CONGESTION CHARGE AND ITS ALTERNATIVES

A Project
Presented to the
Faculty of
California State Polytechnic University, Pomona

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science
In
Economics

By
Mohammed Alassaf
2015
SIGNATURE PAGE

PROJECT: CONGESTION CHARGE AND ITS ALTERNATIVES

AUTHOR: Mohammed Alassaf

DATE SUBMITTED: Spring 2015

Economics Department

Dr. Bruce Brown
Project Committee Chair
Professor of Economics

Dr. Greg Hunter
Graduate Coordinator
Professor of Economics
ABSTRACT

The need for congestion charge is increasing every year due to many reasons mainly the population growth, which affects the number of vehicles on the roads. Therefore, traffic congestion is a real problem due to both the effects it causes such as delays, fuel consumption and pollution, road rage and emergency vehicles problems, and road space being a limited resource in its nature. Therefore, the more an individual uses the space on the road, the less available for others which leads to making drivers to travel more than they desire and results in loss of time value given an increase on time spent traveling, assuming identical drivers and speeds. Reducing traffic has both economic and environmental advantages but choosing the best method can be crucial in achieving these goals. This paper examines whether congestion charge is the best policy for reducing traffic congestion given London and Stockholm experience or better alternatives still exist. In addition, it aims first on examining the results of London and Stockholm congestion charge, and whether they have succeeded or not on achieving their goals. Therefore, the data is obtained from Transport for London and some other researchers such as Jonathan Leape and Jan Owen Jansson. Second, this paper provides alternatives to the congestion charge, which some of them don’t suffer from the disadvantages the congestion charge does such as high cost and regressive in nature. These alternatives will show that better solutions to a traffic congestion can be found without the need of making lower income residents suffer the higher cost burden or government paying much higher costs than they need to.
# TABLE OF CONTENTS

Signature Page ................................................................................................................. ii

Abstract ............................................................................................................................ iii

List of Tables ..................................................................................................................... v

List of Figures .................................................................................................................. vi

Chapter 1: Introduction ................................................................................................. 1

Chapter 2: Literature Review ......................................................................................... 4

Chapter 3: London VS Stockholm Congestion Charge ................................................. 14

  London’s Congestion Charge ....................................................................................... 14
    Design ......................................................................................................................... 15
    Pricing Scheme .......................................................................................................... 16

  Stockholm’s Congestion Charge .................................................................................. 16
    Design ......................................................................................................................... 18
    Pricing Scheme .......................................................................................................... 18

Results of the Congestion Charge ................................................................................. 20

Chapter 4: Disadvantages of the Congestion Charge ................................................... 24

Chapter 5: Alternatives to the Congestion Charge ....................................................... 30

  Encouraging Public Transportation Uses ................................................................. 30
  Redesign Some Roads ................................................................................................. 31
  Discouraging Parking Lot Uses .................................................................................. 32

Chapter 6: Conclusion ................................................................................................... 34

Bibliography .................................................................................................................... 35
LIST OF TABLES

Table 1  Traffic of Cars Entering the Charging Zone During Charging Hours. Annualised weekdays for 2002 (pre-charging), 2003, 2004 and Spring 2005 (charging at £5) and Autumn 2005 (charging at £8). ........................................ 20

Table 2  Cost-Benefit for Both London and Stockholm ........................................ 26

Table 3  Change in Weekly Shopper Numbers: February 2003-January 2004 Versus February 2002-January 2003 ................................................................. 27

Table 4  Change in Shopper Numbers: February 2003-January 2004 Versus February 2002-January 2003 ................................................................. 28
LIST OF FIGURES

Figure 1  London Congestion Charge Zone Map  ................................................. 14
Figure 2  Stockholm Congestion Charge Zone Map ............................................... 17
Figure 3  Stockholm Congestion Tax 2015 Data .................................................... 19
Figure 4  Traffic Entering the Charging Zone by the Time of Day ......................... 21
Figure 5  Congestion Charge and Negative Externalities ...................................... 22
CHAPTER 1
INTRODUCTION

The need for congestion charge is increasing every year due to many reasons mainly the population growth, which affects the number of vehicles on the roads. Road space is a limited resource, which means the more an individual uses the space on the road the less available for others. This leads to making drivers to travel more than they desire which results in loss of time value given an increase on time spent traveling, assuming identical drivers and speeds. The loss of an individual time value can lead to chain of multiple losses of time values, which affects the whole economy; therefore, congestion charge is needed to control this problem. For example, if a worker with a salary of 40 dollars per hour traveling for the work, and his/her productivity will generate a profit of 50 dollars an hour (after paying his salary), then the wasted time is costing the worker $40/hour and the business losing $50/hour, and this can chain to multiple businesses and result in affecting the whole economy. Therefore, the congestion charge can reduce this loss of time value and help the economy avoid the wasted time.

The congestion charge is a fee charged on most vehicles operating in a chosen zone called the congestion charge zone. Over the past 12 years, two major cities, London and Stockholm, have implemented a congestion charge. According to Transport for London (2006), the purpose of the congestion charge is to reduce traffic congestion and journey time for car users, use the profits in improving public transport and cause the distribution of goods and services more efficient.¹ “An independent survey in 1999

identified public transport and congestion as the two most “important problems requiring action”—selected by 46 and 33 percent of London residents, respectively, compared to 20 percent for crime or law and order. Ninety percent of London residents said “there is too much traffic in London”².

Drivers usually ignore the social costs of using the road and only calculate their own benefits to costs ratio of the trip, which results in traffic congestion, air pollution and noise. Pedestrians crossing at corners and traffic lights can result in traffic congestion especially when there are multiple traffic lights that allow drivers to turn right or left. For example, some roads have only one or two lanes resulting in multiple cars lining to turn left or right, which makes drivers to stop periodically and create the traffic congestion. There are other reasons that result in traffic congestion such as accidents or drivers’ road behaviors in using the road, such as unexpected decline in a vehicle’s speed or complete stop while ignoring the costs this can cause on other drivers. Therefore, congestion problem is impossible to eliminate but it could be reduced to a significant amount if the policy used to reduce congestion was planned and researched before the implementing it.

There are other tasks that need to be done before implementing the congestion charge in order for it to be successful in accomplishing its goals. The main purpose of the congestion charge should be using profits generated from the charge in projects that reduce congestion such as subsidizing public transportation with additional bus lanes, metro lanes from congestion charge profits. Moreover, pricing of the charge should be reasonable because high prices will cause people to react aggressively towards it, and low

prices might lead to congestion charge to fail because the number of cars may not
decrease after the charge. Therefore, a good pricing scheme is needed before
implementing the charge and has to be monitored during the charge to observe whether it
accomplished its goals or not.

This paper examines whether congestion charge is the best policy for reducing
traffic congestion or better alternative methods still exist given London and Stockholm
experience. The outline of this paper is as follows: it starts with literature review,
backgrounds and details of London and Stockholm congestion charge experience,
disadvantages of the congestion charge and alternative methods to the congestion charge.
CHAPTER 2

LITERATURE REVIEW

Schweitzer, Lisa and Taylor, Brian D (2008) argue that low-income residents will not suffer higher cost burden of paying to use congested freeways compared to other methods of road pricing. The tests used to support their argument are narrowed to family type and income. The data used in their analysis is from State Route 91(SR91) in Orange County to test for two primary objectives. First, the transportation costs low-income residents already pay. Second, how much would they pay for highway infrastructure if different price strategy is used such as a sales tax. They compare the cost burden between State Route 91 California in Orange County and Orange County’s local option transportation sales tax, Measure M. In addition, they compare whether the cost burden of low-income drivers using sales tax is higher as individuals or groups. Although their results are similar to other analysis, which states that tolls are regressive, they found that this result fails to deal with the fairness problems regarding financing road use. Their results reveal that shifting from value pricing to local transportation sales tax finance would transfer some of the cost burden from low and high-income residents to middle income infrequent users of SR91 and other residents, businesses and tourists in Orange County who don’t use SR91. This research has some interesting results because it contains both some analysis about the low-income residents that already pay for S91 transportation costs and suggestions about different policies to lower the cost burden on low-income. This research provides analysis about congestion charge scheme that

have been used in both Stockholm and London and whether it is overall, not only to low-income residents, better than the sales tax policy, which is the authors suggestion in this article.

Schuitema, Greetje, Linda Steg, and Sonja Forward (2010) explain the reasons behind the increase in public support of Stockholm congestion charge during the trial period. They show how people’s reaction of congestion charge differs from one city to another such as Norway’s Oslo, Bergen and Trondheim and London which they all have shown increases in public support during or after the congestion charge. On the other hand, cities like Copenhagen and Lyon did not have any increase in public acceptance. Also, they include the design of Stockholm trial, which illustrates that the charge was a national charge started in 2007 with objectives of a reduction in congestion, an increase in accessibility and improvements in environmental quality. In addition, they pointed out how both the exemption from the charge of motorcycles, taxis, emergency vehicles, and vehicles using fuel with low emission levels, and increase of public transport services and information given to the public was part of the design. The authors explain the difference between acceptance and acceptability and how beliefs are relevant to both of these. Therefore, acceptance indicates reactions on road pricing scheme before the implementation while acceptability indicates reactions on road pricing scheme after the implementation. However, the hypothesis is the assumption that acceptance of congestion charge in Stockholm is higher than its acceptability because people have more favorable

---

or less unfavorable beliefs about the consequences of the congestion charge after the trial more than earlier, and the authors test the reasons behind this assumption. As a result, the authors concluded, given that their hypothesis was confirmed, that road-pricing scheme can be tolerable when people experience the benefits of the scheme. Therefore, this article shows how people reaction might be negative before the implementation of the congestion charge since they may only look at the costs while ignoring the benefits and how experiencing the benefits may lead them to change their attitudes toward the charge.

Leape, Jonathan (2006)\(^5\) analyzes the design of London congestion charge in details with information provided by Transport for London, and how it overcame challenges against it and what effects it has had. He explains how public concern over levels of traffic congestion was high given that traffic speeds in central London had decline by 20 percent since 1960 and new car registrations in United Kingdom doubled from 1958 to 1963. In addition, he pointed out how urban congestion pricing schemes were generally thought to be unattainable and the idea of congestion charge was not appealing to the public. In 2003, however, London implemented the congestion charge with the fear of these challenges and it was £5.00 daily charge (increased to £8.00 in July 2005) for vehicles within the congestion charging zone between 7:00 am and 6:30pm Monday to Friday excluding holidays. The author includes a map to show the congestion charging zone and describes how economic analysis played a major role in determining the appropriate level of congestion charge. Moreover, he shows how video cameras, which have been used for the congestion charges, have some problems and Transport for

London has undertaken a review to discover other alternative detection technologies such as “Tag and beacon”. The congestion charge results reveal that there are some evidence about actual reductions in traffic and congestion given the data, which have been provided by Transport for London to the author. The congestion charge has a major impact on the increase in bus ridership within the congested zone, and the higher the congestion charge the higher the increase in bus ridership. While the congestion charge reduced congestion and in travel times, which could benefit local businesses, a negative impact of the charge on the sales of some local businesses. One of the arguments this article has is that congestion charge will result in a negative impact on local business; this has been tested by Turner, Sheelah, which she found a different result.

Turner, Sheelah (2005)\(^6\) indicates that congestion charge, which has the goal of reducing traffic congestion in central London, has a negative impact on retail sales for retailers located in this zone. The article includes weekly shopping trends for one year to show percentage of shoppers after the congestion charge versus before. The results were interesting because there was an overall decrease in shopper numbers in the congested zone compared to other zones. However, when changing the data to be more specific between weekdays and weekends, the results reveal that weekends, which there’s no congestion charge, have a significant drop in shopper numbers compared to weekdays. Therefore, the author indicates that the drop in retail shoppers might be due to other causes such as an accident that happened on January 25, 2003 in central London which affected around 600,000 passengers a day and lasted 11 weeks. Another causes suggested

---

by the author are the official Iraq war and SARS disease which both reduced the number of travelers. Moreover, the author investigates the causes of drop in tourism to test whether it has any effect on the drop of shopper numbers, and concluded that while there’s a decline in shopper numbers in the congested zone, the results revealed it is due to other effects which have contributed to this decline and not the congestion charge.

Daunfeldt, Sven-Olov, Niklas Rudholm, and Ulf Rämme (2009)\(^7\) test whether the congestion charge trial that have been implemented in Stockholm affected retail revenues negatively for shopping malls and stored located within the congested zone. They include a detailed description of the Stockholm congestion charge trial, which started on January 3, 2006 and ended on July 31, 2006. They explain that reducing congestion by a specific target of 10-15% during rush hours was the main purpose of the trial. Therefore, the congestion fee was separated depending on the time of the individual chooses to enter the zone where the highest fee set for 20 SEK for the time period between 7.30 until 7.59 in the morning, and the maximum fee per car and day was 60 SEL. In addition, there was no fee charge during weekends or for any environmentally friendly vehicles, vehicles owned by disabled drivers, motorcycles, taxis, buses and other essential vehicles. In the data, they include shopping malls located both within and outside the congested zone, as well as time periods before, during and after the Stockholm congested charge trial. Moreover, it is a monthly data from 2004 to December 2006 and consists of 14 shopping malls within the Stockholm region together with one aggregated revenue measure from a

sample shop located in the inner city of Stockholm. The results reveal that the congestion charge did not affect the retail revenues neither in shopping malls nor in stores located within the congested area.

Fosgerau, Mogens and Van Dender, Kurt (2013)\textsuperscript{8} discusses multiple congestion charge models and how individuals care mostly about the private costs while ignoring the social costs. In addition, individuals compare private traveling costs to benefits, and they choose to drive when benefits outweigh costs. Part of the research focuses on comparing the canonical model to the bottleneck, which they criticize that a static model such as canonical has some flaws. First, it doesn’t take trip timing into account, while bottleneck model explains that travelers prefer to travel around the same times. Second, they argue that congestion is a dynamic and not static, and since bottleneck model is a dynamic phenomenon, it would explains it better. Another part of the research discusses that travelers are heterogeneous rather than homogenous which the canonical model suggests. In addition, they emphasize the importance of value of travel time (VVT) and found some indications it could be included in the generalized travel cost, which resulted in speed being not a sufficient indicator of congestion costs. The research has some valuable information in which bottleneck model should be used instead of canonical but concluded that it’s almost impossible to include every economic interaction that affects congestion charging in one model. As a result, it’s valid to use a basic analysis of congestion charging as a first approximation.

\textsuperscript{8} Fosgerau, Mogens and Van Dender, Kurt. "Road Pricing with Complications." \textit{Transportation} 40, no. 3 (2013): 479-503. (accessed January 22, 2015)
Börjesson, Maria, and Ida Kristoffersson (2014)\(^9\) criticize the standard textbook analysis, which shows drivers as a group loses from congestion charges. In addition, they show how it ignores taste heterogeneity, which are shorter travel times in the larger network and the possibility for drivers to reschedule. They explain that one-link standard textbook analysis have some problems because it assumes that all drivers will be worse off with congestion charges unless compensated by recycling of revenues. This assumption ignores several important factors that show the possibility which some drivers can gain instead of lose from congestion charges. First, the authors argue about the standard analysis assumption that there’s one single origin-destination pair connected by one link. Second, in a dynamic setting the congestion charge may be time varying and the possibility for drivers to reschedule is taken into account. Next, it could lead to high-undervalued social gains if heterogeneity in VTT in a system with a free parallel road ignored. Fourth, the textbook analysis disregards the benefit of improved travel time reliability because of congestion charging. Fifth, benefits from improved urban environment might arise from the congestion charges. The authors support their arguments by including both the Silvester model and multiple examples for each factor except the last one because the benefit in the fifth factor is difficult to value. In addition, they concluded while no previous study has shown how important these factors are for the consumer benefit in a real world setting, they were able to assess this with the Silvester model. This article is important because it can be used to support the argument

---

that drivers will be better off with the implementation of congestion charge regardless of the conclusion of the standard textbook analysis which states drivers will be worse off.

Jansson, Jan Owen (2008)\(^\text{10}\) shows that public transports can minimize the need of a car of central-city travel, which is a necessary condition for a political process towards the introduction of congestion charge. He includes a background of the congestion charging in London and Stockholm and describes some of the differences between them. Moreover, he explains that benefit/cost ratio of implementing the charge should be high in order for the congestion charge to be successful. In Stockholm, however, total costs of charging systems are 84% of total benefits, and in London the total revenue from congestion only just covered the total costs of charging system. This is an exceptional case, which is different than other parts of the market economy where only a small percentage of the revenue brought in is consumed by the real costs of the price system.

Part of the author discussions is how the high costs may make other cities to hesitate in implementing the congestion charge. Therefore, he includes alternative lower costs policies that could be used in order to reduce traffic congestion because it might be a long time until these costs come down to be affordable for other cities. One of the suggestions is a more strict parking policy such as free parking for employees at the employer’s premises in the central city should be taxed. Another suggestion is subsidizing of public transport, which may be easier than congestion charge, and parking policy. However, the author includes a zero-fare policy and shows how it’s very bad to use for central-city-

bound public transport. The article has some interesting analysis such as comparing the benefit/cost ratio between Stockholm and London congestion charge.

Kirk, Jacqueline L., Abigail L. Bristow, and Alberto M. Zanni (2014)\textsuperscript{11} show the future market of natural gas as a transportation fuel in United Kingdom. They include some interviews with a number of professionals with experience in this market and explain that some of new policies that have been implemented in United Kingdom have helped increasing the level of growth of this market. In addition, one of the major policies is the implementation of the congestion charge in central London, which provided an exemption for vehicles with natural gas. In addition, Camden Council in West London invested in natural gas stations in order to make profits in the future. In 2010, however, new admissions to the alternative fuel discount were stopped and the exemption has been revised to be only for CO2 reduction. Moreover, the article includes an interview with a dealership saying the market for gas vehicles just collapsed after the decision that they weren’t going to be exempt. This article has interesting information on how congestion charge indirectly increases the growth in the natural gas market and this can be used as one of the advantages of using a congestion charge that includes exemption of vehicles with natural gas. On the other hand, it can be argued that including such vehicles might not help the primary goal of the congestion charge, which is reducing congestion.

Bread, Matthew (2014)\textsuperscript{12} mentions that by 2020, there will be a pollution costs on top of congestion charge which means non-green cars will pay around 24 pound daily to enter central London. He suggests that all taxis and new private hire vehicles have to switch to green cars in order to reduce costs. According to the article, 4300 people die every year due to none healthy air and the pollution charge will be seven days a week and twenty-four hours a day. This indicates that by 2020 businesses in central London will have to pay 24 pound a day for every worker and the costs might change some of the businesses locations. The article shows that congested charge that have been implemented in central London was not sufficient enough to lower pollution and due to this, a pollution charge will be implemented by 2020. As a result, if the congested charge is implemented in any city in the world with the main goal of reducing overall pollution, it may not reach that goal.

CHAPTER 3

LONDON VS STOCKHOLM CONGESTION CHARGE

London’s Congestion Charge

According to Transport for London, traffic speed has been declining in central London since mid 70s where it was 18 km/h in mid 70s and reached 14 km/h in late 2002 due to high traffic congestion\textsuperscript{13}. Moreover, the numbers of licensed vehicles have more than quadrupled from less than 5 millions in 1950 to around 30 million in 2002.

\textbf{FIGURE 1.} London Congestion Charge Zone Map

Source: Transport for London "Congestion Charge Zone Map."

The zone of London’s congestion charge is called Central London, which includes some areas such as Finsbury and St. Pancras on North, Mayfair and Westminster on west,

Newington and Lambeth on South and Barbican and City on east. These areas can be seen in Figure 1, which the redline shows the boundary, and both the blue and dark yellow show where the 90% residents discount apply. Leape explains how the congestion charge works in his paper, “Video cameras at every entry point and in mobile units within the zone capture images of vehicles entering, leaving, or driving within the zone. Automatic number plate recognition technology is then used to identify the vehicle registration number.”

Design

To control the problem of the traffic congestion, London implemented a fee charged on all vehicles entering or exiting the congested zone, i.e. central London, between 07:00 to 18:00 from Monday to Friday excluding public holidays or between Christmas Day and New Year’s Day on February 17, 2003. The charge is a one-time charge of 11.50 pound (as of June, 2014), which to be paid by the end of the day, and if the person did not pay on that day, the price will increase to 14 pound by the following day. In addition, people who register with Congestion Charge Autopay (CCAP), “This automated payment system will record the number of charging days a vehicle travels within the charging zone each month and bill your debit or credit card each month”15, will have a discounted price of 10.50 pound a day.

---

14 Leape, The London Congestion Charge, 7
Pricing Scheme

The price has been changing throughout the years by Transport for London as it went from 5 pound in February 2003, 8 pound in July 2005, 10 pound in January 2010 to 11.50 in June 2014. According to Transport for London, these changes are to make higher revenues, which will be used in supporting other services that reduce traffic congestion, and reduce unnecessary journeys in the congested zone.16

Prior to November 2002, there was an exemption of Greener Vehicles, which some vehicles benefited from such as small diesel engines. After November 2012, however, the discounts that are available to drivers are residents discount, residents who live in the congested zone or next to it are subject to 90% discount, blue badge holders discount, Ultra Low Emission Discount (ULED), vehicles with nine or more seats, motor tricycles and roadside recovery vehicles.17

Stockholm’s Congestion Charge

Stockholm’s design of the congestion charge is different than London’s but the objectives are similar. They both aim mainly at reducing traffic congestion and using the revenues to further improve the flow speed of roads that suffer from traffic congestion.

---

Figure 2 shows Stockholm congestion charge zone map, which is called Central Stockholm, and it’s similar in size to Central London. As shown on the map, there are 18 gates, which are entrances to the zone where the congestion charge starts. In addition, the black dots show the boundary of the zone, and the green road on the west side of the map, which is called water and the extensive eastern parkland, is excluded from the congestion charge. However, the price of entering this zone from any of the 18 gates depends on the time of entering or exiting the zone, and that’s where Stockholm’s congestion charge design differ from London’s.
Design

Stockholm implemented the congestion charge permanently on August 1, 2007 after the trial period, which lasted seven months from January 3, 2006 to July 31, 2006. Unlike London’s congestion charge, Stockholm’s is called congestion tax because of two reasons. First, the amount of charge depends on what time of the day vehicles enter or exit the congested zone. In addition, the maximum amount of tax per vehicle per day is around 60 Swedish Krona, excluding weekends, public holidays, between 6:30 pm to 6:29 am or during month of July. Second, it’s tax deductible, which means it can be deducted from taxable income for both individuals and businesses.

Pricing Scheme

As mentioned before, the price depends on the time of the day the vehicle enters or leaves the congested zone, and it’s higher on peak hours and lower on non-peak. For example, as shown in figure 3, an individual pay a higher amount of tax on hours between 07:30 to 08:29 and 16:00 to 17:29, and lower amount on non-peak hours such as between 06:30 to 06:59, 09:00 to 15:29 or 18:00 to 18:29. This pricing scheme gives people more options to consider such as what time of the day they want to make their journey, which this will result in lowering the number of cars on the road on peak hours and increasing it on other times of the day. In addition to this unique pricing scheme, Stockholm provide exemptions to some vehicles.
Stockholm congestion tax still provides exemptions to some vehicles such as emergency services vehicles, buses, motorcycles and diplomatic corps registered vehicles. Unlike London’s policy mentioned before, which is the removing of greener vehicles exemption, Stockholm removed the exemption only for newly purchased vehicles and kept it for vehicles purchased before January 1, 2009 until August 1, 2012. However, both have succeeded in achieving some level of traffic congestion reduction.
Results of the Congestion Charge

Table 1 Traffic of Cars Entering the Charging Zone During Charging Hours. Annualised weekdays for 2002 (pre-charging), 2003, 2004 and Spring 2005 (charging at £5) and Autumn 2005 (charging at £8).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All vehicles</td>
<td>-14%</td>
<td>0%</td>
<td>-4%</td>
<td>-4%</td>
<td>-2%</td>
<td>-3%</td>
</tr>
<tr>
<td>Four or more wheels</td>
<td>-18%</td>
<td>0%</td>
<td>-3%</td>
<td>-1%</td>
<td>-4%</td>
<td>-4%</td>
</tr>
<tr>
<td>Potentially chargeable</td>
<td>-27%</td>
<td>-1%</td>
<td>-3%</td>
<td>-1%</td>
<td>-4%</td>
<td>-6%</td>
</tr>
<tr>
<td>- Cars and minicabs</td>
<td>-33%</td>
<td>-1%</td>
<td>-3%</td>
<td>-1%</td>
<td>-5%</td>
<td>-6%</td>
</tr>
<tr>
<td>- Vans</td>
<td>-11%</td>
<td>-1%</td>
<td>-3%</td>
<td>+1%</td>
<td>-4%</td>
<td>-7%</td>
</tr>
<tr>
<td>- Lorries and other</td>
<td>-11%</td>
<td>-5%</td>
<td>-4%</td>
<td>-4%</td>
<td>0%</td>
<td>-3%</td>
</tr>
<tr>
<td>Non chargeable</td>
<td>+18%</td>
<td>+1%</td>
<td>-4%</td>
<td>-3%</td>
<td>+3%</td>
<td>0%</td>
</tr>
<tr>
<td>- Licensed taxis</td>
<td>+17%</td>
<td>-1%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>- Buses and coaches</td>
<td>+23%</td>
<td>+8%</td>
<td>-6%</td>
<td>-2%</td>
<td>-5%</td>
<td>-10%</td>
</tr>
<tr>
<td>- Powered two-wheelers</td>
<td>+12%</td>
<td>-3%</td>
<td>-12%</td>
<td>-16%</td>
<td>+4%</td>
<td>-9%</td>
</tr>
<tr>
<td>- Pedal cycles</td>
<td>+19%</td>
<td>+8%</td>
<td>-3%</td>
<td>-23%</td>
<td>+28%</td>
<td>+20%</td>
</tr>
</tbody>
</table>


According to Transport for London, there’s an overall reduction of 14% of all vehicles entering the charging zone, and part of this is a 27% reduction in potentially chargeable vehicles such as -33% in cars and minicabs, -11% in vans and -11% in lorries and others between 2002 and 2003, which is after the implementation of the congestion charge. In addition, there’s an increase in non-chargeable vehicles specifically a 23% increase in buses and 19% in pedal cycles. Also, these results show the effect of the price change from 5 pounds in February 2003 to 8 pounds in July 2005, which indicates further reductions which is anticipated due to the fact the higher the cost, ceteris paribus, the lower the demand, assuming these reductions coming from unnecessary journeys.
FIGURE 4. Traffic Entering the Charging Zone by the Time of Day


Figure 4 shows a clearer picture of the traffic congestion reduction through the years of 2002 (before the charge), 2003 (after the charge) and 2005 (after the price change). Moreover, it clearly shows there’s a reduction in traffic entering the charging zone at all times during the charging time after the implementation of the charge, this is illustrated as red before the charge and other colors after. The difference of the 3 pound price increase in 2005, which resulted in an overall decrease of 3% of all vehicles entering the charging zone between 2004 and 2005, came from non-peak hours since the peak hours, which is between 08:30 and 09:00 as shown in figure 5, have the same total flow. In addition, the reduction of traffic congestion can be proven with the change of traffic speeds before and after the implementation.
Traffic speeds have been declining since 1975 and reached a minimum of approximately 14 km/h around 2000\textsuperscript{18}, and the decline stopped after the charge and increased to approximately 17 km/h in 2003. The result of this decline in traffic congestion is illustrated in Figure 5.

**FIGURE 5.** Congestion Charge and Negative Externalities

Figure 5 captures the result of the congestion charge reducing traffic congestion that have been mentioned in this paper, and how it can reduce negative externalities that come from the traffic congestion. The equilibrium before the implementation of the congestion charge is at point A, which is the intersection between P1 and Q1. The price

of using the road will rise from P1 to P2 after the implementation of the congestion charge, and this reduces the quantity demanded from Q1 to Q2. In addition, this leads to reduction of the negative externalities that traffic congestion produces such as pollution and time costs because it makes drivers pay the social marginal cost (SMC) instead of the private marginal cost (PMC). This is shown by the shift of the supply curve from PMC to SMC, which shows the marginal damage (MD) done to others that resulted from drivers using the road given $SMC = PMC + MD$. Although these results show how congestion charge has a positive impact on traffic congestion, it also has some negative outcomes, which are demonstrated in this paper as disadvantages of the congestion charge.
CHAPTER 4

DISADVANTAGES OF THE CONGESTION CHARGE

Almost every public policy that makes individuals or businesses pay some amount to something, which was free in the past, is faced with public negativity, and may end up reversing that policy even if both businesses and individuals as a whole are better off paying that cost. The congestion charge, therefore, makes some cities hesitate to implement it, and gets even more challenging during elections.

Public support is one of the disadvantages of congestion charging, and it has shown different result amongst different cities. Greetje Schuitema, Linda Steg, and Sonja Forward show how people’s reaction of congestion charge differs from one city to another such as Norway’s Oslo, Bergen and Trondheim and London which they all have shown increases in public support during or after the congestion charge. On the other hand, cities like Copenhagen and Lyon did not have any increase in public acceptance. Therefore, public support almost always negative before the implementation of the congestion charge and may or may not change their attitudes during or after. This public negativity is understandable given the fact that the charge itself is regressive in nature.

Another disadvantage is that congestion charge is regressive in nature, which means lower income residents will pay higher portion of their income than high or middle income. Given London’s congestion charge with the payment of 11.50 pound per day, an individual that goes to central London every day excluding public holidays and weekends

---

have to pay 2875 pound a year (11.50 pound * 250 days). This means an individual, which works 8 hours a day and 5 days a week, gets the minimum wage of 6.50 pound an hour have to pay 22% of their total income (assuming no tax income for simplicity), and this percentage is higher once the tax income is included.\textsuperscript{20} Therefore, the congestion charge should be lower than 11.50 pound in order to help lower income people paying with this pricing scheme. According to London Evening Standard, this price is not going to be lowered by 2020, and instead they will have 12.50 pound on top of the 11.50, which is explained as a pollution charge.\textsuperscript{21} This will result, for the same individual mentioned earlier, to pay around 50% of their income in order to go to central London every day, which is very high. One of the solutions suggested by Schweitzer, Lisa and Taylor, Brian D (2008), which is covered in literate review, is offering sales tax instead of a one-time charge per day. In addition, both London’s and Stockholm’s congestion charge have very high costs compared to their benefits, which support the argument that this pricing scheme has some flaws.

\textsuperscript{20} It’s calculated as (8hours*6.50pound)*250 days= 13000 pound, and 2875/13000= 22.12%

Table 2. Cost-Benefit for Both London and Stockholm

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Charging system investment costs per year (interest and amortization)</td>
<td>23</td>
<td>4</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Charging system operation costs per year</td>
<td>90</td>
<td>17</td>
<td>21</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Charge-payers compliance costs</td>
<td>30</td>
<td>0</td>
<td>7</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Total costs</td>
<td>143</td>
<td>21</td>
<td>48</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td><strong>Benefits</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel time savings and reliability benefits of private road transport</td>
<td>185</td>
<td>46</td>
<td>38</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>Disbenefits of deterred drivers</td>
<td>-25</td>
<td>-1</td>
<td>-5</td>
<td>-5</td>
<td></td>
</tr>
<tr>
<td>Net benefits of public transport riders</td>
<td>22</td>
<td>9</td>
<td>-4</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Reduced accidents</td>
<td>15</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>CO₂ emissions</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Other savings</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Total benefits</td>
<td>210</td>
<td>71</td>
<td>42</td>
<td>55</td>
<td></td>
</tr>
</tbody>
</table>


Although congestion charge has helped reducing traffic congestion for both London and Stockholm, the results show that the costs associated with it is very high.

Figure 5 shows cost-benefit analysis, which has been calculated by Leape (2006) for London and Transek (2006), SIKA (2006) and JOJ (2008) for Stockholm. This analysis clearly shows that congestion charge has a very high cost as Leape calculated it to be 143 million for London, and 90 million comes from charging system operation costs per year, which is around 69% of total cost. Another interesting result is calculated by SIKA (2006), which shows total costs are higher than total benefits, and due to this some cities might hesitate to implement the congestion charge given that it will be associated with public negativity. In addition to this very high cost, the congestion charge assumed to discourage businesses that operate in the congested zone.

Congestion charge is assumed to discourage businesses in the congested zone given that employees of each business have to pay extra for entering or exiting the congested area or customers that need to get to the business need to pay that extra cost,
which otherwise could go to other businesses outside the congested area for free. For example, if an individual wants to buy some groceries and his best shop is in central London since he has been shopping there for 10 years, given they have the best prices, but the total cost of paying for the charge and shopping has exceeded total cost of shopping from grocery stores outside the congested zone after the implementation of the congestion charge. According to Sheelah Turner, however, there was a decrease in shopper numbers by 11.3% in the congested zone after the implementation of the congestion charge but this change came from weekends, which there’s no charge on vehicles, instead of weekdays.

**Table 3.** Change in Weekly Shopper Numbers: February 2003-January 2004 Versus February 2002-January 2003

<table>
<thead>
<tr>
<th>Region</th>
<th>Change in shopper numbers (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>London congestion zone</td>
<td>-11.3</td>
</tr>
<tr>
<td>Outer London</td>
<td>-0.2</td>
</tr>
<tr>
<td>UK national</td>
<td>-0.8</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Time period</th>
<th>London congestion zone (%)</th>
<th>Outer London (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekdays</td>
<td>-3.6</td>
<td>+1.1</td>
</tr>
<tr>
<td>Weekends</td>
<td>-12.5</td>
<td>-3.2</td>
</tr>
</tbody>
</table>


Unlike residents that live in or near the congested zone, businesses don’t get any discount operating in that zone. This is expected due to the fact that businesses are affected less than residents because they are big and can easily afford paying the cost or small and move out the congested zone, which in turn will help achieve the goal of reducing traffic congestion.

Given a lot of discounts can be included as one of the disadvantages of the congestion charge. Discounts that are given to residents in or near the congested zone as well as blue badge holders are reasonable since it's unfair to make them pay the same amount based on a decision they made in the past. This means that people who bought their houses before 2003 based their investment decision given all the costs they have to pay to live in that area except the congestion charge since no one can predict the future with certainty. As a result, these discounts will allow these people to use the congested zone, given that the cost is either free or 90%, which depends on the discount. This will result in a negative impact on the congestion charge, since more discounts means
cars on the road in the congested zone. Due to these disadvantages, alternatives exist and could be better solutions than the congestion charge.
CHAPTER 5

ALTERNATIVES TO THE CONGESTION CHARGE

Some of these alternatives suffer from the same disadvantage, for example, the high cost of the congestion charge but it’s not as high. This could be fixed by using sales tax to generate the revenue instead of a one-time charge. The suggested alternatives solve the traffic congestion problem for the whole city instead of a specific zone, and due to this, sales tax could be used. Also, the sales tax will solve the congestion charge problem of being regressive in nature. One of these alternatives is making a better public transportation system.

Encouraging Public Transportation Usage

A perfect public transportation system can have a positive impact on reducing the traffic congestion, and may have better results than the congestion charge. Some cities suffer from public transportation being very bad since the design of the system is concentrated around a certain area instead of the whole city. Other cities had have a good public transportation system but it doesn’t have a continuous developing system. For example, if the public transportation system was built 50 years ago but haven’t had any development or redesign, then the population growth will overwhelm this system and make it change from a good system to a very bad one. Los Angeles is an example of a city with a very high population growth that doesn’t have a good public transportation to counter that growth. Matt Novak explains, ” With the continued investment in highways and the public repeatedly voting down funding for subways and elevated railways at almost every turn (including our most recent ballot’s Measure J which would have
extended a sales tax increase in Los Angeles County to be earmarked for public transportation construction) it’s hard to argue that anyone but the state of California, the city of Los Angeles, and the voting public are responsible for the automobile-centric state of the city”\(^{22}\) There are many ways to fix the transportation system to temporarily reduce traffic congestion such as adding additional bus lanes, lowering public transportation costs during peak hours, increasing the number of rail transit and many others. Given how unpredictable the population growth can be, permanent fix can’t be done in one session. In addition to fixing the public transportation system, redesigning some roads can help achieve the goal of reducing traffic.

\underline{Redesign Some Roads}

One of the less costly alternatives is to redesign some roads that have serious traffic congestion problem. There are roads that have many traffic lights in a very small area, and fixing this problem could improve the flow speed of that road. For example, some roads have more than two traffic lights in less than 1 mile between them, and this could be replaced with redesigning the road to have an easy enter or exit to the road and some U-turn shape to make up for those traffic lights. In addition, there are two reasons why multiple traffic lights is a problem. First, the number of pedestrians crossing at the traffic lights can affect the flow speed of the road due to cars either going left or right at the traffic lights. This becomes a serious problem when the road itself has two lanes and multiple cars line up which could end up affecting the whole road. Second, some roads

don’t need traffic lights, and having one makes the flow speed of the road changes to very slow. Moreover, having multiple unnecessary traffic lights creates the traffic congestion. Decreasing the size of the lanes to fit more cars, however, is another way of redesigning a road.

Some cars don’t need the whole lanes size, and that’s why buses and trucks could fit in those lanes. Therefore, creating some small size lanes where it’s illegal for buses and trucks to drive on could result in reducing traffic. On the other hand, creating a lane for only buses to use, which in case of traffic, buses are the best options to get to the destination on time. However, attractiveness of the road could make people enjoy riding bicycles instead of using cars.

Making a road more safe and attractive to cyclist or even snow skating is a way of redesigning a road. Kim Foley MacKinnon explains his experience in Ottawa, “Rideau Canal runs through the city and residents eagerly wait for it to freeze deep enough for them to skate. A 4.5-mile-long (7.8 km) stretch becomes one long, free rink, used not only for play, but for residents who want to commute to work by skating.”

In addition to redesigning a road, discouraging the use of parking lot in the congested zone is one of the alternatives to the congestion charge.

### Discouraging Parking Lot Uses

Parking lot can encourage the use of cars instead of alternatives such as buses, bicycles and trains. It makes individuals to not think about some of the cost associated with using the road. For example, a cheap parking lot tickets or even free can make

---

people driving their cars without rethinking about the cost of the journey. On the other hand, high costs parking lot tickets will discourage some people, which the number of cars on the road will be reduced. Making cheap parking lots outside the congested zone or having it pair with train tickets such as giving free parking lot if a train or bus ticket is purchased could improve the flow speed of traffic inside the congested zone. Another way of discouraging parking lot uses is to decrease the number of parking lot inside the congested zone.

Reducing parking lots inside the congested zone can result in two impacts. First, it can discourage using cars in the congested zone for a long period of time in one day because an individual may not find an empty space in any of the parking lots. Second, it can result in a negative impact in which people driving around the parking lots in order to find an empty space for their cars and could result of them going in and out of the road that suffers from the traffic congestion. Therefore, decreasing the number of parking lots inside the congested zone may not be the most sufficient way of discouraging parking lot uses because of how it may end up in the negative impact.
CHAPTER 6
CONCLUSION

Congestion charge is an effective way of reducing the traffic congestion but due to some advantages may not be the best policy. Some cities may be hesitant to implement it, others want to find a better alternative that doesn’t suffer from public negativity, regressive in nature, high costs, discouraging businesses and encouraging or discouraging some people to live in the congested zone. Cities such as London and Stockholm already faced those challenges and implemented the congestion charge.

Although London and Stockholm have a different pricing scheme, they both have similar results. In the economic perspective, Stockholm pricing scheme, which is charging depends on the time of the day entering or exiting the congested zone, is a better policy giving the fact that there are more traffic in peak hours than non-peak. London’s results confirm the need of Stockholm’s pricing scheme giving they have more traffic between 8:30 and 9:00 than any other time of the day. On the other hand, Stockholm and London should both look for an alternative to the congestion charge.

Some alternatives suffer from some of the disadvantages the congestion charge has, and some don’t. Alternatives such as encouraging public transportation suffer from being costly to the city due to the need of continuous development of the system. This could be fixed by having a sales tax or an income tax to generate the revenue in which both better than the pricing scheme of congestion charge. Other alternatives don’t have as high costs the congestion charge such as redesigning some roads or discouraging parking lot uses. In conclusion, while the congestion charge shows positive results of reducing the traffic congestion, cities should consider alternatives before implementing it.
http://dx.doi.org.proxy.library.cpp.edu/10.1016/j.tre.2014.07.006


http://dx.doi.org.proxy.library.cpp.edu/10.1016/j.trb.2010.02.009


Fosgerau, Mogens and Van Dender, Kurt. "Road Pricing with Complications."
*Transportation* 40, no. 3 (2013): 479-503. (accessed January 22, 2015) DOI:
http://dx.doi.org.proxy.library.cpp.edu/10.1007/s11116-012-9442-5


http://dx.doi.org.proxy.library.cpp.edu/10.1007/s11116-008-9165-9


