions about road pricing. To illustrate the significance of how the question is phrased, we can note that those in agreement with the statement "Road pricing is fair. Motorists in a hurry should pay to get shorter travel time", were about 12%.

Most often a majority is opposed to road pricing (as an isolated measure)

Even though several scientists claim that the question "Do you think that road pricing should be introduced?" is meaningless unless it is specified how the charges will be constructed and where the money goes, and so on, many surveys have, nonetheless, asked this general question. We will mention some examples below.

One of many surveys in Stockholm was done in 2001¹²³, where 51% of the respondents were opposed to road pricing in the inner city of Stockholm, and 38% were positive.

In a similar survey in London, those in favour of road pricing were 51% and those opposed were 30%¹²⁴. The corresponding figures for Great Britain as a whole were 39% in favour and 37% opposed.

Within the EU project TransPrice, the support for a toll ring (charge to enter the city) and the support for a "transport package", which in addition to a toll ring also consisted of traffic investments, was investigated in six European cities (Athens, York, Como, Leeds, Graz and Madrid). The support for a toll ring varied between 16% and 20%, whereas the support for the "package" varied between 36% and 64%. A similar study was done within the EU project AFFORD for the cities of Athens, Dresden, Oslo and Como. The support for road pricing alone varied between 15% and 25%, while support for the package varied between 31% and 48%. Both studies found that respondents in large cities such as Athens were more likely to agree that measures to reduce traffic were needed (89%), and the support for the two "packages" was also higher (64% and 48%, respectively). The corresponding figures for minor cities such as Como were considerably lower.

Support increases when road pricing finally is introduced

In places where road pricing has been introduced, the support gradually increases. In Oslo, 70% were opposed prior to the road pricing. Immediately after the charges were introduced that figure dropped to 64%. Eight years later, 54% were against road pricing.

¹²³ Dagens Nyheter (Temo) Sept 2001.

¹²⁴ Jones (2002).

Between the years 2000 and 2001 the opposition, however, again grew stronger¹²⁵. That the support increases when charges are introduced is also the case in other places, for example in Singapore, Bergen (2/3 against prior to the toll ring and a majority supporting it some time after the implementation) and Trondheim (72% negative prior to the implementation and 35% negative two years after)¹²⁶.

6.3 Common arguments for and against road pricing

Since most scientists and experts agree that road pricing is an effective measure that most people could profit from, many scientists find it a paradox that the support is so weak. In connection with the acceptance studies, the most common arguments against road pricing were also investigated. In this section we give an account of the most common objections among the public and also briefly list the answers from those in favour of road pricing¹²⁷.

“It’s not logical to pay for queuing!”

This is a very common objection¹²⁸. Those that today are affected by congestion and queues are often totally immune to the idea that those in queues should pay a fee. They don’t consider themselves a cause but rather a victim of the congestion. It then seems totally illogical to pay when you are suffering from the congestion. Those advocating road pricing respond that it’s logical with a charge to use a restricted resource such as road space, in the same way as there is a higher charge for using the phone at times when there is peak usage. In other words, it is logical to pay for the costs inflicted on others in terms of congestion.

Another argument is that road pricing is a mock solution, i.e., to eliminate queues by forcing people to give up their travel will not solve the problem, namely the lack of capacity. It’s the same as “get rid of bread queues by prohibiting the eating of bread”. If road space is not sufficient the solution must be new road constructions. The answers to this reasoning are that new roads cause an increase in traffic so that also the new roads will be congested, that it’s often impossible to build new roads because of city planning, and that travelling by car is indirectly subsidized since cars don’t pay for their external costs.

Many find it easier to accept paying to travel on new roads where there are no queues. You then experience that you get something in return for your money, namely an open road. From a socio-economic perspective this pricing is contra-productive because there

¹²⁵ Gorpe (2001), Tretvik (2002).

¹²⁶ Tretvik (2002).

¹²⁷ The synthesis is based on, among others, Giuliano (1992), AFFORD, Jones (2002).

¹²⁸ This is by far the most common objection in Oslo, for example (Tretvik, 2002). It’s interesting to note that this objection has been reduced by almost half since the implementation of the tolls, perhaps because the revenue is used for new roads.

is no cost¹²⁹ to let people use roads once they are constructed, thus there should be no charge.

“It only affects the poor”

That road pricing only affects the poor is a very common argument, especially in the public debate. This argument often occurs along with the argument that those that use their car don't have any other choice. Thus road pricing would be nothing but an extra penalty tax.

Economists have sometimes formulated a similar argument by emphasizing that the willingness to pay does not necessarily reflect how “urgent” or “needless” a trip actually is. Many experts claim this to be a big problem if the distributive effects aren't carefully analyzed¹³⁰. Apart from the “poor”, it's claimed that certain other groups can be unfairly affected, for example geographical areas or professional categories (shift workers, etc). Experts often point out that the redistribution effects between different groups in society can be very big compared with the profit of the system. This has made some experts doubtful about the whole idea of road pricing¹³¹.

What groups that will benefit or lose from a road pricing system is a complicated question that depends on how the system (including use of revenue) is constructed. On one hand, there is no doubt that changes for the worse will afflict different groups and geographical areas. On the other hand, most systems can be constructed in ways that this is more or less avoided. The drawback is then that the system may become relatively complicated. The problem with a complicated system is not primarily that the travellers don't understand it – many studies have shown that road pricing systems can be more or less complicated and still work well¹³². The first problems to occur are the exceptionally complicated political negotiations. In some places this has been solved by the politicians reaching principle decisions on the objectives to be achieved with the charges and submitting the detailed layout to the city traffic planners (for example, in Singapore) or private operators (for example, in California). See the discussion about distributive effects in chapter 4.

“Those with company cars will not have to pay tax for the privilege”

One argument against road pricing that is sometimes mentioned in the Swedish debate is that people with company cars probably will get the charges paid by their employer and thus will be favoured by the system. Considering that private driving with company cars or the fringe benefit of free parking at work are not especially well checked today, it is claimed that neither will the checking on road pricing charges work effectively.

The objection of those in favour is that in a legal aspect it's obvious that such a fringe benefit must be taxed, and the road pricing process must not be prevented by people not obeying the laws.

¹²⁹ With exemption for the operative costs of the road, but the increase is relatively little if the traffic on the road increases.

¹³⁰ Mayet and Hansen (2000), Eliasson (2000).

¹³¹ Evans (1992).

¹³² Small and Yan (1999), Verhoef and Small (1999), Richardson and Bae (1996).

“Improve the public transport system and build new roads instead”

A common opinion is that road pricing should not be introduced before having tried other measures to reduce queues. The most popular measures usually are improvements in the public transport sector and new roads. Fairly many people, although far from all, might consider road pricing if the revenue is directly used for such purposes.

Those in favour of road pricing first of all claim that these measures have proven insufficient¹³³, and secondly that new roads can't be motivated by increased traffic as long as motorists don't pay for the costs they inflict upon others (congestion and emissions)¹³⁴. As long as car traffic is “subsidized” in this way, we will, by definition, have too much traffic. If we have too much traffic due to this, it's illogical to use the increased traffic as an excuse to build new roads. Most people in favour argue that improved public transport and new roads are also urgent, but do not eliminate the need of road pricing.

“Road pricing doesn't reduce queues”

A common objection is that road pricing will not reduce the queues since those that drive a car don't have any other choice. Many people also believe that very large traffic reductions are needed to reduce the queues. Hence, the charges need to be very high to reduce the traffic.

The answer from those in favor, is that it is indeed true that some motorists have no other choice, but this hardly applies to all of them. Relatively many have the possibility to choose a different time for travel, route or mode of transportation. A traffic reduction of about 10-15% would reduce queues considerably¹³⁵. In places where the objective of road pricing has been to reduce queues, for example in Singapore and Trondheim, the results have been evident (see further chapter 4.1 about distributive effects of road pricing)

“Road pricing has negative secondary effects”

Sometimes there is anxiety that the charges are constructed in a way that they cause other problems elsewhere. For example, a toll ring around the city core might cause an increase in traffic on the smaller roads immediately outside the ring. Other misgivings are that the commerce in the city center will be depleted and the housing prices will be affected.

Available studies, however, indicate that these effects, in general, are very small (see further chapter 4.5 about localization effects).

¹³³ For example, Mogridge (1997) and PATS (2001).

¹³⁴ For example, Anas and Xu (1999) and Thomson (1998).

¹³⁵ SIKA (1999).

“The technique will not work”

No matter what technology is proposed, objections are raised such as the inability to identify vehicles, that people will cheat the system, and that the payment system won't work. Emotional arguments are presented, such as “I don't like satellites” (if the system is GPS based) or “cameras take us back to the Soviet era” (if the system photos cheaters). Sometimes other administrative problems are mentioned; such as it's unreasonable to hold the car owner responsible if someone else is driving his/her car.

That the technology will not work was one of the major objections against the system implemented in Singapore in the mid 1990s. Once the system was installed and found to work, it was accepted¹³⁶.

“The system costs too much”

Another technical objection sometimes heard is the misgiving that the cost of registering the charges will wipe out the benefits¹³⁷. The objection, of course, mainly refers to the costs for maintenance and development of various types of electronic systems.

Those in favour of road pricing claim that the costs for maintenance and development are relatively small compared with the revenues and benefits to society (in chapter 5 we describe the costs for different systems in operation).

“It's no business of the government where I drive”

In some places the questions of integrity and anonymity have been the crucial. The system in Hong Kong fell mainly on such a matter. Some of the previous systems with transponders that were studied didn't guarantee anonymity.

The systems now in operation, as well as those being planned, normally provide the possibility to be anonymous. Either the payment transponders are impersonal (as in Singapore), or it's possible to pay cash (as in Norway) or the transaction does not carry data about the vehicle (as in the PROGRESS field trial). The various systems are described in chapter 5 on technique and administration.

Questionnaire studies also indicate that today fewer are concerned by the “Big Brother syndrome” than a decade ago¹³⁸. Apart from the purely technical development that prevents the tracking of personal data, scientists speculate that people to a greater extent have become accustomed to using systems where, in principle, it's possible to track them (for example, credit cards and the internet).

¹³⁶ Gopinath Menon (2002).

¹³⁷ The second most common objection in Oslo (Tretvik, 2002).

¹³⁸ AFFORD, PATS.

6.4 Prerequisites for acceptance

Acceptance for road pricing is, thus, totally dependent on how the question is phrased. If road pricing is presented as an isolated measure, not specifying the design of the system and where the revenue goes or what other measures will be taken, the majority of people are opposed to charges. Typical figures are then about two-thirds against and one-third in favour of road pricing, although it varies between cities and countries. If, on the other hand, road pricing is presented as part of a strategy to improve the transportation system, those in favour are often a majority.

Since most studies have a positive basic outlook on road pricing, many of them have used their results to propose strategies to get support for road pricing. A brief summary of what these studies believe to be prerequisites to get public approval of road pricing is given below¹³⁹. It should be emphasised that we do not take any particular position in favour or against road pricing. What is summarized below are the findings from the research projects.

No major disparities between the view in Sweden and abroad

The numerous international acceptance studies¹⁴⁰ are more or less unanimous about what affects acceptance:

- what the revenue is used for
- the purpose of the charges
- how the system is constructed (what technology is used, the level of the charge and how it is made)
- what other measures that are also implemented to improve the traffic situation
- who decides the level of charge
- what the respondents know about the traffic situation and the effects of various alternative measures

The opinion about traffic and road pricing does not seem to differ very much between Sweden and other countries. According to a study¹⁴¹, a proportionately large share of the Stockholm public believes that the congestion should be handled by improving the public transport system and by building new bypasses. Simultaneously, support for limitation of accessibility to the inner city, etc., is fairly low. Support for road pricing is, however, somewhat higher than in other cities investigated. Among politicians and experts, a frequent comment was that the public need time to get used to new ideas like road pricing. Hence, some of them advocated an implementation step by step, where new roads were to be financed with revenues, while others preferred charges combined with lowered income taxation. Nevertheless, the answers from Stockholm do not very much differ from other cities, and the statements above should thus be relevant also in Sweden

¹³⁹ The synthesis is mainly based on Jones (1995, 2002), Goodwin and Jones (1989), AFFORD, PRIMA, PATS, CAPRI and TRANSPRICE.

¹⁴⁰ For example, Jones (1995, 2002), AFFORD, PRIMA, PATS, CAPRI, TRANSPRICE.

¹⁴¹ PRIMA (2000)

Prerequisite 1: The charges must be needed

A required prerequisite is that the congestion in the road network is considered a serious problem. In addition, the charges must be considered inevitable to solve the problem, either because it's obvious that otherwise there will be no money for other measures to reduce congestion, or the public is convinced that other measures are insufficient (either by calculations and information or by other measures already implemented). The ideal situation is, of course, to have both prerequisites fulfilled. The belief that road pricing would work, and that it would actually reduce congestion is what determines if you accept or reject road pricing, together with whether you believe it to be just and fair¹⁴²

Several studies have shown that information about the traffic situation and the effects of different measures might affect acceptance very strongly¹⁴³. A study in London started out with questions about what measures the respondents believed were needed in order to improve the traffic situation. Then some figures about the traffic increase in London were presented, what the travel pattern looked like and how much that had been invested in roads and public transport, and how the respondent's own travelling would be affected by different measures. Some measures still got practically the same support (for example, entrance parking), others got significantly less support (support for "fast-track" dropped by 41%, "road investments" by 30% and "more parking places" by 39%). Other measures got significantly more support ("higher parking fees" increased by 87% and road pricing by 20%).

Prerequisite 2: The charges must be part of a strategy

The charges must have a distinct purpose, for example to reduce congestion during peak hours¹⁴⁴. To be trustworthy it has to be clear that the road pricing system is designed in a way that it solves the problems as intended, for example by higher charges during peak hours and lower (or zero) at other times. Sometimes it's claimed to be very important with a "simple" design, for example the same level of charge all day and a small number of toll stations. Studies of acceptance, however, indicate that more people are likely to support road pricing if the system is sufficiently sophisticated that it can be trusted to solve the problem concerned¹⁴⁵. On the other hand, a system should not be so complicated that it becomes impossible to grasp. If the system becomes so complex that it's impossible to keep track of different toll levels, the system will then be perceived as random and therefore unfair¹⁴⁶.

The charges must be part of a strategy also including other measures¹⁴⁷. This is partly to do with the fact that the benefit of the revenue must be obvious (prerequisite 3) and that there must be a clear political intention (prerequisite 4). In order for the political intention to be trustworthy, a willingness to use all available measures must be apparent. Other possible parts of such a strategy could, for example, be improvements in the public

¹⁴² Rölle (2002), Goodwin and Jones (1989).

¹⁴³ PATS, Jones (2002).

¹⁴⁴ PATS, PRIMA.

¹⁴⁵ PATS, Jones (2002).

¹⁴⁶ Schade (2002).

¹⁴⁷ Goodwin and Jones (1989), Jones (1992,1995).

transport sector, new or improved roads or information systems for road- and public transport users, etc.

The charges and other measures must be constructed in a way so that there are realistic possibilities to avoid having to pay a charge. With a charge around the clock and for large geographical areas, the charges will hardly affect the car traffic and become meaningless. The charges will then be perceived as an extra tax, and rightly so. Instead, the charges should be designed so that they clearly address the locations and time of day where the problems occur.

The measures in the strategy should make it easier to choose other alternatives than driving a car in places and at times of day when there is congestion, thus when/where there is a charge. Besides an improved public transport system, this might concern improved city plans, information systems telling where and when there are queues, and entrance parking, etc.

Prerequisite 3: The regional benefit of the revenue must be obvious

The strategy must also consist of a plan on how the revenue will be used. It's important to keep in mind that most people affected by the charges will experience a drawback¹⁴⁸, either because they find themselves forced to switch to an inferior alternative, or because they don't feel the time gain is worth the money they're paying. Hence, it's crucial for acceptance that the revenue is used to provide some sort of benefit for the whole region¹⁴⁹.

Acceptance will increase significantly if there are guarantees that the revenue is to be used in the public transport sector¹⁵⁰. Many people claim this to be an absolute condition in order to accept road pricing. This is, however, not all together necessary: there are examples where the revenue has been spent differently and the charges still accepted¹⁵¹. Certain questionnaires have asked the question "Suppose that road pricing is introduced. What do you think is the most important sector to support with the revenues?" where transportation investments were compared with, for example, increased resources for health care and schooling. Sectors other than the transportation sector have then often been given higher priority. Criticism of these studies has sometimes alleged that the respondents were unable to choose an alternative like "Road pricing should not be introduced. Increased resources to health care and schooling etc. should be financed through regular taxes".

The studies do, however, agree that it's an absolute prerequisite that the revenue is used to provide local benefits in the region in order to get public support.

¹⁴⁸ Giuliano (1992).

¹⁴⁹ Johansson and Mattsson (1994).

¹⁵⁰ CAPRI, PATS, Jones (1995, 2002).

¹⁵¹ Tagging money this way is now unusual in most contexts (the car excise in Sweden was however tagged for road investments during the years 1938-1979). Many experts argue that the revenue should be treated just the same as other state revenues, thus they should be used where they provide the best benefit. See further chapter 8 about using the revenue.

Prerequisite 4: The distrust in political commitments must be defeated

There is widespread suspicion of the authorities' intentions with the charges¹⁵². This does not only refer to the public. Also many political scientists have lately singled out the risk of letting the government get access to a new almost inexhaustible source of income¹⁵³. People will be especially sceptical if they suspect the revenue to cause other money to disappear, for example that existing resources to the transportation sector will be reduced or that state subsidies to the region will be reduced.

Therefore many people recommend that the revenue from road pricing should be used in advance in order to make clear the benefit and show political commitment¹⁵⁴. In both Singapore¹⁵⁵ and Norway¹⁵⁶ it was considered important that the benefit from the revenues quickly became apparent.

Some experts are of the opinion that regulations tagging the revenue for use only in the transportation sector are a way to prevent a possible political interest in obtaining more money from dominating over the intention to improve the traffic flow. Another approach proposed by researchers and scientists¹⁵⁷ is to have an independent institution collecting the charges, thereby avoiding governments being tempted to milk the revenues for other purposes¹⁵⁸.

Prerequisite 5: The charges must be smartly designed

Many people are sceptical towards road pricing because they cause unwanted side effects. Hence, the charges must be smartly designed so that these effects will be as small as possible.

A couple of examples: There is anxiety that road pricing will cause commerce to move out from the city core. Conceivable solutions would be to reduce parking fees for those shopping or to have lower or no charges at all at times when many people do their shopping (Saturdays; weekday evenings). Another anxiety is that professional traffic and other urgent transports in society (emergency vehicles, etc.) would suffer. Conceivable solutions would be free passes for certain types of transports or a maximum charge per day.

Prerequisite 6: Important with communication and participation in the decision-making process

Several studies claim that the actual process of designing and implementing the charges is a key issue in itself¹⁵⁹. It is of crucial importance that many groups in society are

¹⁵² PATS.

¹⁵³ Evans (1992).

¹⁵⁴ Jones (2002).

¹⁵⁵ Gopinath Menon (2002).

¹⁵⁶ Gorpe (2001).

¹⁵⁷ For example, Evans (1992).

¹⁵⁸ Some claim that this is what happened with the fuel tax; from being a measure it has now become a public income source (Kiström, 2000).

¹⁵⁹ AFFORD, Catling (2002).

involved, that different alternatives for improved traffic are openly considered, that a good description is given of the positive effects on the problem the charges are meant to address, how potential negative effects should be handled, and what distributive effects are to be expected and how they are dealt with, and so on¹⁶⁰.

A distinct strategy for communication is crucial. Politicians and planners must clearly illustrate the purpose of the charges, and describe how they fit into the overall strategy. Central issues concerning how the revenue will be used, why the charges are designed a certain way, and what other measures that will be taken, must be explained in a trustworthy manner¹⁶¹.

¹⁶⁰ Catling (2002).

¹⁶¹ Jones (2002), PRIMA (2000).

7 Institutional prerequisites

Institutional prerequisites are a factor that is just as decisive as the actual traffic situation for choosing road pricing. The political situation as well as legislation regulating the decision-making process and the possibility to obtain charges then plays an important role. In this chapter we study the political situation in those cities where road pricing has been decided upon, what has been the emphasis in the debate, and how revenue use has been regulated. The discussion of legal aspects is focussed on Sweden since the legislation and traditions are so different from country to country that it's hard to make international comparisons.

Despite the institutional prerequisites being such an important factor, scientists and researchers have spent essentially less time studying this than other factors such as technology and the effects of road pricing. The related issues of acceptance have, however, been the objects of much attention, as described in a previous chapter.

7.1 Cities where road pricing has been, or will be, implemented

In principle, only one decision-making authority in Singapore

In Singapore, the decision-making process was facilitated since they, in principle, only have one level for decision-making. There is no local or regional political level. The state, region and municipality coincide and are ruled by the prime minister and his government. At the same time the political party in office has a dominating position. Another fact that probably facilitated the decision politically is that the citizens are used to strong government since they live in a very dense society with a strong requirement for law and order. In addition, road pricing in a more simple shape had existed ever since the 1970s¹⁶².

There was, nevertheless, a debate addressing the implementation of the new charges, where the foremost argument against them was the disbelief that the technique would work. After the charges had been implemented – and the technique proved to function – the acceptance grew.

There are no rules that the revenue must be used for a specific purpose, instead they go straight into the state budget. Also in other aspects the institutional issues seem to be fairly uncomplicated, since several closely related ruling- and organizational systems support one another. This applies to, for example, the system for road pricing, traffic

¹⁶² Gorpe (2000).

conduction, the regulating of car ownership but also the operation of public transport and the planning of traffic constructions and houses and buildings¹⁶³.

In the Norwegian cities the revenue was needed to improve the infrastructure

Already in 1963 Norway legislated in order to facilitate road pricing on public roads. A prerequisite is that the revenue is used in distinct and agreed investment programs. When the investment program is complete, the charges will be removed. In order to introduce road pricing the agreement must have the approval of the region's political organ as well as the government.

An important reason for introducing road pricing in Norwegian cities was the shortage of money for financing an ever-increasing need for new roads. Another important political incentive was the funding promised by the government, given a regional agreement to introduce charges¹⁶⁴.

The public was still fairly negative to the charges when they were implemented. Bergen was the first city to implement urban charges. Two-thirds of the population in Bergen were opposed when the charges were introduced, even though a majority later accepted them. The situations were similar in Oslo and Trondheim. In Oslo, the charges were opposed by 70% prior to the implementation. Then support gradually increased, and by the end of the 1990's it was almost equal to the opposition. Between the years 2000 and 2001 the negative share, however, grew strongly, most likely due to the animated discussions on a new package of charges¹⁶⁵.

With existing legislature it is today, however, not possible to use road pricing as a measure to regulate traffic. Nevertheless, in Trondheim they've had an experimental project based on more time-differentiated charges¹⁶⁶.

London had a broad political agreement that something had to be done

In London the traffic has been an important political issue for quite some time since the traffic problems have been severe. Earlier attempts to solve the problems by new road constructions have been insufficient to reduce congestion. The London mayor Ken Livingstone therefore had the traffic situation in central London as his most important issue in the elections. Road pricing has, however, been discussed for a long time. An earlier, Conservative, government had already laid the basis for the charges now being planned by making it legally possible to implement road pricing. The law, however, requires certain conditions in order to allow the implementation of road pricing:

- The design should be done in consultation with the national government
- The charges must be part of a larger transportation strategy
- The surplus should be returned to infrastructure investments and maintenance.

¹⁶³ Gorpe (2000).

¹⁶⁴ Ramjerdi (1994).

¹⁶⁵ Tretvik (2002).

¹⁶⁶ Naturvårdsverket (2002).

As in Norway, the revenue thus must be used to improve infrastructure. An interesting disparity is, nevertheless, that English and Scottish legislatures require that the *primary purpose* of road pricing should be to reduce congestion and not to finance new roads.

There has, thus, been a political majority to introduce charges in London. Also the support from the London citizens and industry is fairly high. In the spring of 2001, 51% of the Londoners were positive to charges, while 30% were opposed. Also a majority of the industrial leaders in central London were positive¹⁶⁷.

7.2 The legal situation in Sweden

Political decisions to implement road pricing in Sweden have only been made through the Stockholm and Gothenburg Traffic Agreements. The agreements were, however, torn up before the formal road pricing decision. To implement road pricing in Swedish cities and urban areas, new legislation is necessary. The legal situation in Sweden is described below. The political situation and the public debate at the time of the agreements is not discussed in this report.

The question of tax or charge has been a stumbling-block

Ever since the first investigation of road pricing in Stockholm in the late 1970s, the question of whether charges from road pricing are considered a charge or a tax has been a stumbling-block. The fundamental difference is that a charge is related to a certain service that is received in return. A parking fee is an example of a charge that grants the right to use a certain parking spot. If road pricing charges are considered to be taxes, the constitution stipulates that parliament has to decide the level of the charge and the use of the revenue and it is the state that collects the charges. If the power to decide the level of the charge and how the revenue should be used is not granted to the region concerned, this may reduce acceptance among the citizens and discourage local and regional politicians from introducing road pricing.

The proposed solution for Stockholm within the so-called Dennis Agreement was to let the government decide the charges and then reach agreement with the region whereby the state would invest the same amount of money in the region. Such a solution would not, however, be very suitable for congestion charges, since that approach most likely requires the charges to be frequently revised. A possible solution might be to let parliament decide a maximum charge, and within that framework submit the detailed design of the charge levels to the government, or to an authority appointed by the government.

New legislation has been investigated several times

Is road pricing then considered to be a charge or a tax? Most investigations on this issue establish that the borderline between the definition of charge and tax is indeed floating.

¹⁶⁷ Naturvårdsverket (2002).

Nonetheless, most legal experts consider that road pricing is to be considered a tax¹⁶⁸. Results and conclusions of different investigations, etc. are reviewed below.

In 1989 a committee presented a proposal on legislation that would make it possible to make charges for car traffic within a restricted area. The revenue was then to be used for measures within the traffic system. A prerequisite for the legislation was that, constitutionally, road pricing was to be considered a charge and not a tax. This was the conclusion after long and careful analysis of the issue. However, none of the legal bodies to which this proposal was submitted for review shared this interpretation, and instead claimed that the charges were to be considered as taxes.

As a consequence of the Stockholm and Gothenburg Traffic Agreements in the early 1990s, the Department of Communications then investigated the legal prerequisites enabling road-pricing charges to be made for financing purposes. The result was submitted for review and after some adjustments a proposal for new legislation was presented in 1994. Shortly after that a committee was appointed to consider the implementation of road pricing in the Stockholm and Gothenburg regions. The purpose of the road pricing systems was then to finance the road constructions that were part of the agreements. In contrast to the results of the Stockholm and Gothenburg Traffic Agreements, the committee came to the conclusion that the charges had to be considered taxes. The proposal of the committee then formed the basis of the legislation that the government submitted to the legislating authority. The proposed legislation was, however, never presented to parliament because the Dennis Agreement in Stockholm was torn up, and the regional representatives in Gothenburg no longer accepted the road pricing solution.

In 1999 a special investigator appointed by the government presented a proposal for legislation regarding environmental charges in urban areas. Like previous investigators, this one also came to the conclusion that the charge was to be considered a tax. The explanation was that “a charge is a sum of money paid in return for a specified public service”. According to the constitution, taxes are to be established by law and thus be decided by parliament. However, a municipality might by law be granted the authority to levy taxes for municipality matters. On the other hand, a municipality can only impose taxes on its own citizens, and consequently the investigator considered that the state must levy the tax. The investigator’s proposal intended to solve this problem. The most important authorities and organizations, to which this proposal was submitted for consideration as well as some of the investigator’s specialists, were critical of the proposal. Thus, although the investigation had been extensive the proposal was shelved, which illustrates the legal obstacles and difficulties of implementing road pricing.

The Stockholm Transport Committee investigates how road pricing can be implemented

That the charges are considered as taxes rather than charges makes it practically difficult to implement road pricing. It is, namely, parliament that must decide on taxes, and it is the state that levies the taxes and, as mentioned, this might lessen local and regional

¹⁶⁸ At least this refers to the type of road pricing system, usually discussed in Sweden. It’s not inconceivable that revenue from HOT-lanes (roads with charges for only one of several lanes, see chapter 3) could be considered as charges.

interest. The government acknowledged the issue in the infrastructural proposition of 2001. The government then wrote (translated from Swedish): “If municipalities or regions reach a decision with a considerable majority concerning a proposition to implement road pricing as part of a larger strategy to solve congestion and environmental problems, the government will draft this matter. Such drafting should include the possibility to reach agreement between the state and the municipalities or region concerned about how such a strategy could be realized”.

There is, thus, a promise that the question will be “drafted” if a “considerable majority” in a region wants such an agreement. Among the questions that still have to be answered in such a drafting is whether the state unilaterally can break the agreement, how the region will be able to decide the level of the charges, and the legality of this way of “evading” the constitution.

The Stockholm Transport Committee has been given directives to investigate the issue of how the use of congestion based road pricing can be implemented. The commission results are to be presented, at the latest, by June 1st of 2003.

8 Using the revenue

In several contexts we have established that the revenue is a key issue. Revenue is crucial for the distributive effects, the acceptance and the social benefit. In this chapter we will review different aspects of using the revenue, much of which has already been mentioned in previous chapters. We will start by showing how the revenue is being used in various existing systems, and then continue by examples of the opinions of various scientists and debaters on how the revenue should be used.

8.1 How is the revenue used in existing systems?

For the first 10 years the London revenue goes to traffic improvements

The revenues from the London road pricing system are estimated to be about some €0.3 billion annually. For the first 10 years the London revenue goes to traffic improvements. The London region itself decides how the revenue should be used. The government has promised not to cut back on state allowances, but to continue at the same level as prior to the charge¹⁶⁹.

The Singapore revenue goes to public expenses

In Singapore, the revenue from road pricing charges goes into the state budget like any regular tax. The administrative process is less complicated because there is only one decision-making authority, not several as in e.g. Sweden with the state, region and municipality. The revenue from road pricing is about €40–50 million per year¹⁷⁰.

The Norway revenue goes to road investments

In Norwegian cities that have introduced road pricing, the major part of the revenue goes to road investments. The revenue in Oslo amounts to about 850 million NOK per year¹⁷¹.

¹⁶⁹ www.tfl.gov.uk/streets.

¹⁷⁰ Gorpe (2000).

¹⁷¹ Gorpe (2001).

8.2 How should the revenue be used?

The public: transportation investments

Many investigations have studied public opinion about how the revenue should be used¹⁷². The most common result is that the majority feel that the revenue should go to transportation investments. Many people think that the revenue should be used for road investments only. In some studies, the question instead has been phrased as “Suppose that road pricing is implemented. How do you think the revenue should be used?” The options included, e.g., transportation investments, health care and schools. In these studies, transportation investments were no longer ranked highest (chapter 6 on acceptance).

Some experts: “the best way possible”

Many experts, especially transportation economists, feel that the revenue should be used in “the best way possible”, in other words in a way that gives the best socio-economic benefit¹⁷³. That would imply that the revenue should be added to other public earnings, and that politicians should decide where the money is best used. If transportation investments are considered to be more urgent than other issues in other fields, they should be taken care of, otherwise not. Tagging money for a special purpose will not lead to optimal usage, and the money could then in a sense be “wasted”. In most other circumstances it is unusual to tag money. The car excise in Sweden was, however, tagged for road investments between the years of 1938-1979.

The argument is often reinforced by the comment that it is usually a matter of very large revenues. Even if one is opposed to the tagging of money, there might still be transport investments that are urgent and socio-economically beneficial and thus should be realized. However, sooner or later there will be no more urgent and sensible investments. What should one then do with the money? Build even more, even if the improvements are not needed?

Another argument, also often brought up by economists, is that this is an opportunity that should be taken to shift taxes between road pricing and “regular” taxes¹⁷⁴. Taxes imposed on merchandise and labour have negative effects, since they reduce the economic efficiency. Instead, taxes should be levied for things that are “harmful”¹⁷⁵, and one wants to reduce, as e.g. emissions and congestion. According to these economists, the possibility to shift from taxes imposed on labour and merchandise to taxes on congestion and emissions is the most important benefit of road pricing.

Other experts: transportation investments

There are, however, also experts and debaters who think it’s reasonable to tag the revenue for transportation¹⁷⁶, because it is fair that those paying should also receive part

¹⁷² See chapter 6 for references.

¹⁷³ Goodwin (1995), Smeed (1964).

¹⁷⁴ Smeed (1964), Naturvårdsverket (2001).

¹⁷⁵ To be more accurate; taxes should be adjusted so that external effects are internalized.

¹⁷⁶ Small (1992), Jones (1995), Goodwin (1995).

of the benefit. Another reason is that, in order to be effective, the charges must be supplemented by improving the alternatives, i.e., other modes of transportation and roads. A third reason is simply that tagging is necessary in order to get public approval. Rather than having no road pricing what so ever, it's better to accept the tagging for transportation investments. The fourth and final argument is more unusual. Some experts argue that the politicians simply can't resist the opportunity to raise the charges above the optimal level, from a traffic point of view, in order to finance other projects they fancy¹⁷⁷. Tagging the revenue would reduce this incentive.

¹⁷⁷ Evans (1992), Thomson (1998).

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Oslo	www.fjellinjen.no
Bro & Tunnelsällskapet	www.brotunnel.no
Trondheim (among others)	www.bomringen.no
Norge (payment system)	www.vegvesen.no/autopass
Toronto	www.407etr.com
Melbourne	www.citylink.vic.gov.au
London	tfl.gov.uk/streets
The Netherlands	roadpricing.nl (closing 9/30 2002)

About T&E

The European Federation for Transport and Environment (T&E) is Europe's principal non-governmental organisation campaigning on a Europe-wide level for an environmentally responsible approach to transport.

The Federation was founded in 1989 as a European umbrella for organisations working in this field. At present T&E has some 40 member organisations covering 21 countries. Members are mostly nationally-based NGOs, including public transport users' groups, environmental organisations and European environmental transport associations ('Verkehrsclubs'). These organisations in all have several million individual members. Several transnational organisations are associated members.

T&E closely monitors developments in European transport policy and submits responses on all major papers and proposals from the European Commission. T&E frequently publishes reports on important issues in the field of transport and the environment, and also carries out research projects.

More information about T&E can be found on the website: <http://www.t-e.nu>. This includes a comprehensive list of all publications and position papers, and free access to the T&E Bulletin and news releases.

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About SNRA

The Swedish National Road Administration (SNRA) is the national authority assigned the overall sectoral responsibility for the entire road transport system. The SNRA is also responsible for drawing up and applying road transport regulations. In addition, the SNRA is responsible for the planning, construction, operation and maintenance of the state roads.

This sectoral responsibility involves representing the State at a national level in issues relating to the environmental impact of the road transport system, road traffic safety, accessibility, level of service, efficiency and contributions to regional balance, as well as in issues relating to intelligent transport systems, vehicles, public transport, modifications for the disabled, commercial traffic in addition to applied research, development and demonstration activities within the road transport system.

More information about SNRA can be found on the website: <http://www.vv.se>.



The T&E Secretariat, 34 boulevard de Waterloo, B-1000 Brussels, Belgium

Tel. +32-2-502 99 09. Fax. +32-2-502 99 08

e-mail info@t-e.nu. Internet: www.t-e.nu



781 87 Borlänge. Tel. +46-243-750 00. Fax. +46-243-758 25

E-mail: vagverket@vv.se / Internet: www.vv.se