

Road Pricing – an effective means against congestion?

Abstract

The focus of this paper is to give a general overview of road pricing. First, it explains the difference between the two purposes which a road pricing scheme can have: managing congestion and gaining revenue. Based on the experiences made in the three cities of Singapore, Stockholm and London, it was found that road pricing projects are in principle successful, provided that they are carefully targeted. A major issue is often the lack of political and public acceptance of road pricing projects caused by insufficient information policy. In order to successfully implement a road pricing system, having an open communication culture is thus very important.

1. Introduction

Since the arrival of the industrial era, human mobility has increased exponentially. Especially the mass production of cars such as the Ford Model T enabled humans to move from one place to another easily and in much shorter time than ever before. From the 50s to the 70s of the last century, it was widely believed that a prosperous society is achieved when every household disposes of its own car. History sometimes repeats itself, which can be observed currently in most aspiring economies. In China, for instance, there were 5.4 million registered cars in 1990; by 2020, the government estimates that there will be over 220 million automobiles circulating in the Middle Kingdom (ChinaAutoWeb 2008). However, this increase in mobility has its prize. Environmental degradation, such as air pollution or noise, is one consequence. In addition to this, road providers, be it the government or a private association, also have to face increasing maintenance costs with traffic still growing steadily.

At the same time, industrialisation also lead to another phenomenon. People quit rural areas and moved to cities, where job opportunities were higher. Urbanisation has lead to mass concentration not only in developed but also and above all in developing countries. The population of municipalities like Mexico City, Manila or Cairo has increased alarmingly. In such “megacities”, traffic congestion has become a great issue and endangers the economical functionality in every day life.

Prohibiting private transport though is not an option in a free society and essential supply of medical or nutritional goods would no more be guaranteed. Hence, several countries and municipalities try to tackle the problems of traffic by the principle of “user pays”, today generally referred to as “road pricing”.

This paper shall provide a short overview on the history of road pricing, the state-of-the-art as well as its future potential. Problems alonging with the introduction of road pricing schemes will also be brought up. The positive as well as the negative experience gained in three larger cities will serve as examples for different cases.

2. Two schemes, two aims

As Tsekeris/Voss (2008) stated, the introduction of a road pricing scheme is usually grounded on one of the two following purposes:

a) The road pricing scheme is supposed to generate revenues for the maintenance of existing road systems or the financing of further infrastructure projects. Such systems are mostly applied for expandable, uncongested highways in interurban areas. It is often restricted to a certain type of vehicle (e. g. trucks) or to specific road sections such as tunnels or bridges. To speak in economic terms, this option tries to find an equilibrium between the marginal benefit of road capacity and the marginal cost of supplying it. If the road supplier is not governmental but private, one could also state that the aim is to make a maximal profit.

b) The road pricing model is focused on the demand rather than the price. This is especially applied when it comes to reducing or internalising external costs such as congestion or environmental degradation. This is the case in urban areas where the density of cars in relation to the (non-expandable) road space available is very high. Economically speaking, the goal here is to reconcile the social marginal cost of road use with its private average cost.

According to Tsekeris/Voss, the elaboration of such congestion pricing schemes is based on the equation $p = m + \tau$, while p represents the optimal price, m stands for the marginal cost of road use and τ for the opportunity cost caused by congestion. The opportunity cost again is dependent on variables, which are traffic flow in trips per time unit, the level of service and capacity, as well as the average congestion cost per trip. This equation has been improved constantly. Several theoretical models have been deployed in order to assist governments and municipalities in internalising external congestion costs and thus creating a system optimum. However, one has to be aware of the fact that such congestion pricing models disregard a number of other factors. Human travel behaviour is very complex and may not always be rational. Moreover, the price structure has to be comprehensible to every road user. If a system is too complex and prices change minute by minute, it is not likely that road users can react immediately and in an appropriate manner.

Of course, the purposes of generating revenues and managing travel demand can also be combined. The revenues can, for instance, be spent on promoting or expanding the public transport network, and in doing so, road congestion can be reduced.

3. Historical and current examples

In a broader sense of the term, road pricing dates back to the Middle Age, when toll roads and bridges were already widespread within Great Britain. In the 18th century, turn pike trusts were introduced and the use of most roads in Britain were subject to a toll. In the 20s of the last century, Italy was the first country to charge the use of its motorways, followed by Greece and later on France, Spain or Portugal. The toll served mainly to finance the highway infrastructure in those countries (Albert 1972).

In this section of the paper, the focus lies on the three currently best-known road-pricing schemes. They have been implemented in the cities of Singapore, Stockholm, and London.¹ To a certain degree, they are all congestion-related and rather focus on managing demand than gaining revenue.

3.1 Singapore

The city-state of Singapore has known a road pricing system since 1975. It is reputed to be the first city world wide to have taken such measures against congestion and poor air quality, which both had been a long-time issue due to the high population density. Since then, Singapore's road pricing system has been extended gradually. It consists not only of a cordon around the central district, but also applies to suburban highways. Today, it is the largest congestion-based road pricing network in the world. Singapore was in the vanguard from a technological point of view, too. In 1998, every vehicle was equipped with a specific engine. The system, which before worked with prepaid windshield permits, was now converted fully electronic.

The vehicles are charged every time they cross the cordon. Prices vary by time of the day, location and type of vehicle. At present, they can go up to SGD² 4.00 per passenger car for one gantry crossed; however, prices are adjusted every three months in order to guarantee the desired speed standards, which are 45 to 65 km/h on expressways and 20 to 30 km/h on arterial roads. As a major review showed, these targets were almost achieved in 2008. In

¹ The main information on the three road pricing schemes is taken from Arnold/Smith (2010)

² Singapore Dollar. On 25 April 2011, 1 SGD was exchanged for 0.72 Swiss Francs.
<http://www.oanda.com/lang/de/currency/converter/>

certain areas, traffic decreased by 25 percent. Singapore's road pricing system also yielded a considerable net revenue of SGD 100 million in 2008. This money is generally returned to the customers, for instance in the form of vehicle tax reductions. Vehicle ownership is strictly controlled in Singapore with through a quota mechanism. If one wants to purchase a new car, he or she is obliged to acquire a certificate through an online auction. On 11 April 2011, the price for such a certificate for a vehicle of 1600 cubic centimetres or below was at SGD 44,000.

3.2 Stockholm

Scandinavia has doubtless the longest tradition of urban road pricing in Europe. In 1985, the Norwegian city of Bergen was the first to introduce a road pricing scheme, followed by its national competitors of Oslo and Trondheim in 1990 and 1991 respectively. In all of the three cities, the main purpose of road pricing was to gain funds for financing the road infrastructure, which in Norway is very costly due to topographical reasons. Nevertheless, the project that still attracts most attention and media coverage is the Stockholm road pricing scheme. It was first subject to a 7-month trial in 2006 to see whether the system actually works and also to gauge the residents' reactions. After the trial, the system was shut down again and the road pricing scheme was subjected to a referendum. It turned out that the public's approval had changed radically during the time that the trial was held. While in January 2006, only 25 percent were in favour of a road pricing system, the approval augmented to 52 percent in September 2006. Consequently, the referendum was accepted by the people. After the eventual introduction of the Stockholm road pricing cordon in August 2007, public approval even reached the 65 percent mark.

Every vehicle that crosses one of the eighteen control points, whether entering or exiting the urban area, is charged. Prices per check point cross range from EUR 1.00 during medium-volume periods up to EUR 2.00 in peak periods. In the evening, at the weekend and on holidays, no charge is levied. These prices can be regarded as fix, since any possible price adjustment would require national parliamentary approval. The system works fully electronic as cameras automatically recognise the car number plates. One target of the project was to reduce traffic volume, which happened by 10 to 15 percent; congestion even fell by 20 percent. Besides this, the aspect of environmental protection was an important matter of concern. The trial of the system led to a 10 to 14 decrease of emissions, whereas 6 to 9 percent more people used public transports. The implementation of the system cost SEK³ 1.3 billion. Additionally, an investment of SEK 2 billion was made in order to enlarge the public

³ Swedish Krona. On 25 April 2011, 1 K was exchanged for 0.14 Swiss Franc.

transport's capacity, to provide 2,400 park-and-ride-spaces as well as new bus lanes and an improved rail service.

3.3 London

In Britain, road pricing has been part of the political debate since the publication of the Smeed report in the 1960s. The study concluded by stating that road user should pay the costs that he imposes upon others and by suggesting that road pricing should be considered an alternative for congested roads (Smeed 1964). The first British road pricing scheme was introduced in Durham. It was supposed to serve as a feasibility test for the City of London. For the United Kingdom's capital, economists calculated the costs of congestion-caused delays up to GBP 6 million per week.

To enter the 8-square-mile central London congestion charging zone, road users pay a flat rate of GBP 8 per day, while local residents benefit from a 90 percent reduction. The number of vehicles entering the zone decreased indeed by 25 percent, whereas travel speed augmented by 30 percent. Nevertheless, the system still remains unpopular among many residents and the new mayor decided to abort the before-planned "western extension" of the pricing cordon. In 2009, congestion returned to the same level as it had been before the introduction of road pricing six years before. This is partially explained by the fact that with traffic reduced, the city converted streets into pedestrian or bicycle areas and had more road parts dedicated to bus lanes. Hence, street capacity was decreased; the demand having remained the same, however, congestion returned. The road pricing scheme is also regarded controversially because of its very high costs, although the system generated revenues of GBP 268 million in 2008. These must be spent by law on public transport, road safety, environment improvements as well as pedestrian and cycling facilities. As a result of the abovementioned criticism expressed in London, the residents of both Edinburgh and Manchester voted against the introduction of a road pricing scheme.

4. Political and legal concerns

We have already seen in short that the introduction of road pricing is dependent on political and legal constraints. From a political point of view, a road pricing project must often not only convince the politicians themselves. It should also gain acceptance within the residents of the area concerned as those often have, by means of a referendum, the last word on political decisions. As we have seen by the example of Great Britain, a major concern that people voice against road pricing is its costs. Another one is privacy. In Singapore for example, the

authorities anticipated a controversial debate by introducing pre-paid smart cards, which do not contain any private user data. In the planning of a road pricing project, the stakeholders also have to take into consideration that the political situation may change in a very short time. This is currently the case in the Netherlands, where a national distance-based travel tax for all vehicles ought to be implemented by 2018. However, the future of the project is now considered uncertain after the major-party coalition incurred heavy losses in parliament seats in the election 2010 and the transport minister resigned from his post. (Arnold/Smith 2010)

Even if the introduction of a road pricing scheme is only planned in one municipality, projects often need national approval, as it was the case in Stockholm. In Switzerland, road pricing is at the moment not possible due to constitutional reasons. In Art. 82, section 3 of the Swiss Constitution (2008), it is said that “the use of public roads is free of charge”. Hence, the implementation of any road pricing scheme would require a constitutional amendment by public referendum. To state more precisely, it should be mentioned here that there is actually one Swiss road tunnel, the Great St Bernard, that is subject to a toll as it is maintained by a private actor (Banister 2005).

5. Conclusion

Having seen how both revenue-based and congestion-based road pricing systems work in theory and practically, it can be said that so far they have been successful and that the idea has great future potential. With road capacity being limited, especially the instruments to manage demand will in the long run be unavoidable to many global cities. In Singapore and Stockholm, the targets corresponding to traffic volume have been achieved. On the other hand, project teams and governments need to be aware of the fact that information and transparency is the key to success. People want to know exactly, why road pricing is needed and what it is good for. They also want to know how the charges are formed and how the revenues are redistributed. The case of Stockholm shows that a long-term trial followed by a referendum is a good way to win the public's acceptance.

6. References

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