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Equity Effects of the Stockholm Trial

ABSTRACT

This study is a complement to the report “Equity Effects of the Stockholm Trial” (Transek 2006:31). The main focus of the study is how the equity effects of a permanent congestion tax system differ among various groups of citizens.

The amount of congestion tax paid varies widely. Most car owners in the county pay congestion tax at least occasionally, but relatively few pay a lot: about 4% of the privately owned vehicles in the county – corresponding to about 1.2% of county residents - accumulated a total cost of SEK 200 or more during one two-week study period, but that 4% accounted for one third of revenues from privately owned vehicles. Thus, a large proportion of congestion tax payments are paid by a relatively small number of drivers. The study presents the average effects for various groups – but variations *within* groups are substantial.

If one looks at the groups that pay the most congestion tax *on average*, the statistics show that:

- Residents of the inner city and Lidingö pay nearly twice as much per person as residents of other areas
- Households with high discretionary income (income/household member) pay nearly three times as much as households with low discretionary income
- Employed people pay about three times as much congestion tax as others
- Men pay about 50% more than women
- Households with children pay more congestion tax; households made up of two adults pay more congestion tax (per person)

How revenues are used largely determines overall equity effects – the differences in the distribution profile of equity effects among various possible revenue uses are often greater than the difference in the distribution profile for the actual congestion tax.

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FOREWORD

The Stockholm City Council voted on 2 June 2003 to propose a trial of environmental charges/congestion tax – the Stockholm Trial. On 16 June 2004, the Riksdag (Swedish parliament) passed the Congestion Tax Act (SFS 2004:629), which allowed congestion tax to be charged in Stockholm through 31 July 2006. On 28 April 2005, the Swedish Government decided that the environmental charges/congestion tax trial in Stockholm would commence on 3 January 2006. The principals involved in the Stockholm Trial are the City of Stockholm, the Swedish Road Administration and Stockholm Transport (SL). The trial is being financed by the Swedish state.

The Stockholm Trial consists of three components: expanded public transport, environmental charges/congestion tax and more park-and-ride facilities.

The objectives of the trial are to:

- Reduce the number of vehicles that pass the congestion charge zone during morning and afternoon maximum charge hours by 10-15%.
- Improve traffic flow on the busiest roads in Stockholm.
- Reduce emissions to air of carbon dioxide, nitrogen oxides and particles in the inner city.
- Improve the urban environment as perceived by people in the inner city.

The Congestion Charge Secretariat is the project office for the City of Stockholm. It has been given a Government mandate to plan, coordinate and evaluate the project and inform stakeholders. Aimed at determining the extent to which the objectives are attained and studying the effects of the Stockholm Trial, the Congestion Charge Secretariat, the Swedish Road Administration, the Office of Regional Planning and Urban Transportation (RTK), SL, various research institutes (including the Faculty of Engineering at Lund University [LTH] and the Royal Institute of Technology [KTH]), independent consultancies (Transek, Trivector et. al) and certain City of Stockholm administrations (the Traffic Office, the Office of Research and Statistics [USK] and the Environment and Health Administration), have developed a comprehensive evaluation programme. The measurements, analyses and reports were performed by government agencies and

administrations as well as consultancies that specialise in the indicator areas included in the evaluation programme. All evaluation reports are published as they become available on the Stockholm Trial website (www.stockholmsforsoket.se).

Joanna Dickinson (MSc) was the original project manager for the evaluation programme. She was succeeded by Murial Beser Hugosson (PhD) and Ann Sjöberg (Licentiate in Engineering). In addition to the project managers, Camilla Byström (PhD), Annika Lindgren, Oscar Alarik, Litti le Clercq, David Drazdil, Malin Säker and Ann Ponton Klevstedt were involved in the evaluations.

This report analyses the equity effects of the Stockholm Trial. It is intended to complement the report on the general equity effects of the Stockholm Trial (Transek 2006:31). The analysis was performed by Anders Levander and Jonas Eliasson (project manager, PhD).

Solna, August 2006

Marika Jenstav
Managing Director
Transek AB

EXECUTIVE SUMMARY

This study (Transek 2006:36) is a complement to the report “Equity Effects of the Stockholm Trial” (Transek 2006:31). The study focuses on the effects a permanent congestion tax system would have on various groups of citizens.

The analysis focuses on the direct road-user effects of the congestion tax or the effects that directly affect how citizens travel. These include changes in travel time, costs of paid congestion tax and costs of adaptation (sacrifices in travel due to the congestion tax). Environmental and road safety effects are not addressed as there is no research available on the estimated cost-benefit of these effects among different groups.

To present a complete picture of the net effect for citizens, the equity effects of three hypothetical revenue uses are analysed: equal return to all citizens in the county, reduction of income tax and reduction of public transport fares. How revenues from an actual system should be used is a purely political question and is not addressed in the study. The revenue uses in this study are examples whose purpose is to illustrate the effects of the chosen revenue use. These revenue uses were selected because they are easy to explain and their equity effects are simple to calculate, not because they are necessarily realistic or desirable.

A few drivers pay the majority of congestion taxes – but most pay occasionally

A large percentage of drivers in the county pay the congestion tax at least occasionally. During one two-week period¹ of investigation alone, nearly half of all privately owned cars in Stockholm paid congestion tax at least once. Nevertheless, only a small number pay a high amount of congestion tax; about 4% of the county’s vehicles – which equals 1.2% of the county’s residents – accumulated a total cost of SEK 200 or more during the studied two-week period. However that 4% accounted for one third of all revenues

¹The Swedish Road Administration cannot compile statistics for a longer period than this, because data is not allowed to be stored for more than two weeks.

from privately owned vehicles. Seventy-five percent of revenues from privately owned vehicles originated from fewer than 100,000 vehicles, which corresponds to about one fifth of all cars in Stockholm County or 5% of county residents². (if we assume for simplicity's sake that one person represents every car). The disparity over a year should be slightly less than during a two-week period, but the conclusion that a small number of drivers account for a large percentage of congestion tax payments still stands.

Substantial variation within groups

The figures above indicate that there is great variation as to how much congestion tax people pay. The study presents the average effects for different groups, but the variation *within* groups is substantial. Even within the groups that on average pay very little congestion tax, there are individuals who pay a lot of congestion tax. Likewise, even in the groups that pay a lot of congestion tax, there are many individuals who rarely pay congestion tax.

Affluent men in the inner city pay the most

Looking only at the direct road-user effects – changes in travel time and increases in travel costs – it is estimated that all groups experience an economic loss (on average). It is only when the revenues are used to benefit citizens that they make a net economic gain. Examining the degree of loss for different groups *on average*, the conclusions are that

- Residents of the inner city and Lidingö lose about twice as much as residents of other areas
- Households with high discretionary income³ pay nearly three times as much as households with low discretionary income
- Employed people pay about three times as much congestion tax as others
- Men lose nearly twice as much as women

² A certain percentage of revenue comes from cars outside of Stockholm County.

³ In other words, high income per household member, taking into consideration the age of the members.

- Households with children pay more congestion tax; households with two adults pay more congestion tax (per person)

Statistically, one is thus “hardest hit” by the congestion tax if one is an affluent, employed male living in a household with two adults and children in the inner city or Lidingö.

Residents of the inner city and Lidingö affected most

Residents of the inner city and Lidingö experience the greatest average net loss per person when direct road-user effects (travel time, congestion tax and adaptation costs) are taken into account. (Note this does not consider benefits of the revenues of the congestion tax.) On average, the loss is estimated at approximately SEK 500 and SEK 450 per person and year, respectively. The loss for other areas is about half as much – with the radical exception being the northern outer suburbs, where the average economic net loss was only SEK 78 per person and year.

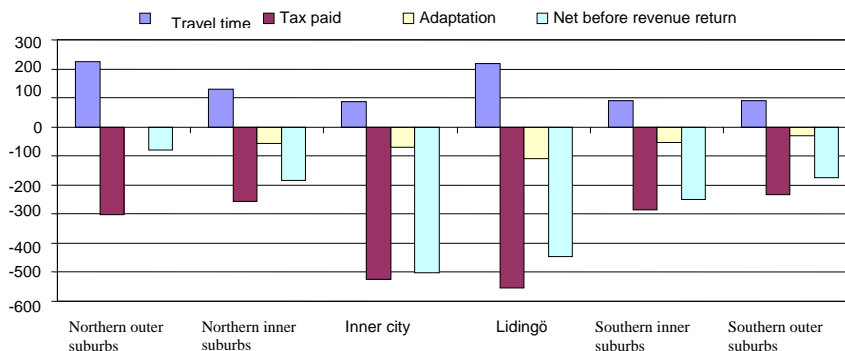


Figure 1: Total road-user effects by residential area (SEK per person and year).

Residents of central areas have also changed their travel habits the most. The number of congestion-charged car journeys to and from the inner city decreased by about 25-30% for residents of the inner suburbs, Lidingö and the inner city. The decrease in the outer suburbs is considerably smaller, at about 10%. On average, residents living closer to the city seem to find it easier to reduce their car travel by choosing, for example, other modes of transport or destinations.

The introduction of congestion taxes meant that car travel costs increased by barely 5% for residents of the outer suburbs, 11% for residents of the inner suburbs and 31% for residents of the inner city.

Thus, inner city residents have the least travel time gain even though they pay the second-highest amount of congestion tax. One reason is that most drivers save travel time in the morning driving into the inner city and in the afternoon driving out of the inner city while those living in the inner city tend to be driving in the opposite direction. According to the cost/benefit estimations, however, inner city residents suffer the greatest net losses due to the congestion tax. Despite this, inner city residents are the most positive to the tax, according to opinion surveys. It is interesting to note and speculate on why it is that inner city residents' opinions do not match the predictions. Perhaps this is because those who use their cars only occasionally place a higher value on their time than the average driver, which means the predictions underestimate the value of the time gain. This may be because those factors that are hard to measure, such as environmental benefits and increased road safety, are underestimated in the calculations. In the estimation above, these factors are missing completely, but the estimated economic value is so strong in comparison to the travel time gains that the phenomenon remains.

High-income individuals affected more than low-income individuals

(The following analysis is based on *discretionary income*, that is, estimated income per person in the household after adjustment for the ages of the members of that household. The conclusions do not change if the analysis is instead based on household income only.)

Accordingly, the more affluent a household is (meaning the higher its discretionary income), the more likely it is to make congestion-charged journeys compared to the average household. This is partly because affluent households use the car more frequently and partly because they are more likely to live in or near the inner city. Taking all direct road-user effects into account, the average economic net loss (excluding the benefit of the revenues) varies between SEK 106 for the group with the lowest

discretionary income to SEK 405 for the group with the highest discretionary income.

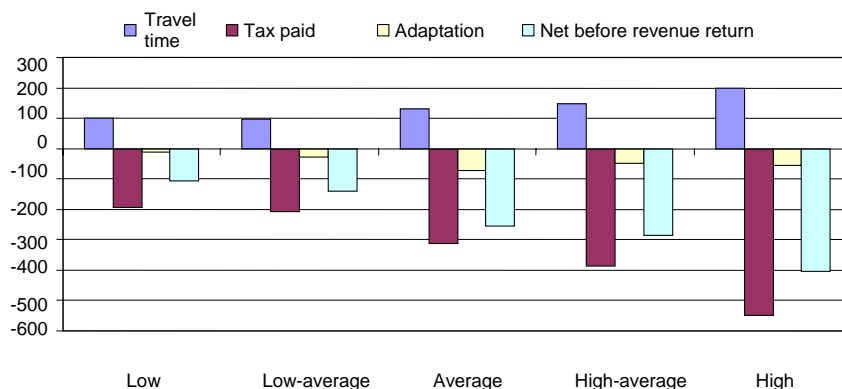


Figure 2: Total road-user effects for households by discretionary income (SEK per person and year)

The percentage of increased costs also varies according to discretionary income. The implementation of congestion tax increased the cost of car travel by 6% for the two groups with the lowest discretionary income, 8% for the group with average discretionary income and 9% and 11% respectively for the two groups with the highest discretionary income.

However the equity effects of a congestion tax system are utterly determined by how the revenues are used. The chart below illustrates three hypothetical uses of revenue: all residents in the county share the revenues equally, the revenues are used to lower taxes and the revenues are used to lower public transport fares.

Equity Effects of the Stockholm Trial

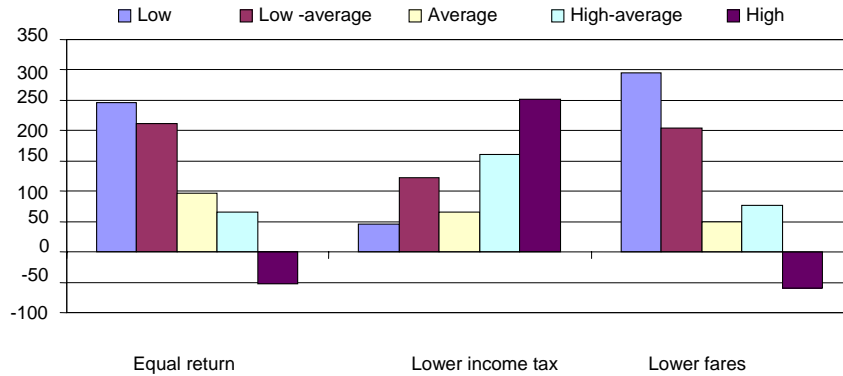


Figure 3. Net effects for households by discretionary income and hypothetical revenue use (SEK per person and year)

Equity effects determined by how revenues are used

The analyses illustrate that the use of revenues is key to the total equity effects. The difference in the distribution profile for equity effects among conceivable revenue uses is often greater than the differences in the distribution profile for the actual congestion tax.

Young and low-income individuals gain if fares are reduced

If the revenues are used for public transport – illustrated in our calculation as reduced fares – those who gain most from the measure as a whole are young people, low-income individuals, single people, women and residents of the inner suburbs. These groups pay relatively little congestion tax (on average) and use public transport more often than other groups.

The main groups that would, on average, be adversely affected by the measure as a whole are employed people with children, high-income individuals and residents of the inner city and Lidingö. These groups pay relatively high congestion tax and use public transport less often than other groups.

The groups that, on average, would be affected adversely if the revenues were used in this manner are for the most part employed people with children, high-income individuals and residents of the inner city and

Lidingö. These groups pay a lot of congestion tax and use public transport less often than other groups.

Lower income tax benefits high-income individuals and suburbanites

If the revenues are used to lower the income tax rate – or if we imagine that the revenues are used to finance something that would otherwise be tax-financed – high-income individuals, senior citizens, single parents and residents of the northern suburbs will make a net gain. Residents of the inner city and Lidingö would sustain a net loss if such a measure were taken.

Commercial traffic and business travel

Personal journeys comprise approximately 64%, business travel 20% and commercial traffic 16% of journeys across the congestion-charge zone cordon during congestion-charge hours. Commercial and business traffic pay approximately SEK 275 million per year in congestion tax, but make gains in travel time worth SEK 370 million per year. Thus, business travellers and commercial traffic make a net gain even *before* they even share in the revenues. The value of travel time gains is calculated to be (on average) greater than the congestion tax paid by these groups. Slightly more than 60% of travel time gains in the equity effects analysis are made by commercial and business traffic, even though those segments comprise only about 35% of all traffic.

1 INTRODUCTION

This study is a complement to the report “Equity Effects of the Stockholm Trial” (Transek 2006:31), which presented an economic analysis of the Stockholm Trial comprising all costs, revenues and general social impacts. That type of analysis covers effects only at the aggregate level, for society as a whole – not the effects on various social groups. Such an “equity effects analysis” is the purpose of this report.

The focus of the study is the effects a permanent congestion tax system would have on various groups of citizens. This report discusses the effects on commercial traffic and business travellers only generally (section 2.1), but several specialised business performance impact studies have been performed as part of evaluating the Stockholm Trial.

The economic effects of congestion tax – an overview

The following charts show the economic effects of congestion tax. They are categorised as follows:

1. **Travel time gains** minus **adaptation costs** (“adaptation cost” is the sacrifice involved in changing personal or commercial/business travel habits due to congestion tax).
2. **Congestion tax paid** for personal and commercial/business travel respectively, environmental and road safety effects (reduced emissions and fewer road accidents).
3. **Congestion tax revenues** which are equal to the total congestion tax paid for personal and commercial/business travel.
4. **Other public revenues and expenditures** including higher public transport revenues.
5. **Operating costs** for the congestion tax system.
6. Economic **distortion costs and opportunity costs**.

A detailed description of the items and how they were calculated is provided in the earlier report on equity effects (Transek 2006:31).

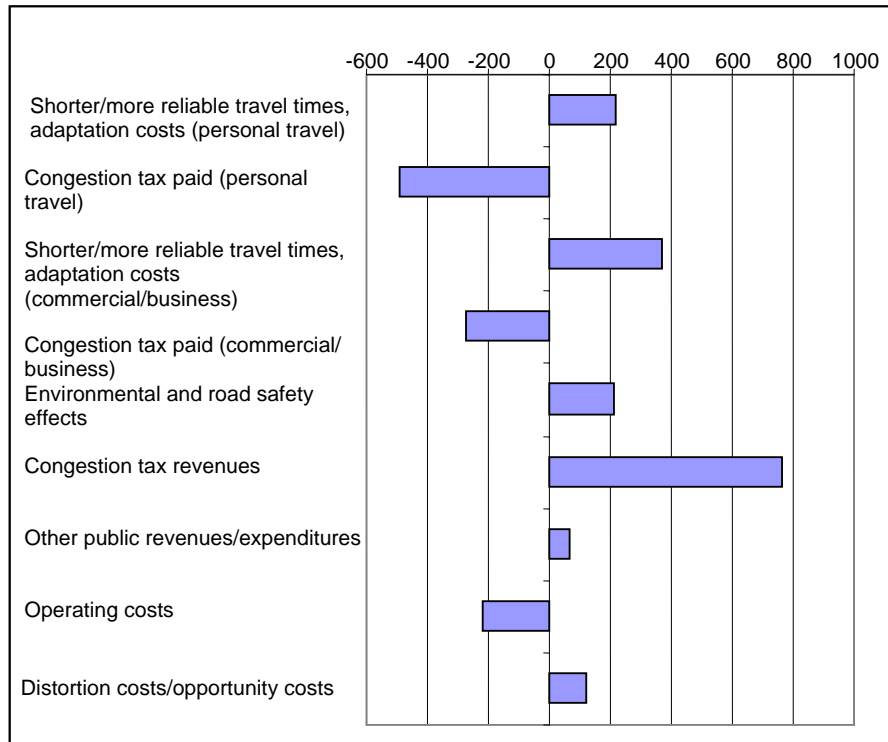


Figure 4. Total economic effects of congestion tax (SEKm/year).

The largest items are the congestion tax payments, which appear as a cost item for personal travel (SEK 488m/year) and commercial/business travel (SEK 275m/year), but as a revenue item for the public (SEK 763m/year). The three largest benefit items are travel time gains for personal travel⁴ (SEK 220m/year), travel time gains for commercial traffic (SEK 368m/year) and environmental and road safety effects (SEK 211m/year). A permanent congestion tax system would provide an estimated economic surplus of SEK 765m/year.

Direct road-user effects and revenue use

The equity effects analysis focuses on the *direct road-user effects* of congestion tax, that is, the effects with direct impact on how citizens travel. These include travel time gains, costs of congestion tax paid and adaptation costs (the sacrifice of changing travel habits due to congestion tax). But including only direct road-user effects in the analysis provides a skewed picture of the effects of congestion tax on citizens, as it ignores the revenues

⁴ Adaptation costs of SEK 13m/year were deducted from travel time gains.

from congestion tax that benefit citizens in one way or another. It has already been established⁵ that how revenues are used utterly determines total equity effects. As it has not yet been decided how revenues from a permanent congestion tax system will be used, we have studied three hypothetical revenue uses here: equal return to all citizens in the county, reduction in county income tax and reduction of public transport fares. These revenue uses were selected because they are easy to explain and their equity effects are simple to calculate, not because they are necessarily realistic or desirable. The main purpose is to illustrate the critical significance of various revenue uses on the end result. The calculations of the equity effects of revenues provided in the report refer to net revenues, that is, after all operating costs for the congestion tax system are deducted.

Certain items in the economic analysis are not included in the equity effects analysis:

- travel time gains and adaptation costs for commercial traffic and business travel
- congestion tax paid for commercial traffic and business travel
- environmental and road safety effects
- other public revenues/expenditures
- economic distortion costs and opportunity costs

The effects on commercial and business travel are not included in the equity effects analysis because the primary focus of the study is equity effects for different groups of citizens, not the impact on business. Environmental and road safety effects are not included because there is no input data for calculating how these effects are distributed among various groups. The items “other public revenues/expenditures” and “economic distortion costs and opportunity costs” are not covered for the same reason.

Seven group categories analysed

The study explores how congestion tax affects various socioeconomic groups of citizens. We have divided citizens into groups according to the following seven criteria:

⁵See e.g. Transek (2003) *Equity Effects of Congestion Taxes*.

- Sex (section 2.3)
- Residential area (section 2.4)
- Level of discretionary income: household income divided by the number of “consumer units” in the household, which roughly corresponds to the number of household members (section 2.5). (A division by household income is provided in the appendix.)
- Type of occupation: employed, student, etc. (section 2.6)
- Type of household: single, two adults with children or without children, etc. (section 2.7)
- Age groups (section 2.8)
- Native birth or foreign birth (section 2.9)

Effects presented

The following are shown for each group division:

1. A general description of the group’s average travel before congestion tax was implemented: distribution by mode of transport, trip length using various modes of transport, number of “charged journeys”⁶ per person and day.
2. How the group’s travel was affected by implementation of congestion tax: number of charged versus non-charged journeys in our out of the congestion charge zone.
3. Economic effects: travel time gain, congestion tax paid and adaptation cost, and the total of these effects (per person and year, on average).
4. “Return” per person (on average) according to revenue use.
5. Net effect per person (on average) of direct road-user effects plus revenue return.

⁶ Journeys that would have been subject to congestion tax if it were implemented.

2 RESULTS

2.1 How many people are affected by congestion tax?

The analyses presented in this report show average costs and travel time gains for different groups of county residents. The danger in using averages is that it is easy to forget the considerable variation found within groups - some individuals pay a lot, others little or nothing; some gain a great deal of time, others lose; some value their time highly, others less so. There is thus a fragmented reality behind the average figures.

How much variation is there among individuals? For instance: are mainly the same individuals paying congestion tax every day, while the vast majority do not pay at all – or are congestion tax revenues generated by a large number of individuals who pay occasionally?

A few drivers pay the majority of congestion tax – but most pay once in a while

The chart below shows the percentage of vehicles in the county that paid various amounts of congestion tax during one two-week period⁷ in March-April 2006. The average cost for a vehicle was SEK 41.50. A total of 230,962 privately owned cars paid congestion tax during the period. There are about 536,000 privately owned cars registered in the county. This shows that most vehicles in the county pay congestion tax at least occasionally: nearly half the vehicles in the county paid congestion tax at least once during this fourteen-day period alone.

⁷The Swedish Road Administration cannot compile statistics for longer periods as data may not be stored for more than two weeks.

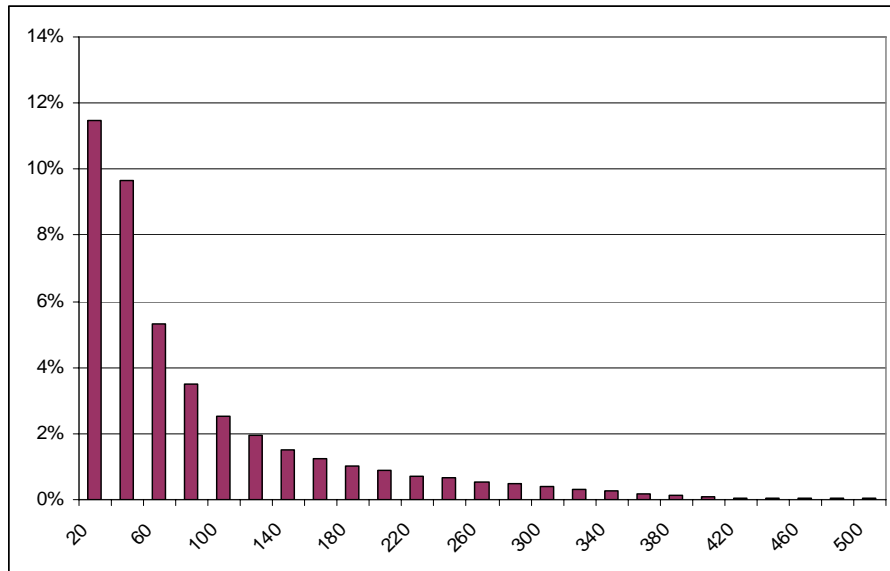


Figure 5: Distribution of congestion taxes paid by all privately registered vehicles during one two-week period (SEK/vehicle for two weeks). Percentage of all privately owned vehicles in the county. Approximately 55% of vehicles in the county paid no congestion tax (the bar is not shown on the chart).

Another interesting conclusion is that a small group of drivers account for a large percentage of revenues. About 20% of vehicles accounted for 75% of revenues (from privately owned cars). The differences can be expected to even out somewhat over a period of longer than two weeks, but the conclusion that a small percentage of drivers generate a large percentage of congestion tax revenues remains valid.

The third conclusion is that relatively few drivers accumulate the theoretical maximum tax. About 0.4% of vehicles in the county (corresponding to about 0.1% of county residents) accumulated an average expenditure of at least SEK 40/day during the two-week period. About 5% of vehicles in the county – corresponding to about 1.5% of county residents - accumulated a cost of SEK 200 or more during the two-week period. That 5% accounted for one third of the revenues from privately owned vehicles, which reinforces the above conclusion that a relatively small percentage of drivers generate a large percentage of the revenues.

Substantial variation within groups

As will become evident in the following, the differences between the average effect for different groups are smaller than the variations shown above. This means the differences within groups are often considerably greater than those between groups.

The travel habits survey upon which this study is based covered only *one* day of travel, so we do not know the magnitude of variation *within* any single group. But it is beyond doubt that the variation within groups may be considerably greater than between groups: for instance, we can safely assume that the women who pay the most congestion tax have substantially higher costs than the men who pay the least, even though men *on average* pay 50% more than women (as shown below).

The *relative* distribution of congestion tax payments within the groups is probably similar for most of them. In other words, if a certain group pays twice as much congestion tax as another group, then about twice as many in the first group pay, let's say more than SEK 400 a month, compared to the second group. We cannot prove this, as we only have statistics for one day's travel. The distribution by errand for charged journeys is similar for all groups, however, which supports the assumption (see appendix 2). This makes it unlikely that the relative distribution within groups differs sharply from the average distribution (with some obvious exceptions such as groups categorised by occupation and age).

2.2 Commercial traffic, business travel and personal travel

The following chart illustrates direct road-user effects distributed by personal travel, commercial traffic and business travel.⁸ Personal travel accounts for about 64% of passages in or out of the congestion charge zone during congestion charge hours, business travel 20% and commercial traffic 16%.

⁸ The difference between commercial traffic and business travel is that business travel is when a person travels somewhere during working hours (as required by the employer), while commercial traffic is made up of vehicles carrying any type of freight or paying passengers, such as goods transport or taxi service.

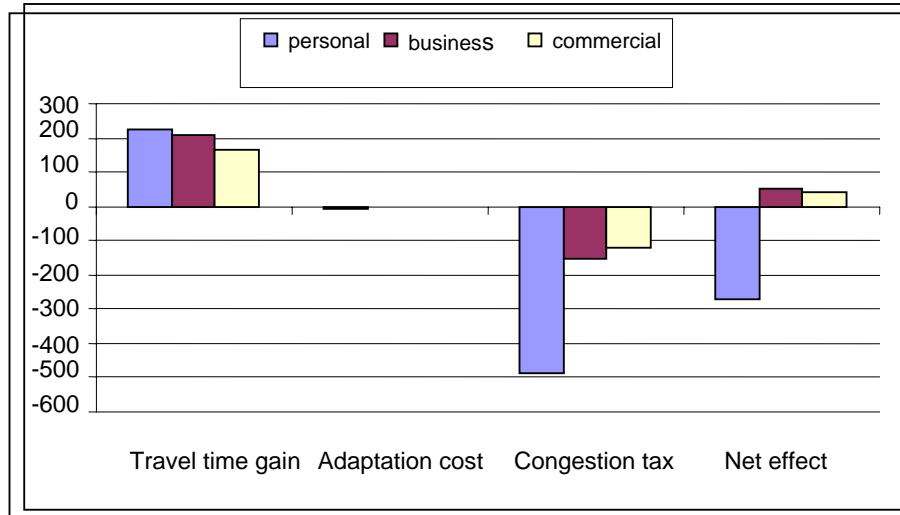


Figure 6. Direct road-user effects for personal, commercial and business travel (SEKm/year).

The most important conclusion that can be drawn from the chart is that business travellers and commercial traffic have a net gain even *before* any share in revenues – that is, regarded as a group. The variation between different groups and journeys is obviously considerable. The value of travel time gains is⁹ (on average) higher than the congestion tax these groups pay. The estimated direct effect on private drivers, on the other hand, is negative: drivers pay more in congestion tax than the estimated value of the time gain.¹⁰ Private drivers (as a group) do not make a net gain until they receive a share in congestion tax revenues.

Interestingly, more than 60% of travel time gains in the economic calculation come from commercial and business travel, even though they make up only slightly more than 35% of traffic in or out of the charge zone.

The adaptation costs are so low that they do not show up in the chart. The reason for this with regard to commercial and business travel is that there was no appreciable change; with regard to personal travel, the reason is that

⁹ Commercial and business travellers are assumed to value their travel time at SEK 190/h – see *Review of cost-benefit calculation. Methods and values in the transport sector – ASEK*. SIKa Report 2002:4. Private drivers are assumed to value their travel time at SEK 65/h – see *Bilisters värdering av förseningar och trängsel*. Transek, 2003.

¹⁰ While this is what one would expect according to transport economics theory, oddly enough it does not coincide with the opinion surveys conducted during the trial, wherein an unexpectedly large number (from the theoretical standpoint) of respondents seemed to regard the time gain as worth the tax paid. The opinion surveys may disagree so radically with theoretical predictions because earlier studies underestimated the value of drivers' time or the spread of time values (or both).

improved traffic flow allowed some drivers to choose to drive at better times or on better roads than before – a gain for road-users. These effects partially offset one another, so the net effect is negligible.

2.3 Effects for men and women

Men and women travel equally often – but men drive more often

Both men and women made 2.1 journeys by car or public transport on one average day in autumn 2004. Both groups travelled 57 minutes per weekday by these modes. The groups differ with regard to the choice of mode, destination and trip length.

Men took a larger percentage of their journeys by car. Not counting journeys by foot and bicycle, men took 68% of their journeys by car (and thus 32% by public transport), while women took 52% of their journeys by car (and 48% by public transport). Women spent 64% of their travel time riding public transport and men 48%.

Men travel farther than women, regardless of mode of transport. Men's average journey by public transport was 15 km and their average car journey 14 km. Women's average journey by public transport was 13 km and their average car journey 12 km..

Men and women travelled to and from the inner city to about the same extent – but men drove cars more often. Both men and women took 138 journeys to or from the inner city per year. For men, 40 of those journeys were subject to congestion tax, while 21 were for women.

Before the trial (2004)	Average trip length, km		Percentages by mode of transport		Passages in or out of the charge zone per year
	Car	Public transport	Car	Public transport	
Men	14	15	68%	32%	53
Women	12	13	52%	48%	31

Including charged “through journeys” (journeys across the inner city), men made nearly twice as many passages in or out of the charge zone as women – 53 to 31.

Men changed their travel habits more than women did

Men changed their travel habits due to congestion tax considerably more than women did. Men took 22% fewer charged journeys to and from the inner city during the trial (March 2006) than before the trial (September 2004), while the corresponding figure for women was 9%. One possible interpretation of this is that more men than women proved to have access to acceptable alternatives (such as a different mode of transport) once the congestion tax induced them to try and reduce travel subject to tax.

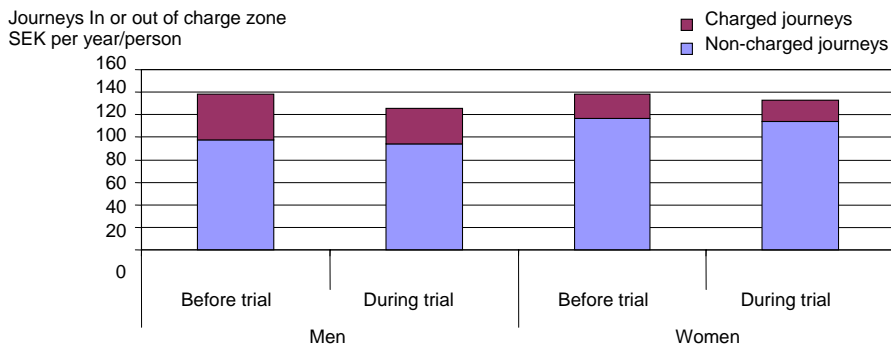


Figure 7: Trips to and from the charge zone, weekdays, not including through journeys.

The total number of journeys to/from the inner city declined by 9% for men and 4% for women. The figures should be interpreted with some caution as there is an element of seasonal variation (a decline in the number of journeys of about 5% between September and March on average – the “normal” seasonal variation for men versus women is unknown).

Men pay 65% more congestion tax than women do

As men drive cars more often and a considerably higher percentage of men's journeys are subject to congestion tax, they are on average affected more than women: they change their travel habits more, they pay more tax and their travel time gains are greater. The road-user effect is thus greater for men.

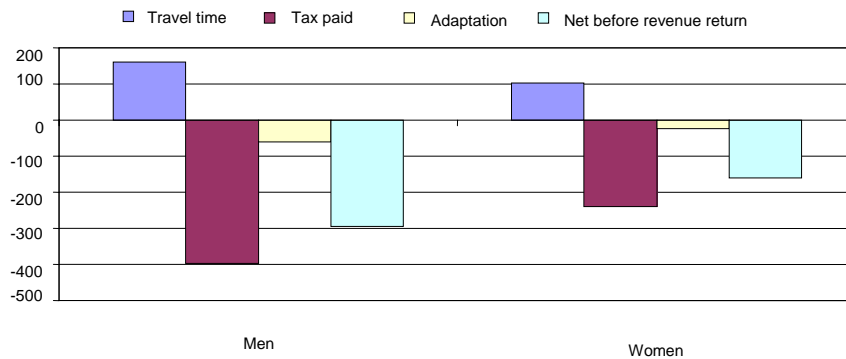


Figure 8: Total road-user effects for men and women (SEK/person and year).

Men pay 65% more congestion tax on average than women do, but their travel time gains are 60% greater. The net economic loss for men (referring only to direct road-user effects) is nearly twice as high as for women – an average of about SEK 300 per person and year compared to SEK 160. Congestion tax increased drivers' travel costs by 9% for men and 8% for women.

It may be worthwhile to once again point out that travel time gains and travel costs are not evenly distributed within groups. The variations within groups are in all likelihood greater than the differences between group averages.

Revenue use is critical

Congestion taxes generate revenues of about SEK 500 per person and year,¹¹ of which about SEK 140 is used to pay for the technical system and administration of congestion taxes. How the rest of the money is used utterly determines the total effect on the groups. To illustrate the importance of

¹¹ Commercial traffic and business travellers pay tax of approximately SEK 180 per year and county resident, in addition to the congestion tax paid by private drivers (approximately SEK 320 per year).

how revenues are used, Figure 9 shows how the returns of congestion tax are distributed among men and women for three hypothetical scenarios.

Women gain the most if revenues are used to reduce public transport fares because they use public transport more often. If the returns are distributed equally to everyone or are used to lower income taxes, men and women gain equally from the measure.¹²

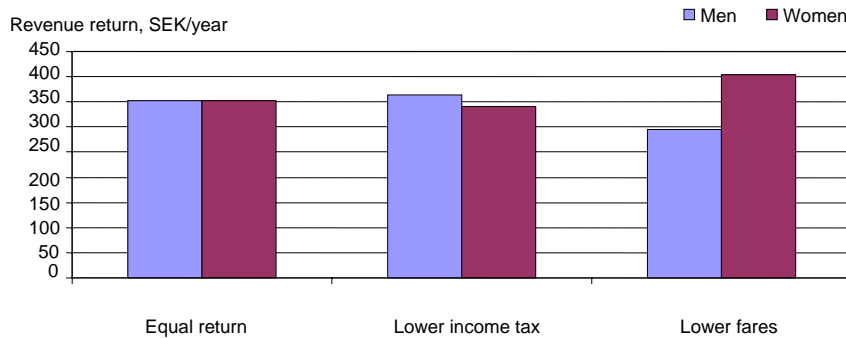


Figure 9: Effects of different revenue uses on women and men (SEK/person and year).

Women benefit the most when tax revenues are included

Figure 10 shows the net effect of the Stockholm Trial, that is, both road-user effects and revenue return (but not including factors such as environmental and road safety effects).

¹² The study on which the analyses were based provides information only about total household income. In order to estimate individual income, it was assumed that all adults in the household earn equal wages and that adolescents under age twenty have no income. As a result, the disparity between men's and women's wages is relatively small because many households consist of a man and a woman who are both gainfully employed. This also means that the two groups gain equally from lower county income tax. Accordingly, the calculations overestimate the gain from reduced income tax for women and underestimate the gain for men.

Equity Effects of the Stockholm Trial

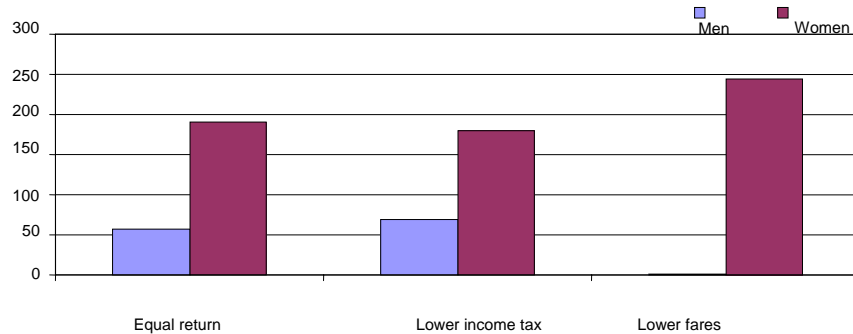


Figure 10: Net effects for men and women by revenue use (SEK/person and year).

County citizens make an average welfare gain of SEK 127 per year. If revenues are distributed equally among all residents of the county, both groups become “economic winners,” but women gain nearly five times as much as men. Lower income tax and equal return yield similar equity effects.

If revenues are used to lower public transport fares, women make an economic gain of SEK 244 per year. The large gain makes sense, as women use public transport more often and have a smaller negative road-user effect. Men make a net gain of SEK 1 per year.

2.4 Effects for various residential areas

Shorter journeys in central areas – and a lower percentage of journeys by car

The percentage of journeys by public transport tends to be larger for people who live in the city centre. About three fourths of journeys are taken by car in the outer suburbs, while about one third of journeys in the inner city (not counting journeys by foot and bicycle) are by car. Residents of Lidingö also have a very high percentage of journeys by car - considerably higher than for residents of other inner suburbs.

Journeys are considerably shorter for people who live in the city centre – journeys by public transport in particular are shorter than average.

Before trial (2004)	Average trip length, km		Percentages by mode of transport		Passages in or out of the charge zone per year
	Car	Public transport	Car	Public transport	
Northern outer suburbs	15	22	74%	26%	35
Northern inner suburbs	11	12	55%	45%	38
Inner city	12	8	36%	64%	60
Lidingö	10	11	67%	33%	71
Southern inner suburbs	12	11	50%	50%	41
Southern outer suburbs	14	19	68%	32%	36

The number of journeys affected by congestion tax increases with proximity to the city centre (naturally enough). Residents of the inner city (before the trial) took nearly twice as many journeys that would have been taxed than did suburban residents, and residents of Lidingö nearly three times as many.

Lidingö residents reduced charged journeys by one third

The number of charged journeys to/from the inner city (thus excluding “through journeys”) declined by 17% on average for the entire county. Lidingö residents changed their travel habits the most – the number of charged journeys by car to/from the inner city declined by nearly one third.¹³ The corresponding reduction for residents of the inner suburbs and the inner city is nearly as large, at about 24%. The decline in the outer suburbs was considerably less: residents of the southern suburbs reduced their charged journeys by 13% and residents of the northern suburbs by 9%.¹⁴ People who live closer to the city thus seemed to have found it easier to find alternative modes of transport or destinations.

¹³ Note that part of this decline, just as before, is probably due to seasonal variation. On average, the number of journeys by privately owned car across the congestion zone usually declines by about 5% between September and April; how that average varies by residential area is unknown.

¹⁴ At present, we cannot explain this peculiar result, other than to say that it may simply be coincidence - despite all, the sample of respondents is limited.

Equity Effects of the Stockholm Trial

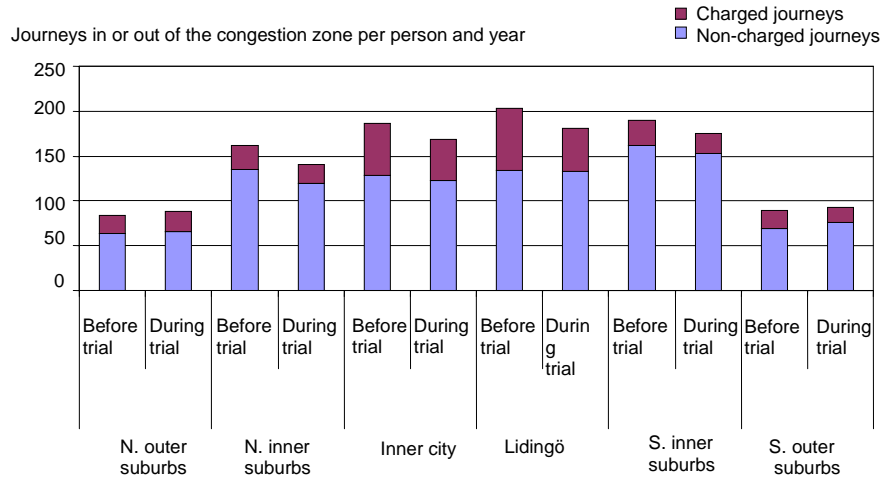


Figure 11: Number of journeys (per person and year) to or from the charge zone (excluding through journeys).

Inner city and Lidingö residents pay the most congestion tax

Lidingö residents pay SEK 660 on average per year in congestion tax. Residents of the inner city pay SEK 520 per person and year on average. The average congestion tax paid by residents of other areas is considerably lower at SEK 240-300 per person and year. Implementation of congestion tax increased the cost of travelling by car by barely 5% for residents of the outer suburbs, 11% for the inner suburbs, 18% for residents of Lidingö and 31% for residents of the inner city.

Residents of Lidingö and the northern outer suburbs save 2.7 hours per person and year, for which the economic value is about SEK 230. Residents of the northern inner suburbs make a travel time gain of SEK 130 per year. Other groups gain by about SEK 90. It is noteworthy that the calculations show such a small travel time gain for inner city residents compared to residents of other areas.

When direct road-user effects are combined, residents of Lidingö and the inner city sustain the greatest net loss. The average estimated loss is SEK 500 and SEK 450 respectively, per person and year. The loss for other areas

is about half as large. One glaring exception is the northern outer suburbs, which lose only SEK 78 per person and year.

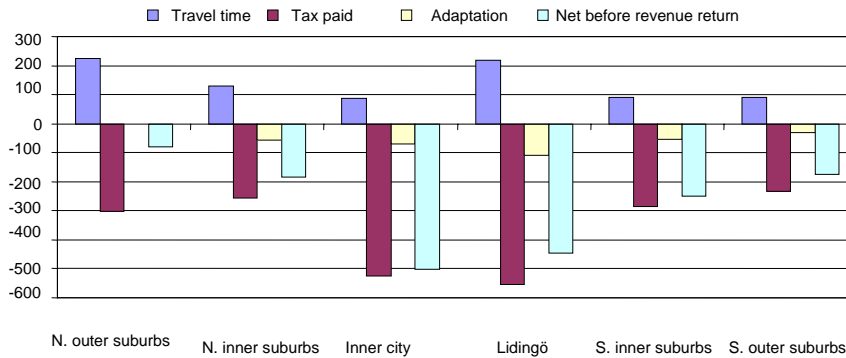


Figure 12: Total road-user effects by residential area (SEK/person and year).

People who live in the inner city thus make the least travel time gain of all areas, despite paying the second-highest amount of congestion tax. Suburban residents make relatively large travel time gains, despite paying relatively little congestion tax. One reason may be that a large percentage of car journeys from these areas do not cross the charge zone, but still take less time than before. It is also noteworthy that the traffic flow improvements created by reduced congestion around the charge zone are underestimated by traffic models that calculate travel time effects. Travel time gains in the suburbs are thus probably greater than those estimated here.

Lower fares benefit the inner city and inner suburbs the most

If congestion tax revenues are used to lower public transport fares, those who use public transport the most will naturally gain the most. Residents of the inner city and the inner suburbs use public transport more than the average and would also get back more than the average county resident.

The average income of residents of the inner suburbs is on par with the county average. Accordingly, their return is the same for the lower income tax scenario and the equal return scenario. Residents of Lidingö and the inner city, whose incomes are higher, gain more by lower income tax. Wages

are below the average in the outer areas and they accordingly gain less if income tax is reduced.

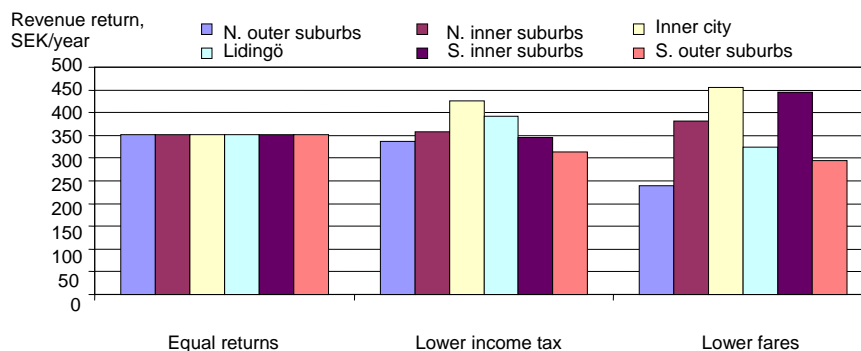


Figure 13: Revenue return - Effects by residential area (SEK per person and year).

Net loss for Lidingö and inner city residents

Depending on the return model, the total welfare loss for residents of Lidingö is SEK 50-100 per person and year. Inner city residents lose SEK 77 if income tax is reduced and SEK 48 if public transport fares are reduced.¹⁵

Residents of the inner suburbs gain the most if fares are reduced: about SEK 200 per person and year. Residents of the outer suburbs gain a total of SEK 160 in the north and SEK 120 in the south.

If income tax is reduced, the gain is larger for residents of northern suburbs than for southern suburbs and the outer suburbs gain more than the inner suburbs.

¹⁵. Note that this does not include environmental and road safety effects. Also remember that the time value used (SEK 65/h) may very well be underestimated, especially for high-income groups. This issue is discussed in the section on methods.

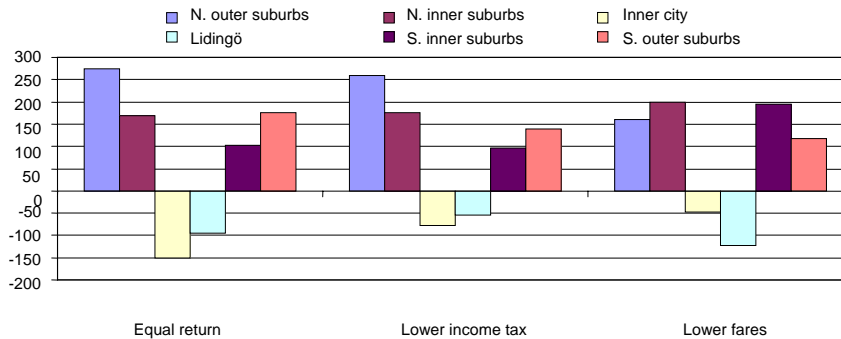


Figure 14: Net effects by residential area and revenue return model (SEK/person and year).

2.5 Effects for groups with varying discretionary income

This section analyses the effects on households based on discretionary income. The division is based on the measurement (“consumer units”) recommended by the National Board of Health and Welfare for calculating economic assistance (“income support”). The factors the NBHW take into account are household income, number of persons in the household and their ages. This method enables more accurate estimation of costs during various life stages and the “economies of scale” enjoyed by larger households.

The groups each represent about one fifth of the county population.

A similar division is presented in the appendix, which takes only household income into account – not the number of people the income is meant to support.

Affluent people take more charged journeys

The groups with low and low-average discretionary income used public transport more than other groups. They also took fewer charged journeys.

Journeys by public transport were shorter for people with high incomes and they travelled by public transport to and from the inner city more often, perhaps because they live closer to the city centre.

Before trial (2004)	Average trip length, km		Percentages by mode of transport		Passages in or out of the charge zone per year
	Car	Public transport	Car	Public transport	
Low	13	14	53%	47%	25
Low-average	12	14	57%	43%	28
Average	13	15	68%	32%	51
High-average	13	14	61%	39%	49
High	15	12	62%	38%	63

The higher the discretionary income, the more charged journeys people tend to take. A partial explanation – beyond the obvious one that these groups also drive cars more often – is that more people in these groups live in or near the inner city, as shown in the following chart. As shown below, groups with higher discretionary income also take more journeys by public transport in our out of the inner city charge zone.

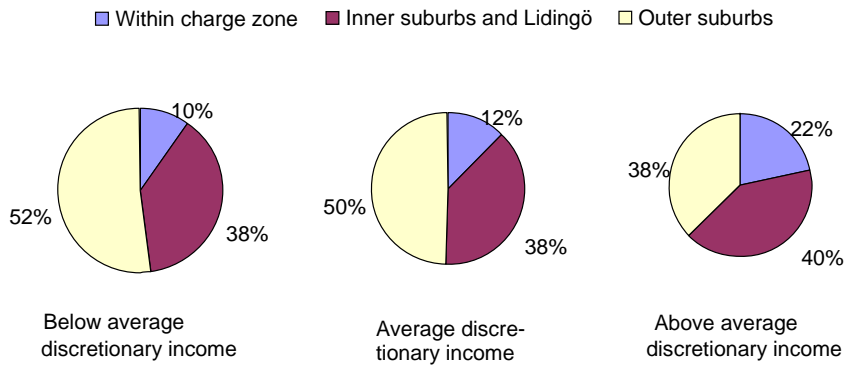


Figure 15: Group distribution by discretionary income and residential area.

The pie chart on the left refers to both low and low-average discretionary income. The middle chart describes the group with average discretionary income. The chart on the right covers both high and high-average discretionary income. As shown, groups with higher discretionary income live closer to the city centre.

People of average income reduce charged journeys the most

There is no clear correlation between discretionary income and how much people changed their travel habits. The group with average discretionary income reduced the number of charged journeys to and from the inner city the most at 30%. The corresponding reductions were 9% for the group with high-average discretionary income and 15% for the group with high discretionary income. The reductions were 25% for the group with low-average discretionary income and 6% for the group with the lowest discretionary income.

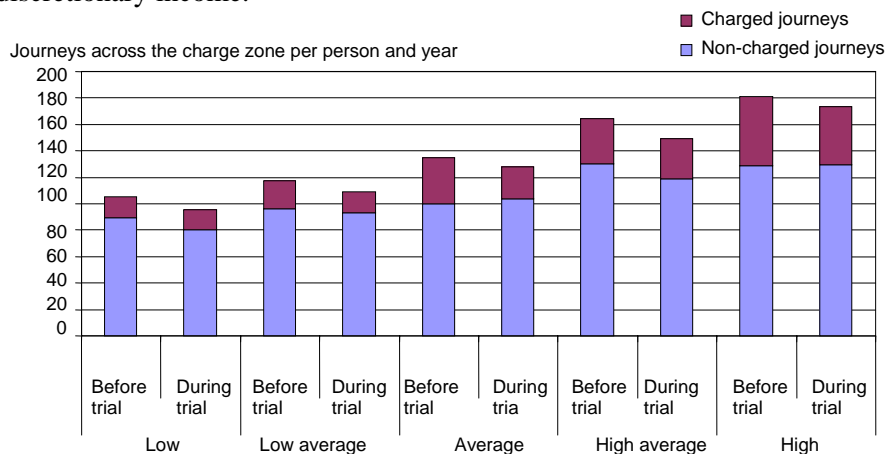


Figure 16: Passages to and from the inner city, per person and year.

Road-user losses greater for groups with higher discretionary income

People with higher discretionary income cross the charge zone more often, and more often by car during congestion charge hours, so it is not surprising that they pay more. People with high discretionary income also save more travel time.¹⁶

When road-user effects are combined, there is a clear co-variation with discretionary income – from SEK 106 for the group with low discretionary income to SEK 405 for the group with the highest discretionary income.

¹⁶ Affluent people are generally willing to pay more to reduce their travel time, which was not considered in the analysis. This implies that the value of the reduction in travel time for the groups with high and high-average discretionary income may be higher than shown on the chart.

Equity Effects of the Stockholm Trial

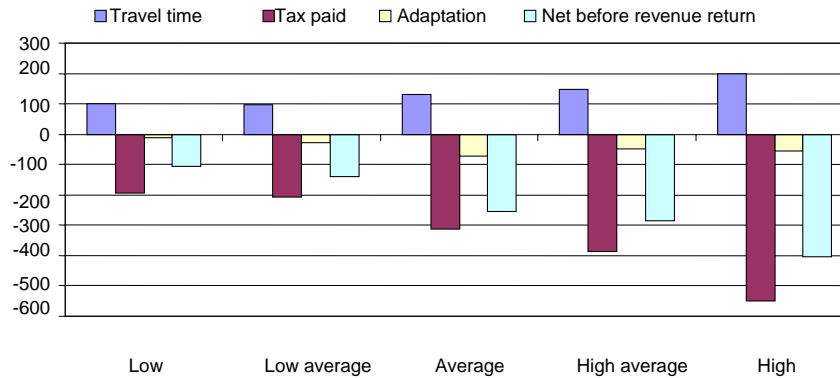


Figure 17: Total road-user effects (SEK/person and year).

The cost increase expressed as a *percentage* also co-varies with discretionary income: implementation of congestion taxes entailed a cost increase for journeys by car of 6% for the two groups with the lowest discretionary income, 8% for the group with average discretionary income and 9% and 11% respectively for the groups with the highest discretionary income.

Lower fares yield equal returns

Groups with low discretionary income gain the least by lower income tax, since they have lower income.

All groups take about equally as many journeys by public transport – even though the *percentage* of journeys by public transport is lower for higher income groups. For that reason, lower public transport fares benefit all groups about equally.

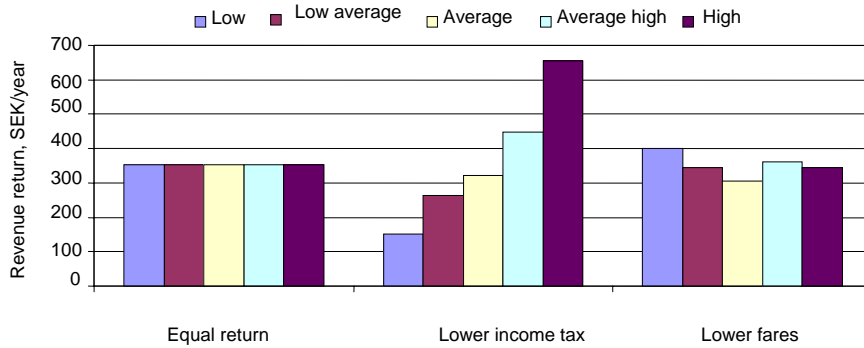


Figure 18: Return of congestion tax revenues.

Return model determines equity effects

The groups with higher discretionary income gain the most if income tax is reduced, but they also have the most negative road-user effect. Accordingly, the choice of return model utterly determines the equity effects. Lower income tax and lower public transport fares yield entirely opposite equity effects.

If income tax is reduced, the most affluent 20% gain SEK 250 per year while those with the lowest discretionary income gain SEK 46 on average.

If public transport fares are reduced instead, those who gain the most are the groups with low and low-average discretionary income at SEK 300 and SEK 200 per person and year, respectively. The most affluent group sustains a welfare loss of SEK 60.¹⁷

¹⁷ It is worth noting again that this is excluding environmental and road safety effects and that all groups are assumed to have the same time value (SEK 65/h) – which is probably underestimated, especially for high-income groups.

Equity Effects of the Stockholm Trial

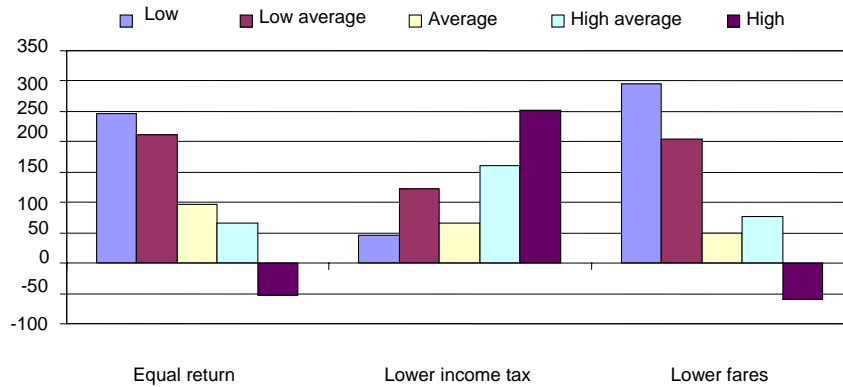


Figure 19. Net effects for households by discretionary income and revenue use (SEK/person and year).

2.6 Effects are dependent on type of occupation

Employed people affected most by congestion tax

There are clear differences in travel patterns between people of differing occupations. Students and employed people both travel a lot, but employed people travel mostly by car and students mainly by public transport. Employed people take longer journeys than others. Pensioners take shorter and fewer journeys than the other groups.

	Average trip length, km		Percentages by mode of transport		Passages in or out of the charge zone per year
	Car	Public transport	Car	Public transport	
Before trial (2004)					
Employed, no children	15	14	60%	40%	51
Employed, with children	12	16	75%	25%	65
Pensioners	11	10	65%	35%	26
Students	11	13	28%	72%	16
Job-seekers	12	13	59%	41%	27

Employed people take considerably more charged journeys than other groups – about two and a half times as many. Employed people who have children cross the charge zone even more often than employed people who do not have children.

Students reduced their travel the most – employed people with children the least

Students took few charged journeys to and from the inner city even before the trial and later reduced that number by two thirds to five journeys per person and year on average. Job-seekers and pensioners reduced the number of charged journeys by one fourth. Employed people with no children reduced their journeys by 18%. Employed people with children reduced the number of charged journeys by 9%, which is considerably less than other groups.

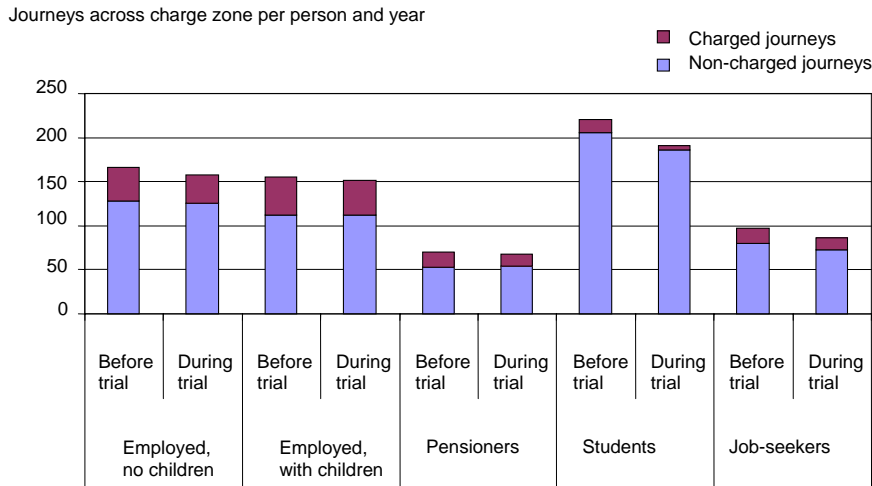


Figure 20: Passages to and from the inner city, per person and year. (Note that the number of journeys to/from the inner city normally declines by about 6% between September and April.)

Substantial road-user loss for employed people

Employed people pay considerably more than other groups. Employed people with children, who travel the farthest by car, pay one third more than employed people without children. Students pay only SEK 47 per year.

As previously noted, the pattern for saved travel time essentially follows the structure for the groups’ payment of congestion tax. Employed people save nearly quadruple the time compared to other groups.

Pensioners and job-seekers sustain a total road-user loss of about SEK 117 per year, students SEK 46. Employed people with children lose SEK 380 per year and employed people with no children SEK 300.

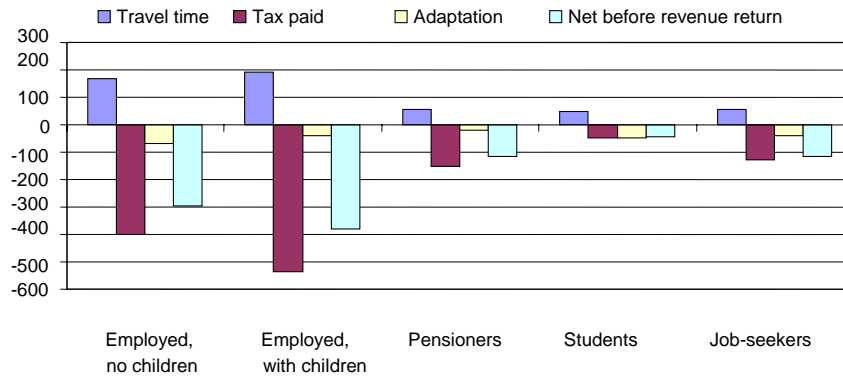


Figure 21. Total road-user effects (SEK/person and year).

On average, congestion taxes increased the cost of travel by car by 8% for employed people, 8% for students and 6% for job-seekers and pensioners.

Students gain the most if fares are reduced

Students, who take almost nine journeys by public transport per week on average, would gain the most if public transport fares were reduced. The return is greater for employed people with no children and pensioners if county income tax is reduced.

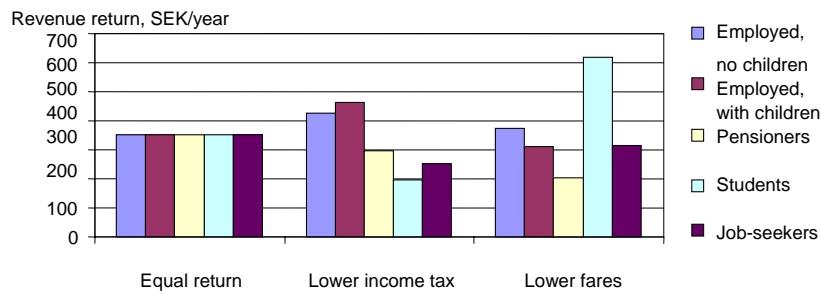


Figure 22: Revenue returns by occupational group and revenue use (SEK/person and year).

Employed people with children sustain a net loss

Employed people with children sustain a net loss if public transport fares are reduced, as they do in the equal return scenario. Students gain the most if revenues are used to reduce fares.

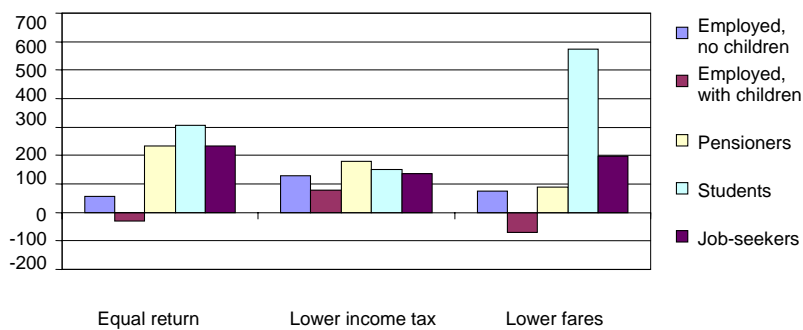


Figure 23: Net effects by occupational group and revenue use (SEK/person and year).

2.7 Effects for different types of households

This section reports the results of analysis of equity effects on households of varying compositions. We have defined six types of households:

- Single adults with no children in the home
- Two (or more) adults with no children in the home
- Single adults with teenagers in the home (youngest child older than age 12)
- Two (or more) adults with teenagers in the home
- Single adults with children in the home (youngest child age 12 or younger)
- Two (or more) adults with children in the home

Single people took fewer charged journeys

Households consisting of a single adult take a larger percentage of journeys by public transport. Households with children take a smaller percentage of journeys by public transport.

On average, households with children take shorter journeys by car and longer journeys by public transport – perhaps because shorter journeys are also taken by car.

	Average trip length, km		Percentages by mode of transport		Passages in or out of the charge zone per year
	Car	Public transport	Car	Public transport	
Before trial (2004)					
Single adults	14	12	43%	57%	28
Two or more adults with no children	14	14	61%	39%	42
Single adults with teenagers	13	15	46%	54%	29
Two or more adults with teenagers	13	14	56%	44%	45
Single adults with children	12	13	56%	44%	40
Two or more adults with children	12	15	71%	29%	52

The table also shows that households with two adults take more charged journeys than households with one adult and that the number of charged journeys increases when there are teenagers and (especially) children in the household.

Couples with teenagers reduced charged journeys the most

Couples with teenagers reduced charged journeys to and from the inner city the most – by about one third. The reduction was 13% for single adults with teenagers. Couples with no children, single adults and single adults with children all reduced their charged journeys by about one fifth. Families of two or more adults with children reduced their charged journeys to the inner city by only 2%.

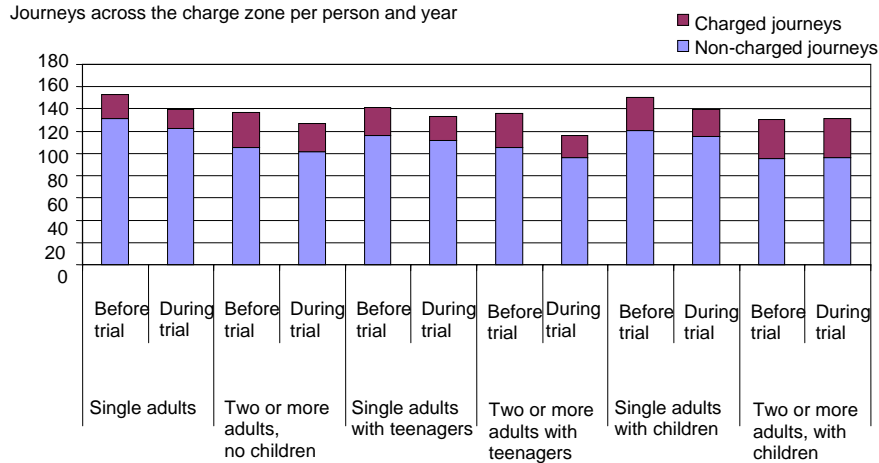


Figure 24: Passages to and from the inner city, per person and year. (Note that the number of journeys to/from the inner city normally declines by about 6% between September and April.)

Families with children pay the most congestion tax

Households with children pay the most congestion tax and make the greatest gains in travel time. Families of two or more adults with children paid an average of SEK 450 per person and year, while single adults with children paid SEK 315. Single adults paid SEK 230 regardless of whether they had teenagers or no children in the home. Families of two or more adults with teenagers paid SEK 260 and couples with no children paid SEK 300. Travel time gains are largely proportional to the congestion tax paid.

It is interesting to compare the total road-user effects for single people to those for households consisting of two or more adults. Single adults with children are affected less than families of two or more adults with children. Single adults with teenagers are affected less than families of two or more adults with teenagers. Single adults with no children are affected less than couples.

Equity Effects of the Stockholm Trial

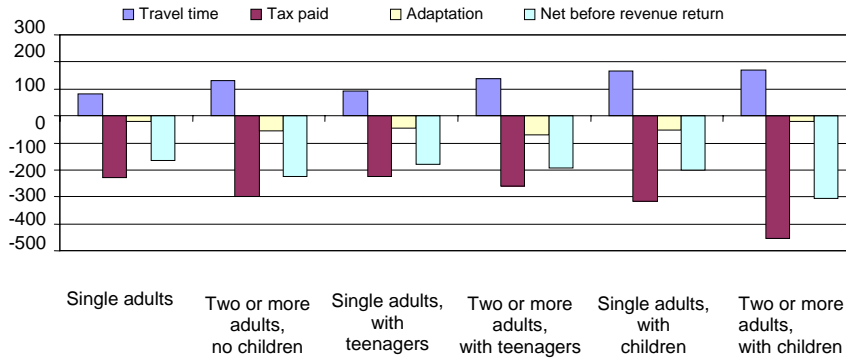


Figure 25: Co-weighted road-user effects, SEK per person and year.

Congestion tax increased the cost of car travel by approximately 9% for all groups.

Lower fares benefit households with teenagers

Figure 26 shows that lower public transport fares provide much larger gains than lower income tax for households with teenagers. Families of two or more adults with children gain 20% more if income tax is reduced than if fares are reduced.¹⁸ There is about a 10% difference between the two return models for the other groups.

¹⁸Note that we have no information on children’s travel habits. The chart shows the result if children under twelve gain nothing if fares are reduced. At present, children over six must pay to ride public transport with SL. Accordingly, the gain for families with children is underestimated for the lower fares scenario.

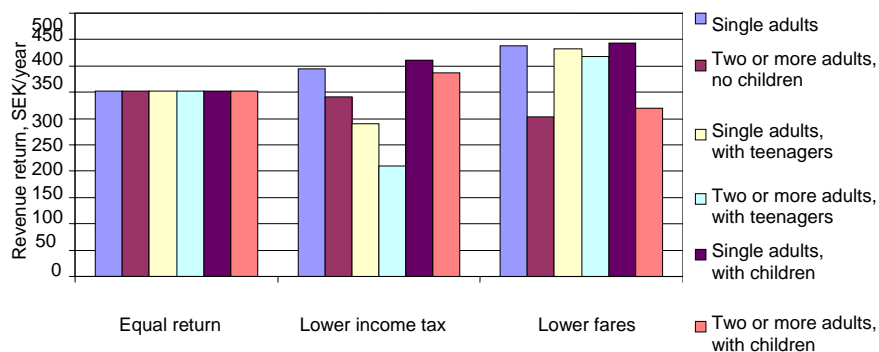


Figure 26: Return of congestion tax revenues.

Greatest net gain for single adults

Single adults with teenagers gain SEK 110 if congestion tax revenues are used to reduce income tax. In other cases, single adults gain between SEK 210 and 270 per year, regardless of whether they have children, teenagers or no children in the home and regardless of whether income tax or public transport fares are reduced.

Households with two or more adults gain SEK 120 or less in the two scenarios, with one exception: Families of two or more adults with teenagers gain about SEK 230 if congestion tax revenues are used to reduce public transport fares.

Equity Effects of the Stockholm Trial

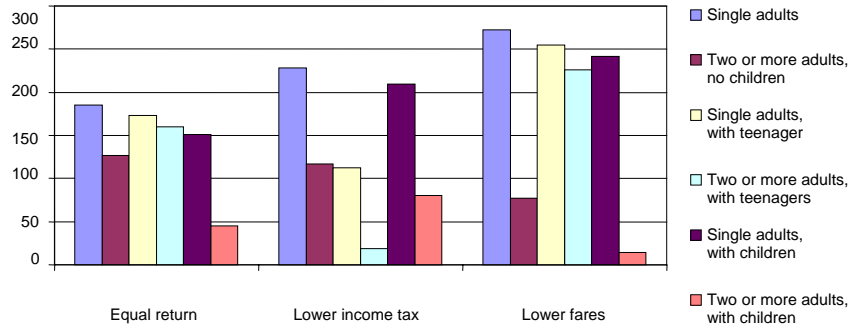


Figure 27: Total welfare effects by income category, SEK per person and year. Families of two or more adults with children sustain a net loss.

2.8 Effects on various age categories

Young people use public transport more – middle-aged people take more charged journeys

Younger groups use public transport more often. Middle-aged people generally travel more by car. Middle-aged people also take charged journeys considerably more often.

Before trial (2004)	Average trip length, km		Percentages by mode of transport		Passages in/or out of the charge zone per year
	Car	Public transport	Car	Public transport	
12-19	11	13	39%	61%	24
20-29	14	13	44%	56%	56
30-49	13	14	66%	34%	101
50-64	15	15	65%	35%	76
65-74	12	11	67%	33%	56
75-84	9	9	59%	41%	33

The four oldest groups all take seven charged journeys per 1,000 km by car. The corresponding figures are three for people in the 12-19 age group and five for people in the 20-29 age group.

Teenagers reduced charged journeys the most – people aged 50-75 hardly at all

The youngest group reduced the number of charged journeys to and from the inner city by two thirds. People aged 20-29 and 74-84 reduced the number of charged passages by 29% and people aged 30-49 by 18%. People aged 50-64 reduced this type of journey by 7% and people aged 65-74-by 15%.

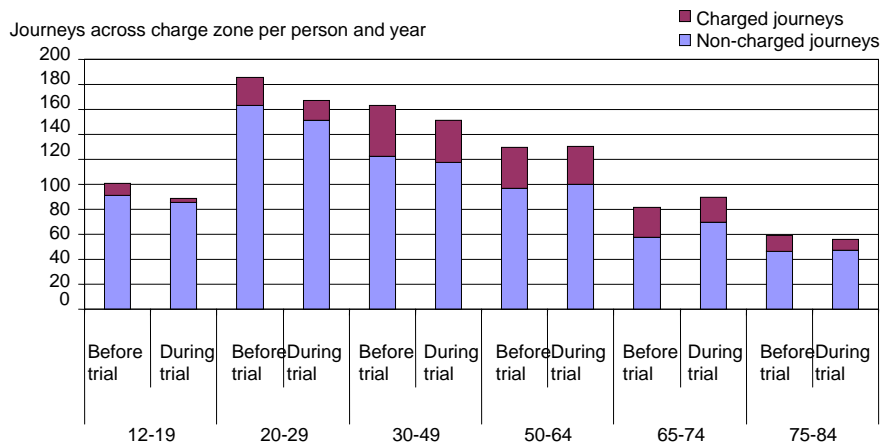


Figure 28: Passages to and from the inner city, per person and year, excluding through journeys.

Congestion tax increased the cost of travel by car by 6% for the youngest group, 8% for the 50-64 age group, 10% for people aged 30-49 and 7% for other groups.

Middle-aged people pay the most

Middle-aged people pay considerably more congestion tax than other groups. They also have the greatest time gains and the highest adaptation costs. People aged 30-49 pay SEK 440 per year and people aged 50-64 SEK 370.

Teenagers aged 12-19 were the only group in the study to save more travel time than they pay in tax. On the other hand, the assumed time value (SEK 65/h) may in reality be overestimated for this group.

Middle-aged people sustain the largest road-user loss. The 30-49 age group lose SEK 330 per year. Older and younger groups lose less. The road-user

effect for the youngest group yields a gain equal to SEK 18, while the oldest lose about SEK 70.

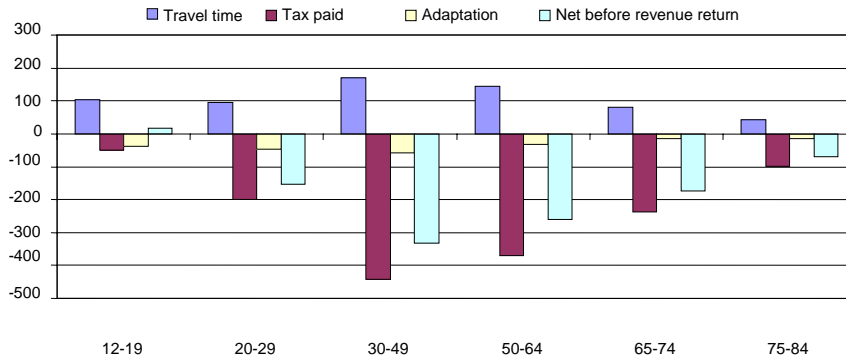


Figure 29: Co-weighted road-user effects, SEK per person and year.

Lower fares benefit young people more

People aged 30-75 gain about SEK 100 more if income tax is reduced than if public transport fares are reduced. The two youngest groups on the other hand make substantial gains if fares are reduced. This is especially obvious for the youngest group, who have low incomes¹⁹ and use public transport frequently.

¹⁹As the study upon which the analysis was based provides only data on total household income, certain approximations were made to estimate individual income, including the assumption that people under age 20 have no income.

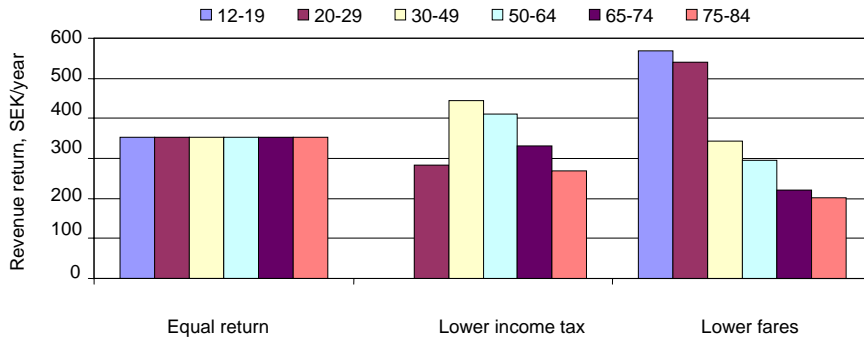


Figure 30: Return of congestion charge revenues, SEK per person and year.

Lower income tax benefits the older half of the population

If revenues are used to reduce county income tax, congestion taxes have essentially no effect on the youngest group. Other groups gain SEK 110-200, with older people gaining the most.

Citizens under age 30 gain the most if public transport fares are reduced instead.

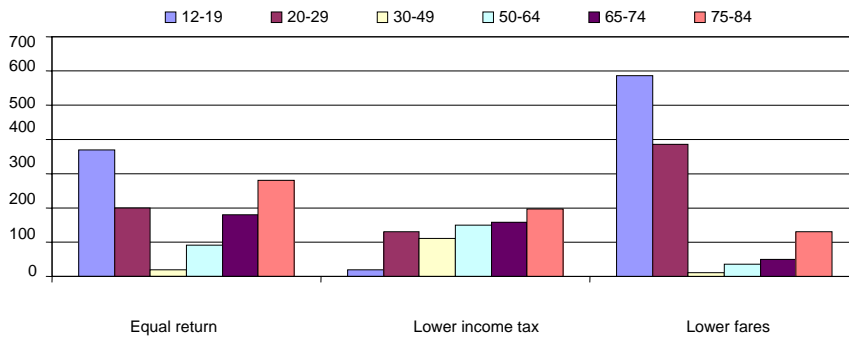


Figure 31: Total welfare effects by income category, SEK per person and year.

2.9 Effects on native-born and foreign-born people

People born in Sweden travel by car to a greater extent

Native-born people take somewhat longer journeys and travel by car to a greater extent. Foreign-born people take somewhat fewer charged journeys than native-born people (approximately 15%).

Before trial (2004)	Average trip length, km		Percentages by mode of transport		Passages in or out of the charge zone per year
	Car	Public transport	Car	Public transport	
Native-born	13	14	61%	39%	43
Foreign-born	12	13	53%	47%	36

A large part of the differences is probably due to differences in income and residential area – for instance, we have previously shown that people with high incomes and residents of the inner city are affected more than others.

Native-born people reduced charged journeys twice as much as foreign-born people

Native-born people reduced the number of charged journeys to and from the inner city by 19% and foreign-born people by 10%. Both groups reduced the total number of journeys to the inner city by 6% (seasonal variation may account for part, perhaps even all, of this reduction).

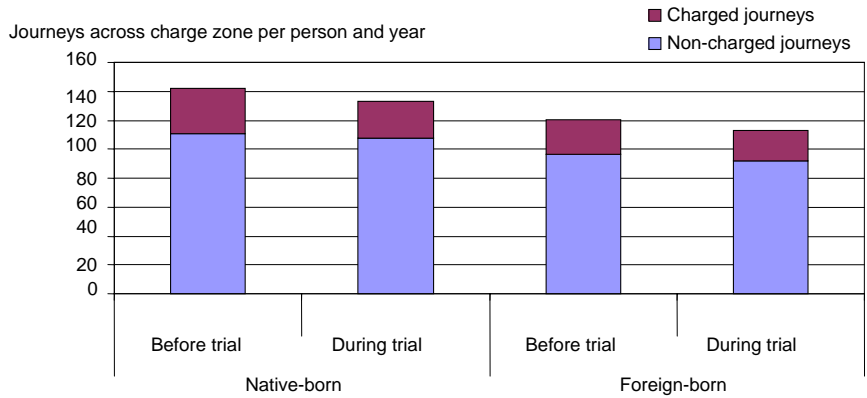


Figure 32: Journeys to and from the inner city, per person and year (excluding through journeys).

Implementation of congestion tax increased the cost of travel by 8% for native-born drivers and 9% for foreign-born drivers.

Travel affected more for native-born people

Native-born people pay one third more than foreign-born people and save one fourth more travel time. Both groups have an adaptation cost of about SEK 40 per year.

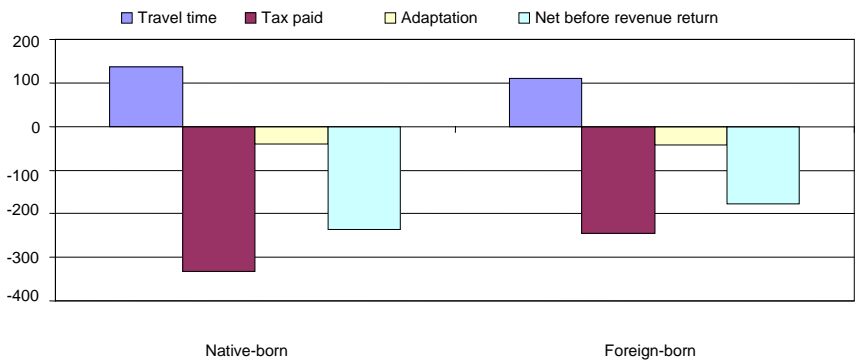


Figure 33: Co-weighted road-user effects, SEK per person and year.

When all effects are combined, the net loss is SEK 240 for native-born people and SEK 180 for foreign-born people.

Native-born people gain slightly more with lower tax

Native-born people gain somewhat more if income tax is reduced, but the differences between the groups are minor. The gains become even more equal if public transport fares are reduced; see Figure 34.

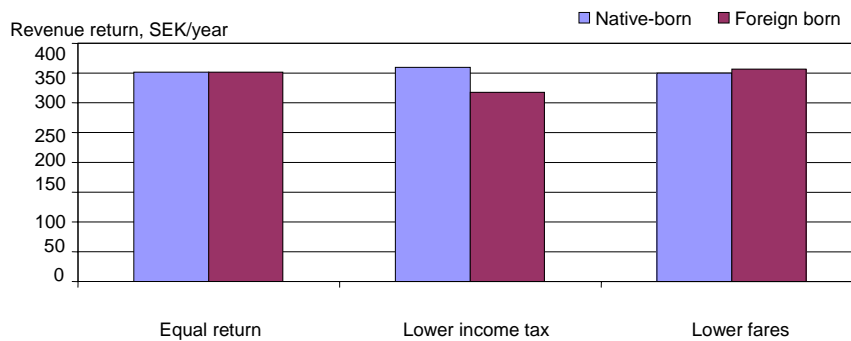


Figure 34: Return of congestion tax revenues, SEK per person and year.

Net gain the greatest for foreign-born people

Native-born people, the overwhelming majority of the population, make a welfare gain of about SEK 120 per year, regardless of how revenues are used. The choice of return model makes a greater difference to foreign-born people. Equal returns and lower fares yield a welfare gain of SEK 170-180 for foreign-born people. The gain through lower income tax is smaller, at SEK 140 SEK.

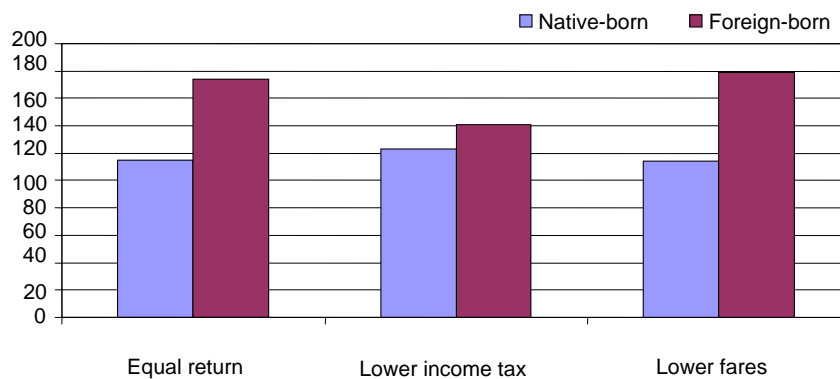


Figure 35: Total welfare effects, SEK per person and year.

2.10 Summary chart

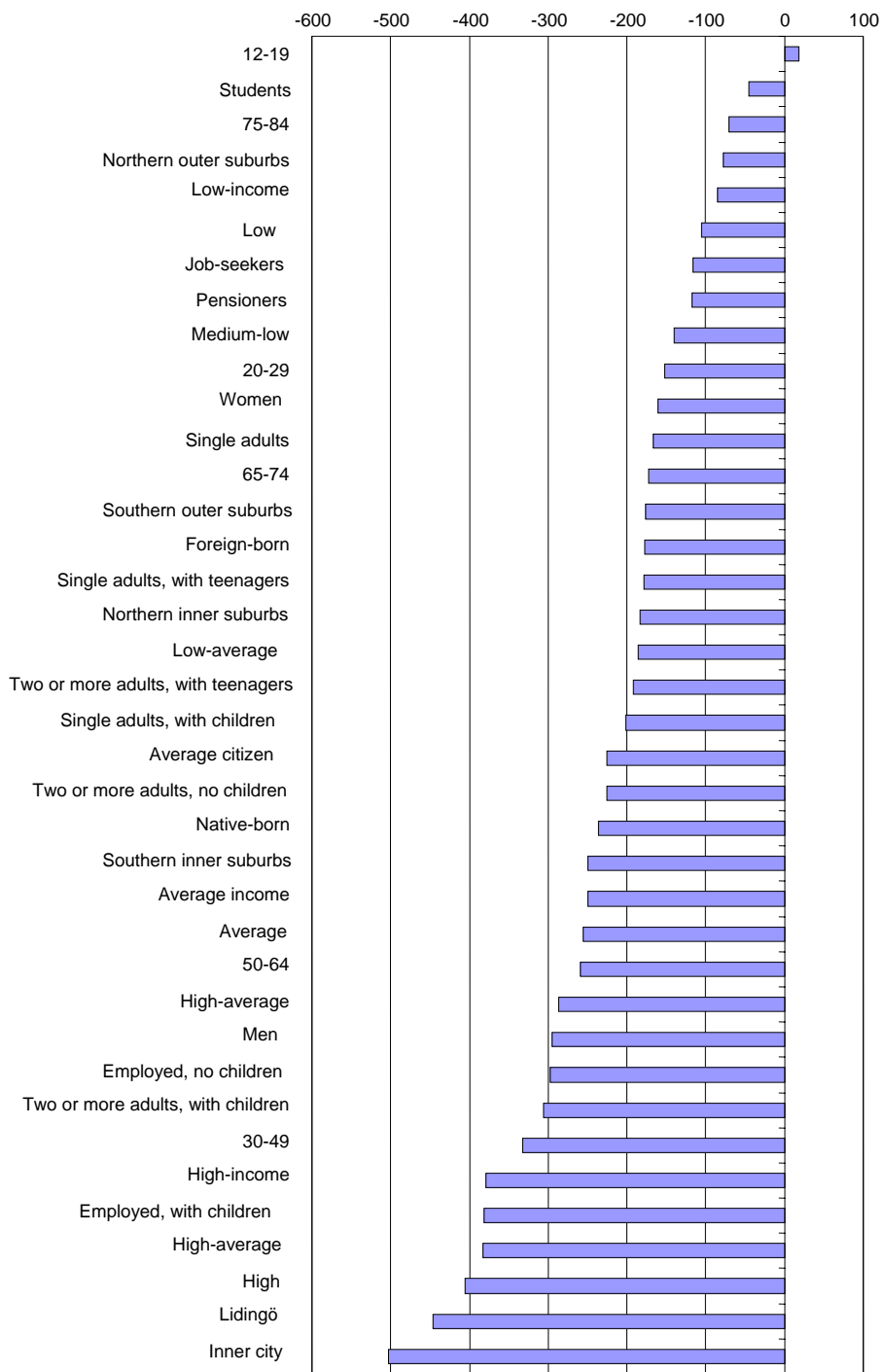


Figure 36: Total road-user effects (SEK per person and year).

Equity Effects of the Stockholm Trial

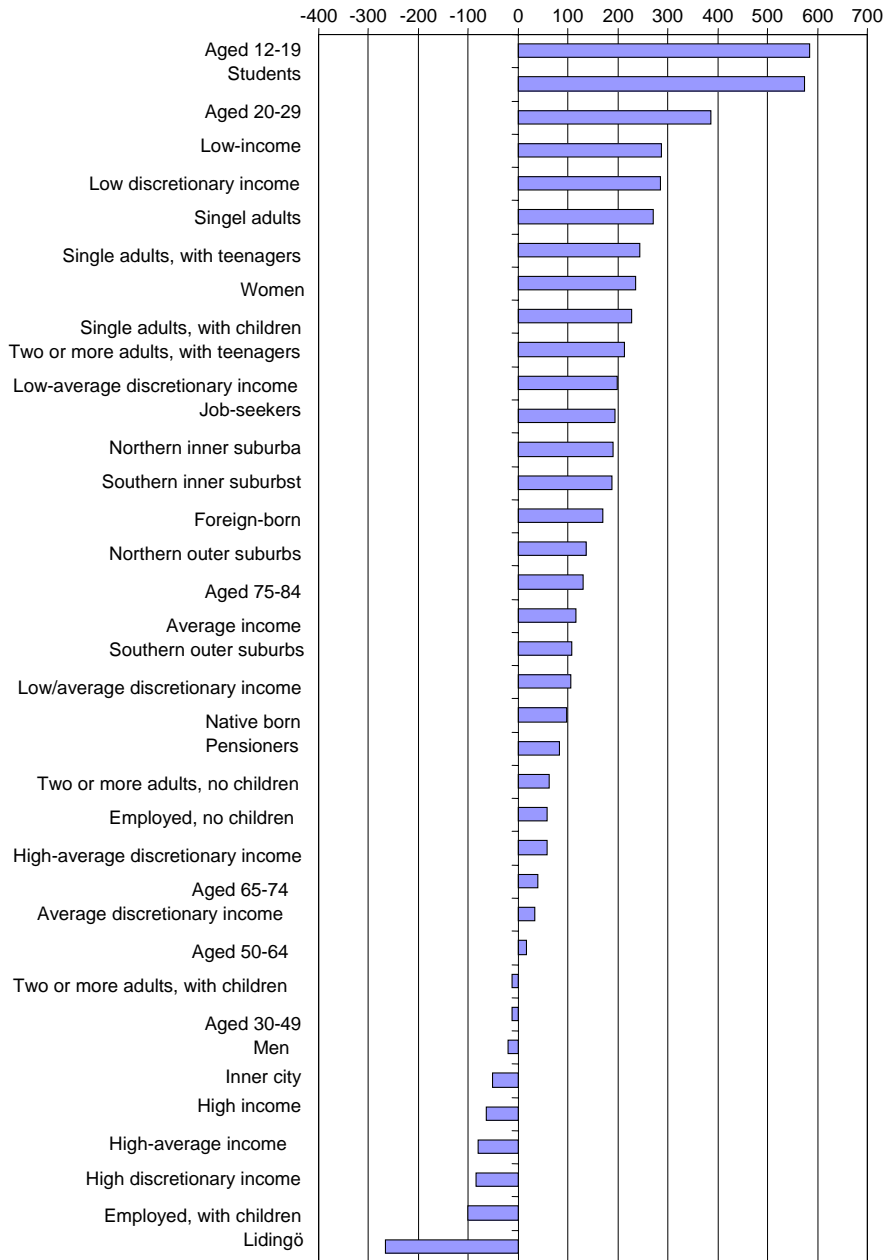


Figure 37: Net effects if congestion tax revenues are used to reduce public transport fares. SEK per person and year.

Equity Effects of the Stockholm Trial

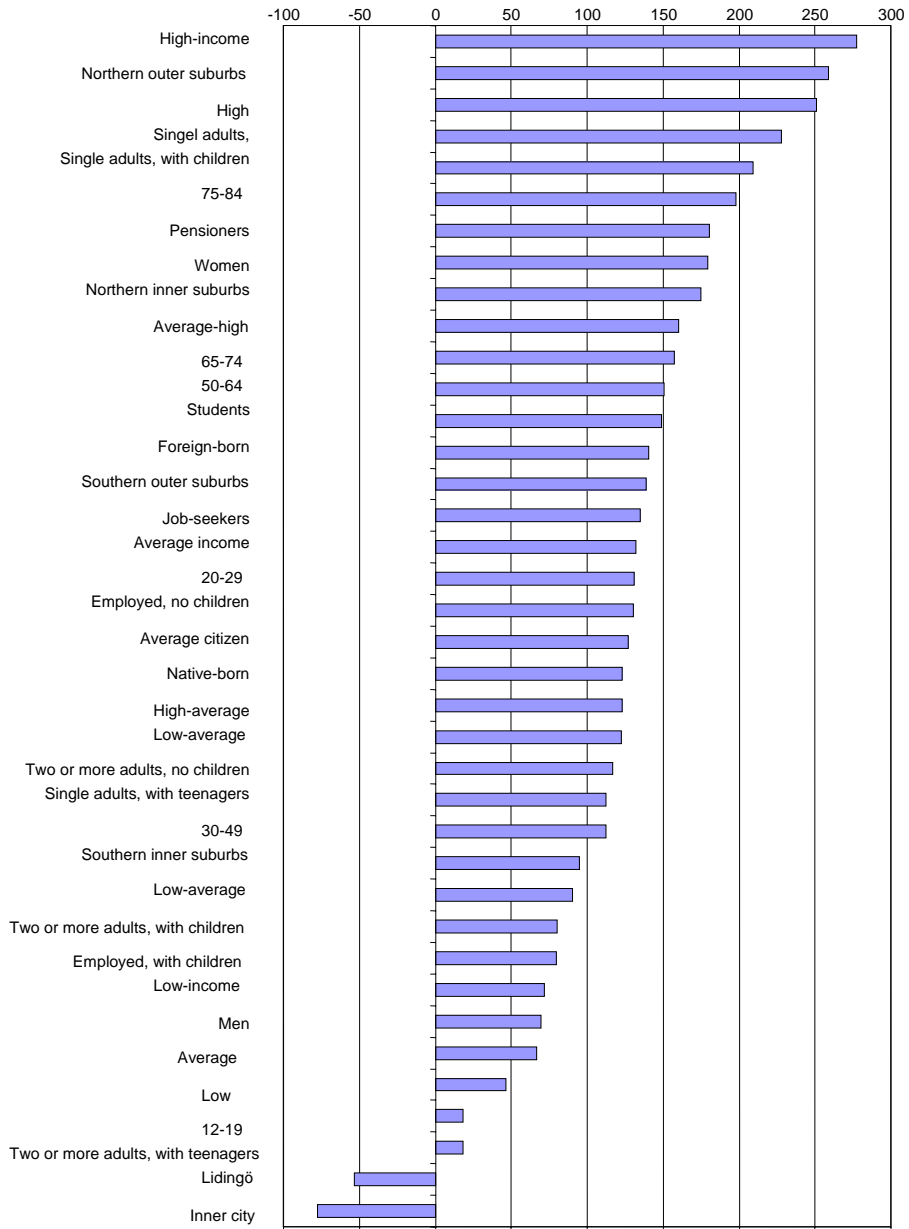


Figure 38: Net effects if congestion tax revenues are used to reduce county income tax. SEK per person and year.

Equity Effects of the Stockholm Trial

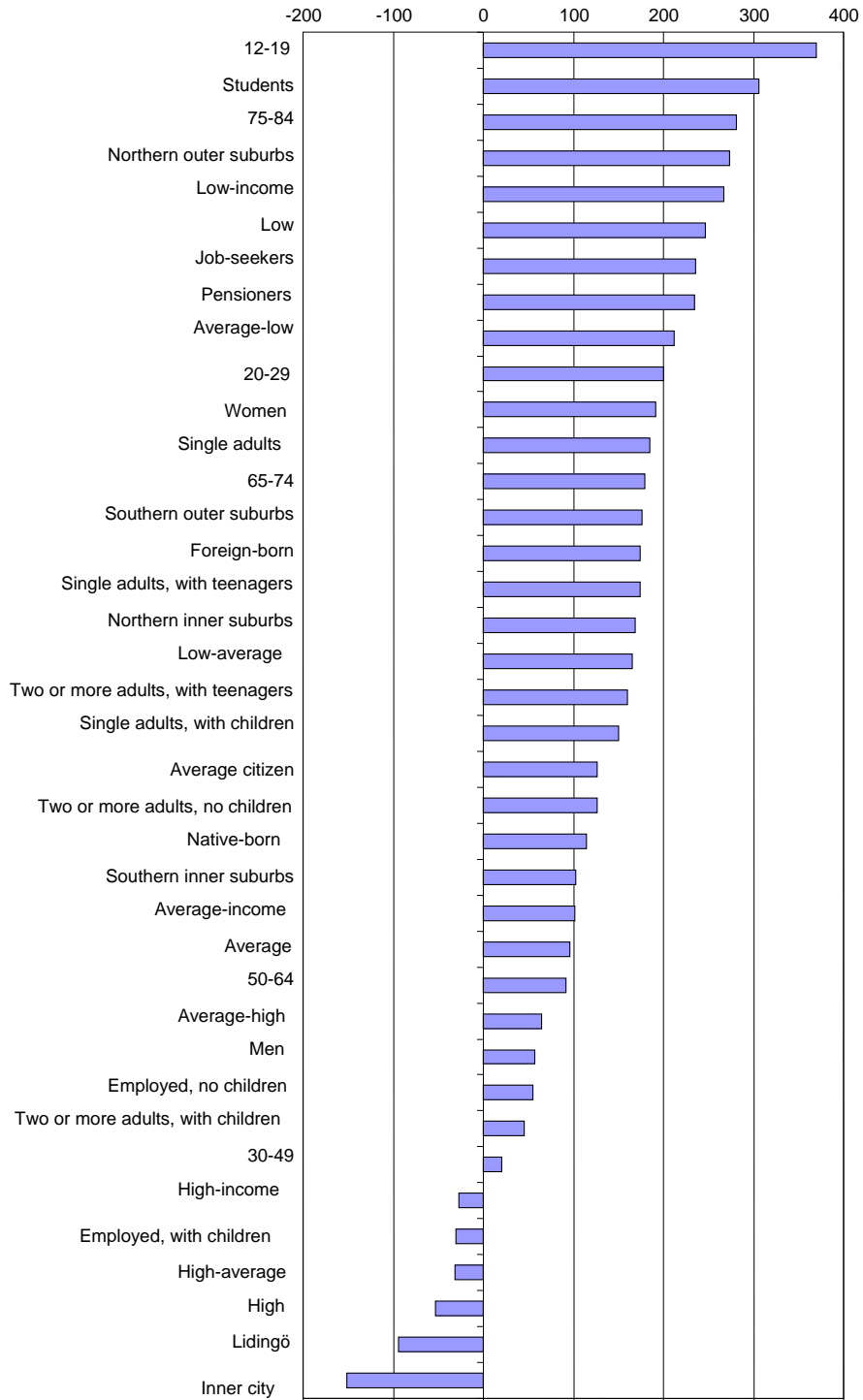


Figure 39: Net effects if revenues are divided equally among county residents (SEK per person and year).

3 CONCLUSIONS

The calculated total economic value of direct road-user effects – changed travel times, changed travel habits and the actual payment of congestion taxes – is negative. That applies to essentially all groups, on average. Citizens make no economic gains until they share in the benefits of congestion tax revenues (in one way or another). In this respect, congestion tax is like any other tax.

The estimation that travel time gains are worth less than the congestion tax paid is based on the assumed average travel time value of SEK 65/h. In reality, the value of people’s time varies widely – and not only from one individual to the next (according to factors including age and income): the value of individuals’ time may vary depending on errand, time of day and so on. As a result, the estimations of the “total road-user effect” of congestion tax should be regarded with some caution.

The main purpose of the study is however to investigate how the effects of congestion tax differ among different groups. Although there may thus be uncertainty as to how time saved should be valued, the main conclusions of the study as to the groups that would gain or lose (on average) in connection with various measures *relative to one another* can probably be regarded as relatively certain.

A few drivers pay the majority of congestion taxes

Analysis of the Swedish Road Administration’s data collected from charge zone entry points for a two-week period shows that congestion charges are very unevenly distributed. Of the congestion tax revenues generated by privately owned cars²⁰, 75% came (during this two-week period) from about 100,000 vehicles, which corresponds to about one fifth of the cars in Stockholm County²¹, or, if we assume that vehicle owners pay the entire cost, 6% of county residents. The differences over one year should be somewhat less than over a two-week period, but the conclusion that a small number of drivers pay a large percentage of congestion taxes still stands.

²⁰ About 60% of revenues are generated by privately owned cars.

²¹ While a certain percentage of revenues are surely generated by cars from outside Stockholm County, it makes no difference to the argument.

Substantial variation within groups

The figures above indicate that there is great variation as to how much congestion tax people pay. The study presents the average effects for different groups, but there is substantial variation *within* groups. Even within the groups that on average pay very little congestion tax, there are individuals who pay a lot of congestion tax. Likewise, even in the groups that pay a lot of congestion tax, there are many individuals who rarely pay congestion tax.

A large percentage of drivers pay congestion tax at least occasionally

Thus, although a relatively small group of drivers generate a large percentage of congestion tax revenues, one can also draw another conclusion: a large percentage of drivers in the county pay congestion tax at least occasionally. During the studied two-week period, 231,000 different privately owned cars paid congestion tax at least once, which would correspond to about half of all privately owned cars in Stockholm (although a minor percentage of the cars were driven in from outside the county). If one were to study a period of longer than two weeks²², the percentage of cars that pay congestion tax at least once in a while would increase further.

Affluent men in the inner city pay the most

Congestion taxes negatively affect

- the inner city and Lidingö more than other areas
- high-income individuals more than low-income individuals
- employed people more than others
- households with two adults with children more than other types of households
- men more than women

As a rule, the groups that pay the most congestion tax also make the greatest time gains. Residents of the inner city, who pay a lot of congestion tax but whose time gains are nonetheless small, are one exception.²³ Residents of

²² It is unfortunately impossible to study longer periods as the Swedish Road Administration is not allowed to store data for more than two weeks.

²³ But inner city residents will probably benefit the most from environmental gains, which were not considered in this analysis.

the northern outer suburbs are another exception, as their time gains are relatively large despite rather limited average tax payments.

Once again: the average affects referred to here should be interpreted with caution. The variation within each group may be very large.

Equity effects are determined by how revenues are used

The total equity effects of the congestion tax system depend in part on how direct road-user effects (time gains and changes in travel costs) affect different groups and in part on how citizens benefit from the revenues. The analyses illustrate that how revenues are used determines the total equity effects: the differences in distribution profiles for equity effects between the different revenue uses are often greater than the difference in the distribution profile for the actual congestion tax.

Young and low-income individuals gain if fares are reduced

If the revenues are used for public transport – illustrated in our calculation as reduced fares – those who gain most from the measure as a whole are young people, low-income individuals, single people, women and residents of the inner suburbs. These groups pay relatively little congestion tax (on average) and use public transport more often than other groups.

The main groups that would, on average, be adversely affected by the measure as a whole are employed people with children, high-income individuals and residents of the inner city and Lidingö. These groups pay relatively high congestion tax and use public transport less often than other groups.

Lower income tax benefits high-income individuals and suburban residents

If the revenues are used to lower the income tax rate – or if we imagine that the revenues are used to finance something that would otherwise be tax-financed – high-income individuals, senior citizens, single parents and residents of the northern suburbs will make a net gain. Residents of the inner city and Lidingö will sustain a net loss if such a measure is taken.

4 METHOD AND MEASUREMENT DATA

This study was based on two surveys of travel habits in which 24,002 residents of Stockholm County answered questions about their journeys on one day in autumn 2004 and one day in spring 2006.

The two surveys were conducted 18 months apart, meaning the survey panel had aged. As a result, some of the groups compared are not really the same as they were. Even though the groups were made up of the same individuals, the average age increased by 18 months. The number of pensioners, for instance, increased by 10%. This type of problem complicates the analysis, but does not appreciably impair the study results.

4.1 Estimation of road-user effects

Changes in travel time

A model calculation performed in EMME/2 makes it possible to estimate travel time between two places in the county at different times of the day and using different modes of transport. The calculation was performed for two scenarios: with congestion tax and without congestion tax. This made it possible to estimate the change in travel time for each route.

The travel habits survey provides information about the points between which all individuals travelled, which makes it possible to calculate how much travel time each person saved as a result of the implementation of congestion tax.

Time value

The travel time gain was then expressed in monetary terms to make it comparable with other effects. The conversion was done by multiplying the time gain by the amount the traveller is willing to pay to reduce his or her travel time, which is referred to as the *time value*.

The time value is of course different for different people. It is also different in different situations. High-income individuals tend for example to be willing to pay more than low-income individuals. People generally assign a

higher value to their time when they are on the way to work than during their leisure hours. Figure 40 shows how another study found that time value was distributed for men and women and different errands. Note that the distribution differs according to sex (which in turn is often due to income) and errand, and that there is a *distribution* of time values. In this study, however, *only one* time value was used.

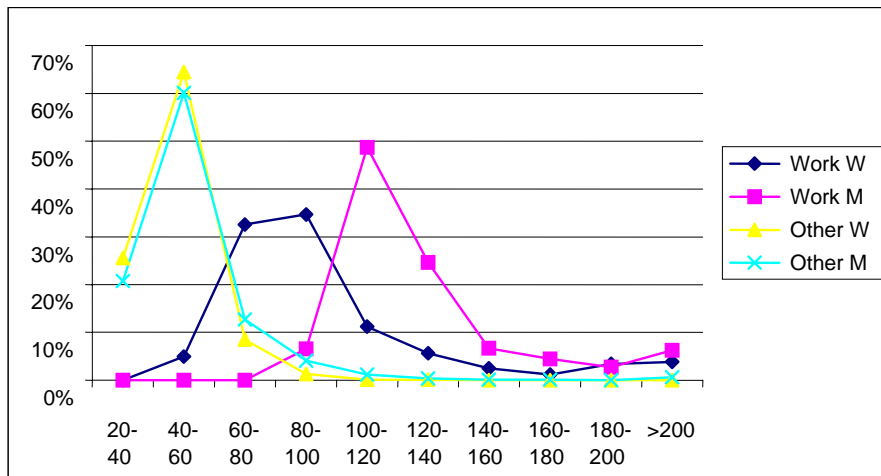


Figure 40. Distribution of time values by sex and errand.

Effects on the predictability of travel time

The value of more predictable travel times was not estimated separately in this study. Instead, a standardised calculation was performed by assuming that this value is proportional to the value of the reduction in travel time. The previous economic study of the Stockholm Trial estimated the value of more reliable travel times at SEK 78 million per year or 14.9 % of direct travel time gains.

In this analysis, the welfare gain of more predictable travel times was combined with the direct time gain. As a result, 13% of the reported travel time gains represent the value of more reliable travel times.

Changed travel habits

Adaptation costs are the welfare losses individuals sustain when they refrain from a journey because it has become too expensive. It can be shown that

this welfare loss is approximately equal to half the cost increase, as long as the cost increase is not excessive (the “rule-of-a-half”).²⁴

Adaptation costs overestimated

Stockholm residents normally travel more in September when the first survey was performed than in March when the follow-up survey was performed. The sharp reduction in the number of journeys that was measured is thus not due only to the implementation of congestion tax.

This indicates that the calculated adaptation cost is seriously overestimated, perhaps by nearly double. The adaptation cost is however relatively minor compared to congestion tax payments and travel time gains, so this has little influence on the net effect.

4.2 Calculation of the effects of revenue return

Analysis of the travel habits survey reveals that congestion taxes generate revenues from private individuals of a half billion kronor per year. Other studies have estimated that personal travel represents 64% of total revenues. This indicates that total congestion tax revenues should be SEK 784 million per year.²⁵

Of the SEK 784 million, 220 million would be used to run the congestion tax system. The remaining 564 million can be used in some other way.

How that money benefits the various groups obviously has an impact on their net effects. The choice of return method is of course wide open, but three alternatives were studied in the analysis:

- Equal return
- Reduction of public transport fares
- Reduction of county income tax

²⁴The “cost increase” refers to two effects. First, some journeys are subject to congestion tax, which makes them more expensive. Second, some journeys take less time (and some take more time), resulting in a cost reduction (or cost increase).

²⁵More direct measurements have shown that total revenues would be SEK 763 million per year, but the calculations in this study were based on the results of the travel habits survey.

Calculation of returns in the equal return scenario

In this part of the analysis, we calculated the amount each individual would receive if revenues were divided equally among all residents of the county. The calculation is simple: as there are 1.57 million residents (ages 12-84, as covered by the travel habits survey) and SEK 564 million to divide, each individual would receive SEK 359 per year.

Calculation of returns if public transport fares are reduced

Fares can be reduced in a variety of ways: discounts can be instituted, the price of a monthly pass reduced, etc. This analysis assumes that the fare for every journey by public transport is reduced by an equal amount.

The 2006 travel habits survey showed that county residents make 1.13 journeys by public transport per day, which adds up to 413 journeys by public transport per year. If SL was allocated SEK 564 to subsidise fares, it would suffice to reduce the fare by SEK 1.37 per journey, presuming unchanged volume. To calculate how much this fare reduction would benefit any particular group, the number of journeys by public transport for the group was thus multiplied by 1.37.

Calculation of returns if income tax is reduced

Tax relief can be designed in several different ways. This analysis uses the reduced tax rate alternative. This kind of reduction benefits individuals in proportion to their income.

Unfortunately, the travel habits survey did not provide information about the personal incomes of respondents. Instead, respondents indicated one of eight income brackets for their household. For that reason, household income was presumed to be equally divided among all adult members, which permitted individual incomes to be estimated.

The travel habits survey estimated total income for the county at SEK 355 billion per year.

If tax revenues were reduced by a total of SEK 564 million, every citizen would keep 1.59 more per SEK 1,000 in income. Individual income was

Equity Effects of the Stockholm Trial

multiplied by 1.59 and divided by 1,000 to calculate the benefit of the tax reduction to each group.

APPENDIX 1: EFFECTS FOR THE AVERAGE COUNTY RESIDENT

Travel habits before the trial

Of all personal travel in the county (September 2004), 41% was by car, 28% by public transport and the remaining 31% by foot, bicycle or another mode of transport.

The average trip length by car was 13 km and the average trip length by public transport was 14 km.

An average resident made 36 journeys per year²⁶ that would have been subject to congestion tax during the trial: 30 to/from the inner city and 6 through the inner city (between the northern and southern parts of the county outside the inner city).

Passages of privately owned cars in or out of the charge zone declined by 30%

If travel in September 2004 (before the trial) is compared to travel in March 2006 (during the trial) the number of charged passages in and out of the inner city declined by 30%. Some of this decline is probably attributable to seasonal variation: the number of passages of privately owned cars is usually about 5% lower in March than in September.²⁷ This would mean that congestion charges reduced the number of passages by privately owned cars by about 25%. According to traffic volume measurements, the number of passages in or out of the charge zone declined by 20-25%. The figures are not directly comparable, since traffic volume measurements also include commercial and business traffic, but they seem to agree with each other.

²⁶ It was assumed that travel during the 2004 travel habits survey could be adjusted upwards by 240 weekdays/year to arrive at the annual travel figure.

²⁷ This estimate is relatively uncertain: it is based on traffic volume measurements at a number of points during 2005 and the assumption that commercial traffic and business travel vary considerably less than personal travel when comparing volumes in September and March. The total number of vehicle passengers across the inner city charge zone was about 3.5% higher in September than in March; slightly more than one third of vehicle passengers were commercial and business travellers.

The number of charged journeys to/from the inner city declined by 17%

Looking only at car journeys to/from the inner city during congestion charge hours – thus excluding “through journeys” – these journeys declined by 17% (part of which is probably attributable to seasonal variation). The remainder of the decline in passages in or out of the charge zone is thus attributable to “through traffic” being moved to other roads (primarily the Essingeleden bypass), modes of transport or destinations.

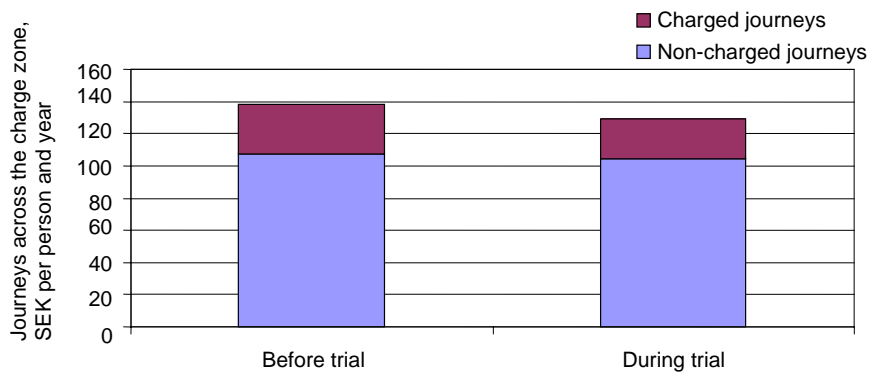


Figure 41. Journeys per person and year to and from the inner city, weekdays. (“Before trial” refers to September 2004. “During trial” refers to March 2006. Note that the number of journeys is normally higher in September than in March.)

Direct road-user effects generate a loss of SEK 127 per year

Figure 42 shows the effects for the average county resident. The value of travel time gains is less than the total of congestion tax and adaptation costs, meaning the total *road-user effect* is negative. By comparison, congestion tax increases the total cost for (personal) travel by car by 8%.

On the other hand, congestion tax generates revenues that can be used to reduce income tax, improve public transport or for some other purpose. When the effects of this revenue return are included in the calculations, one arrives at the *net effect*, which is positive for the average citizen. These effects yield an average gain to private individuals of SEK 127 per year.

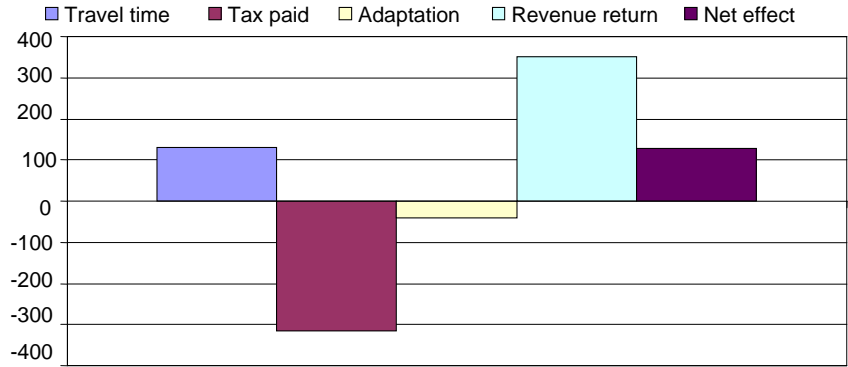


Figure 42: Total annual effects of congestion tax for the average county resident.

As mentioned in the introduction, this analysis does not factor in environmental and road safety effects, whose value amounts to approximately SEK 134 per person and year, mainly because there is no basis for calculating how these gains are distributed among citizens (which is the focus of this study).

APPENDIX 2: EFFECTS FOR VARIOUS INCOME CATEGORIES

This appendix reports the equity effects of the Stockholm Trial for various income categories. Five categories were defined, each representing about one fifth of the population. The division took into account only the average income per adult member of household. The number of children and teenagers in the home was not considered. This means for instance that a family with three children and annual income of SEK 300,000 ends up in the same income category as an employed couple with the same income and no children in the home.

A description of household economic situations that is more interesting in many respects instead considers household *discretionary income*. Such an analysis is presented on page 3.

Low-income individuals use public transport more often

Travel habits differ among income categories, especially with regard to the number of passages in or out of the charge zone. High-income individuals travel to and from the inner city more often. The sharpest difference is in the number of charged journeys.

Low-income individuals travel by public transport more often and high-income individuals travel by car more often.

	Average trip length, km		Percentages by mode of transport		Passages in or out of the charge zone per year
	Car	Public transport	Car	Public transport	
Before trial (2004)					
Low income	12	13	46%	54%	19
Low-average	14	15	66%	34%	40
Average income	14	14	60%	40%	46
High-average	13	14	69%	31%	65
High income	14	12	63%	37%	61

Average income individuals change their travel habits the most

Average income and low-average income individuals reduce the number of charged journeys to and from the inner city by 28% and high-average income individuals by 14%.

Both high-income and low-income individuals reduce the number of charged journeys by 7%.

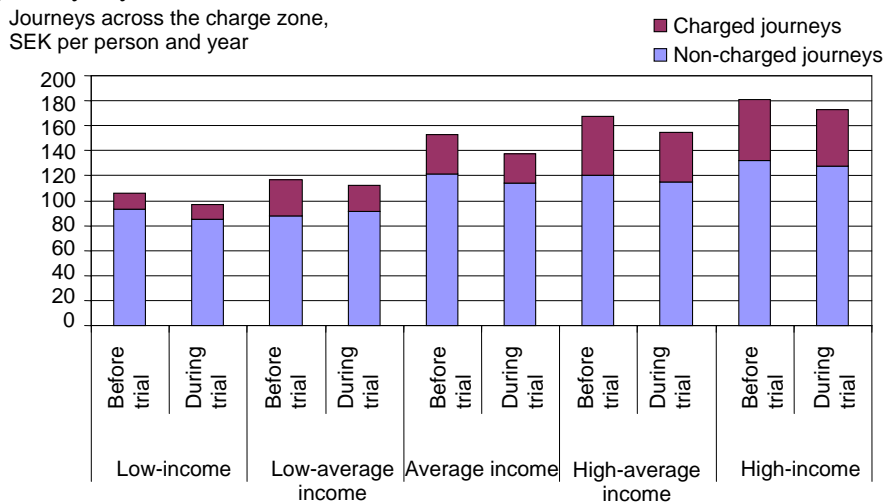


Figure 43: Journeys to and from the inner city, per person and year.

Congestion tax increases the cost of travel by car by 6% for drivers whose income is below average, 9% for average-income individuals and 11% for high-income and high average-income individuals.

High-income individuals pay SEK 590 per year in congestion tax

The higher a household's income, the more they tend to pay in congestion tax. This may conceivably depend on two factors: they often have to travel farther to work and they live closer to the city centre and nearer the charge zone.

The differences are substantial. On average, high-income individuals pay SEK 590 per year, high average-income individuals SEK 490 per year, low

average-income individuals SEK 250 and low-income individuals SEK 150 per year.

The value of the travel time gain is 38-48% of the congestion tax paid by the group. The travel time gains are SEK 230 per year for the high-income category, SEK 120 for the average-income category and SEK 73 for the low-income category.

High average-income individuals have the highest adaptation cost at SEK 83, followed by average-income individuals at SEK 71 and low average-income individuals at SEK 48. The adaptation cost is SEK 17 for high-income individuals and SEK 6 for low-income individuals.

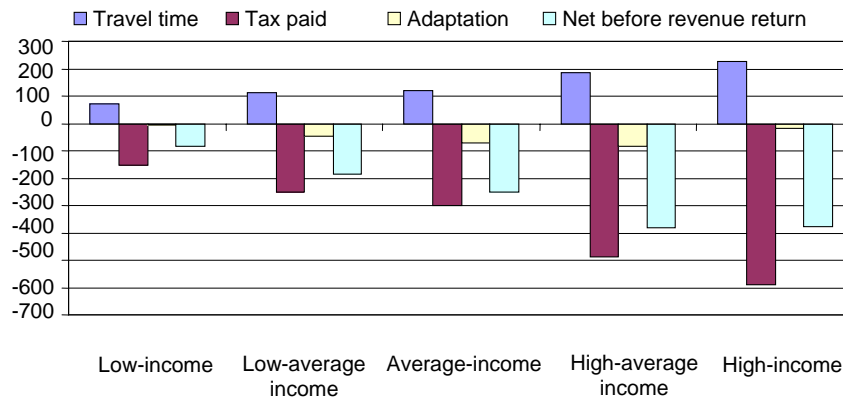


Figure 44: Co-weighted road-user effects, SEK per person and year.

Lower income tax benefits the high-income category

High-income individuals gain the most and low-income individuals lose if the income tax rate is reduced. Lower public transport fares yield very equitable effects among the groups, since they use public transport about equally often.

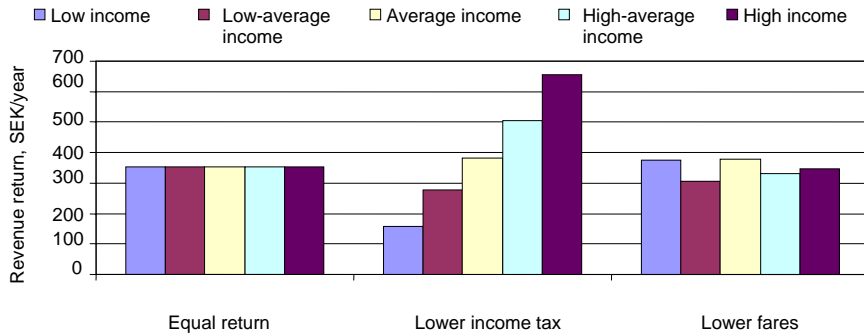


Figure 45: Return of congestion tax revenues.

Equity effects determined by return model

As in the analysis of discretionary income, the equity effects are determined by how congestion tax revenues are used.

Lower income tax benefits high-income individuals the most. Lower public transport fares and equal returns benefit low-income individuals.

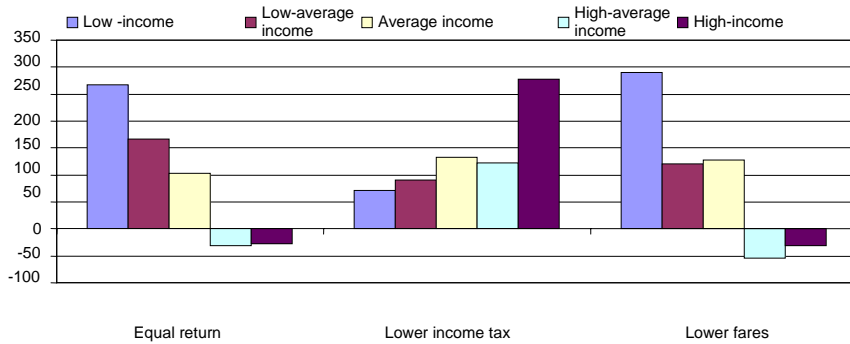


Figure 46: Total welfare effects by income category, SEK per person and year.

APPENDIX 3: DISTRIBUTION OF ERRANDS FOR CHARGED JOURNEYS TO/FROM THE INNER CITY

	Work	Recreation/visit	Shopping/service	Other
Low	47%	16%	24%	13%
Low-average	44%	20%	22%	14%
Average	44%	17%	25%	14%
High-average	47%	18%	21%	13%
High	58%	18%	18%	6%
Northern outer suburbs	49%	23%	16%	12%
Northern inner suburbs	51%	20%	16%	13%
Inner city	48%	17%	26%	9%
Lidingö	43%	26%	15%	16%
Southern inner suburbs	49%	23%	16%	12%
Southern outer suburbs	46%	28%	13%	13%
Men	53%	21%	16%	10%
Women	41%	24%	21%	14%
Total	48%	22%	18%	12%

The table above shows travellers' errands when they make their charged journeys to/from the inner city. About half the journeys are work-related for all groups, about one fifth are for recreation/visits or shopping/service and 10-15% are for other reasons. High-income individuals differ in that a higher percentage of their charged journeys are work-related.