Congestion charges

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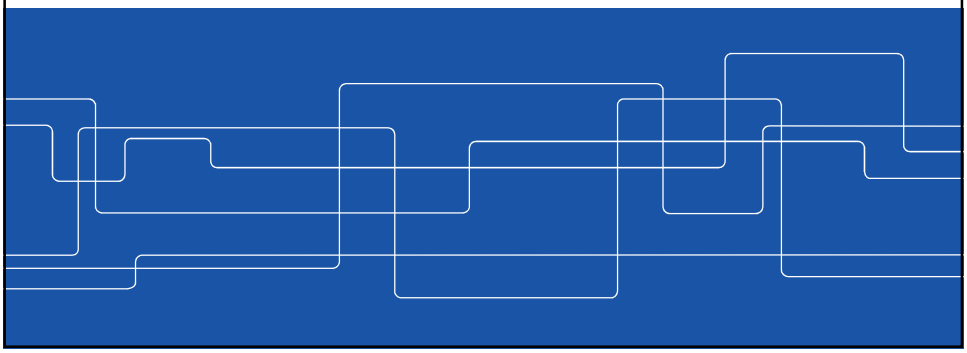
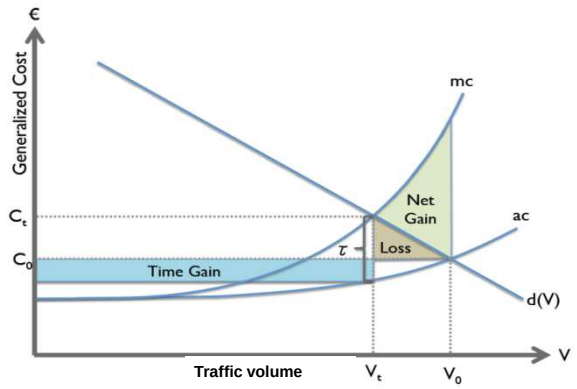


Today's agenda

- Congestion pricing – why all the fuss?
- Does it really work?
- Designing – can we trust the forecasts?
- What makes people love or hate charges?
- … and why do they change their mind?
- Additional complications – a sample
  - Equity
  - Costs and procurement
  - Distortive taxes and external benefits
- The political dangers – the cautionary tale of Gothenburg

A little intuitive theory



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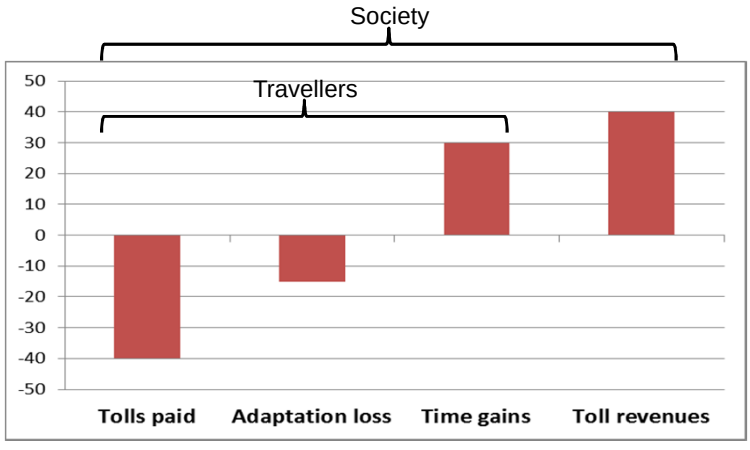
Costs & benefits of congestion charges



Tolls paid = revenues
Adaptation loss < Time gains

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Notes

- Heterogeneous values of time increases value of time gains
- Accounting for time dynamics reduces adaptation loss
- Reduced spillback congestion increases time gains

- Time gains only if there's congestion
- Designing in theory is easy – practice is difficult
- Systems are expensive
- Increased transit crowding may reduce total benefits

- A lot of money changes hands

Case studies: Stockholm and Gothenburg

Some cases

Notable implementations:
- Singapore (1975/1997)
- Trondheim (1990s)
- London (2003)
- **Stockholm (2006)**
- Valletta (2007)
- Milano (2008)
- **Gothenburg (2013)**
- US HOT lanes

Notable failures:
- Edinburgh
- New York
- Manchester
- Copenhagen
- Netherlands

Thinking or planning:
- Beijing (+ several)
- San Francisco
- Budapest
- Moscow
- …

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Stockholm

- Introduced 2006 as a trial, followed by referendum
- Purpose: reduce congestion, improve urban environment
- Hostile opinion turned to narrow majority in referendum, gradually winning large public support
- Later: revenues earmarked for infrastructure

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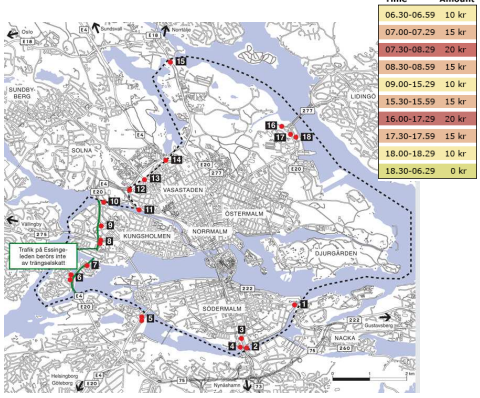
The Stockholm charges



- 10-20 SEK (1-2 €) per cordon crossing, depending on time of day
- No charge evenings or weekends
- Alternative-fuel cars exempt
- Max 60 SEK/day

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First transponders, now replaced with ANPR

- Free-flow identification
- Automatic invoice each month
- Transponder handling expensive
- Automatic number plate recognition effective

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Gothenburg

- Inspired by Stockholm
- Purpose:
  - Revenues for unlocking and leveraging national funding
  - Congestion reduction (not a lot of congestion…)
- Introduced January 2013
- Hostile opinion became (a bit) more positive
- Revenues earmarked for infrastructure

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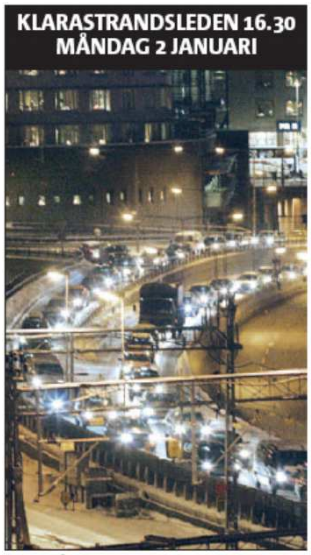
Does it really work?



LUGNT PÅ KLARASTRANDSLEDEN. Lugnt på Essing

Eliasson, J. (2008) Lessons from the Stockholm congestion charging trial. *Transport Policy* 15(6), p. 395-404.

Eliasson, J. (2009) Expected and unexpected in the Stockholm Trial. In Gullberg and Isaksson (ed.): Congestion taxes in city traffic. Lessons learnt from the Stockholm Trial. Nordic Academic Press.

Börjesson, M., Eliasson, J., Hugosson, M. B., & Brundell-Freij, K. (2012). The Stockholm congestion charges — 5 years on. Effects, acceptability and lessons learnt. Transport Policy, 20(0), 1-12.

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Yes, it actually works.

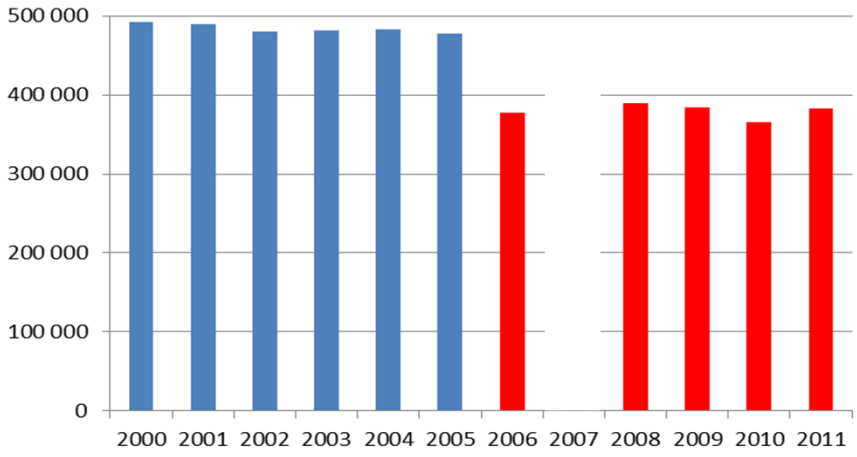
LUGNT PÅ KLARASTRANDSLEDEN. Lugnt på Essingeleden. Lugnt i kollektivtrafiken. Ingen visste i går med säkerhet vart stockholmarna tagit vägen.

Stockholmare, vart tog ni vägen?

”Stockholmers, where did you go?

”Every fourth car disappeared”

Persistent decrease (≈20% across cordon)



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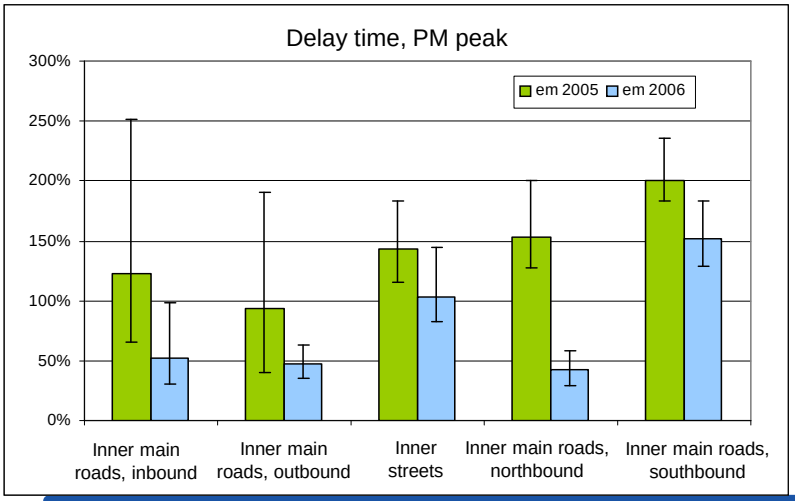
30-50% less time in queues, and less variability

April 2005/2006



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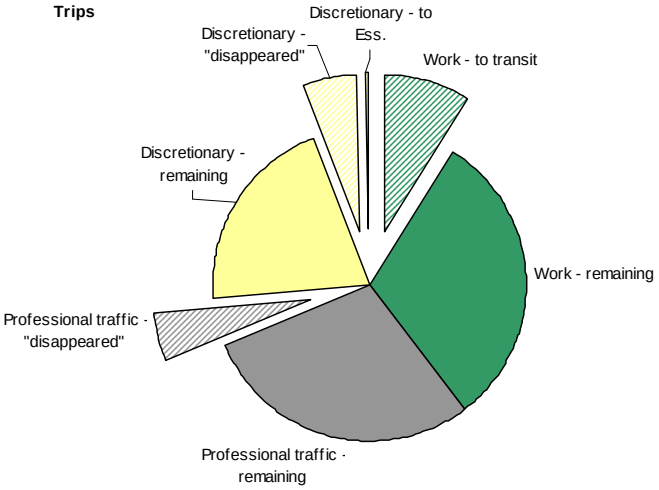
What happened to disappearing traffic?



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People can't predict or remember their own behaviour or opinions

Predicted and retrospective behavioural change:

- Respondents' own predicted change: ~5-10% less traffic
- Actual measured change: ~30% less traffic
- Respondents' own reported change: ~5-10% less traffic

Attitude change: "I became more positive during the trial"

- March 2006 (during trial): 29%
- Nov 2007 (a year after trial): 13%

Eliasson, J. (2014) The role of attitude structures, direct experience and framing for successful congestion pricing. *Transportation Research A* 67, 81-95.

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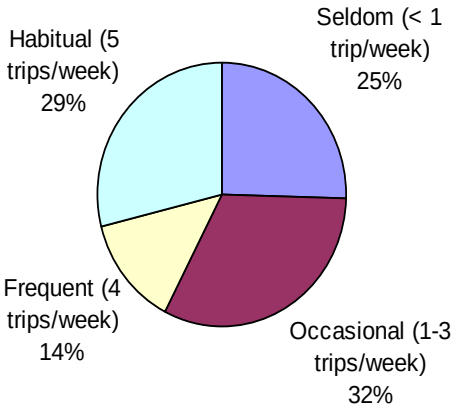
People change from day to day

Private cars across cordon



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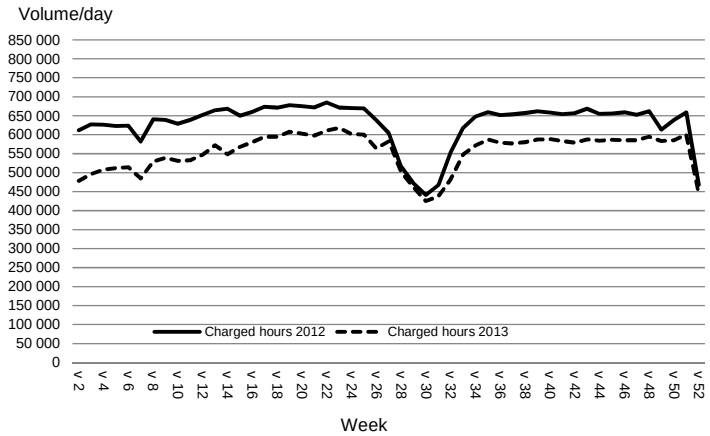
Gothenburg: ~12% less traffic across cordon



Börjesson, M., Kristoffersson, I. (2014) The Gothenburg congestion charge: Effects, design and politics. CTS Working paper 2014:…

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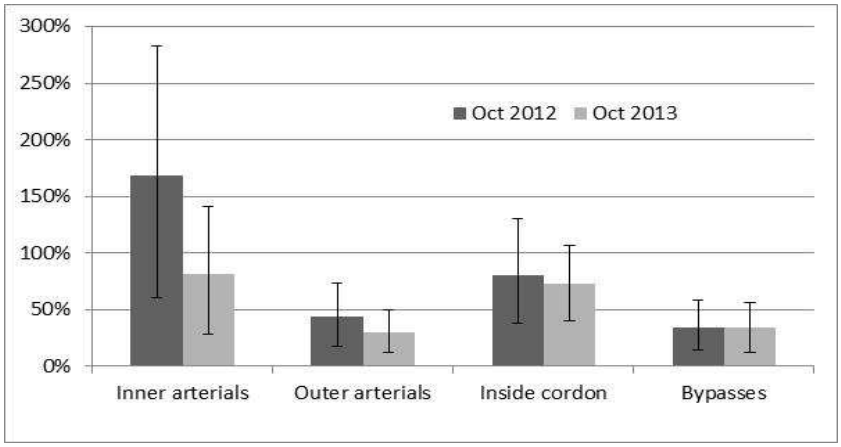
Gothenburg:
Less congestion, hence less travel time savings



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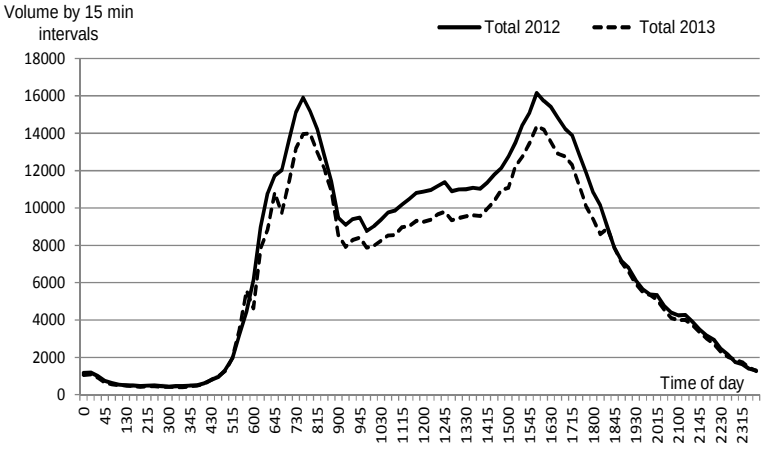
Departure times little affected (*Gbg*)



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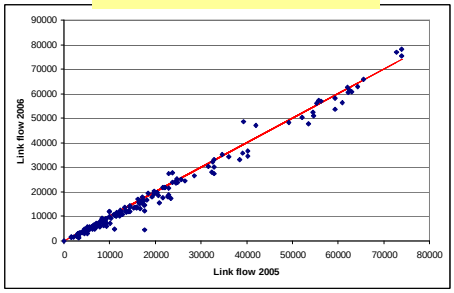
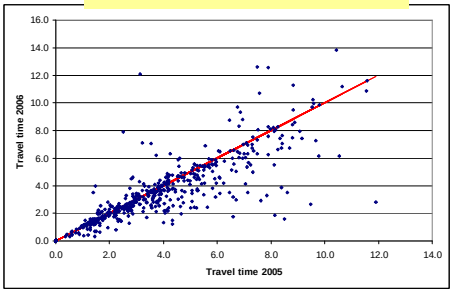
Measuring social benefits in practice… (*Sth*)

Link flows 2005/2006



Link travel times 2005/2006



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Cost-benefit analysis (*Sth*)

M€ per year	
Time gains	56
Reduced emissions	10
Increased traffic safety	14
Operational cost	-24
Increased public transit revenues	20
Necessary increase in public transport capacity	-7
Decreased revenues from fuel taxes	-6
Marginal cost of public funds, shadow price of public funds	13
Total socioeconomic surplus, excl. investment costs	**76**
Annualised investment cost (over 20 years)	-16

Toll revenues: 80 M€

Eliasson, J. (2009) A cost-benefit analysis of the Stockholm congestion charging system. *Transportation Research A* 43(4), pp. 468-480.

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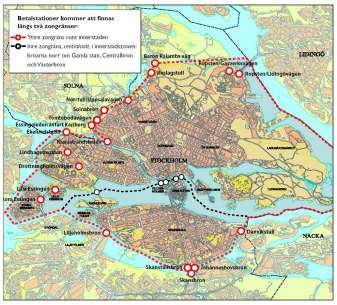
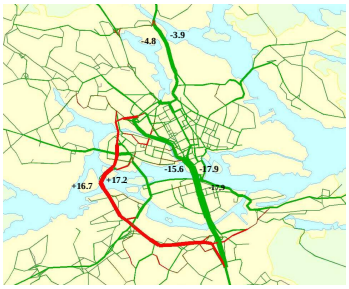
Designing and forecasting





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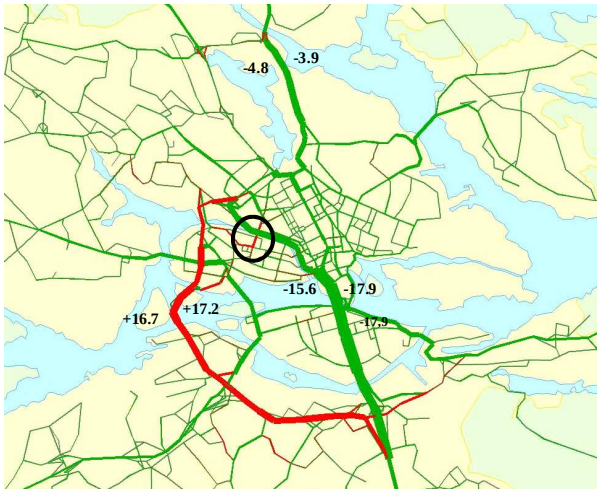
Designing charges is difficult



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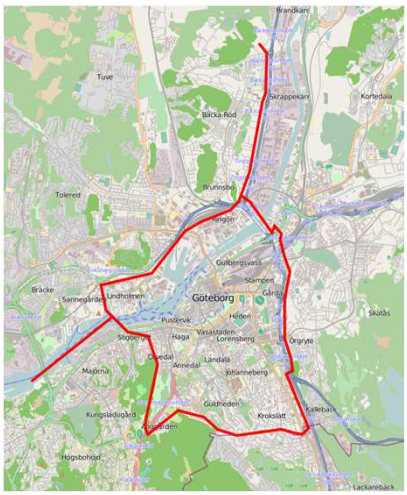
… and even more difficult in Gothenburg



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Forecast compared to outcome (Stockholm)

	Forecast	Actual
Traffic across cordon	-16%	-20%
Rush hours	***-17%***	***-18%***
Public transport	+6%	+5%
Travel time gains:		
- links across cordon	282	294
- links within cordon	201	266
- links outside cordon	-87	460

Eliasson, J., Börjesson, M., van Amelsfort, D., Brundell-Freij, K., Engelson, L. (2013) Accuracy of congestion pricing forecasts. *Transportation Research A* 52, 34-46.

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Forecast compared to outcome (Gothenburg)

October 2012 to October 2013	Observed	Forecast
AM Peak	-13%	-18%
PM Peak	-12%	-18%
Mid-day	-12%	-13%
Charged hours	-12%	-15%
Uncharged hours	-2%	0%

Börjesson, M., Kristoffersson, I. (2014) The Gothenburg congestion charge: Effects, design and politics. CTS Working paper 2014:...

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Were forecasts accurate enough?

- Effects on travel demand fairly OK
  - Aggregate flow forecasts OK
  - Effect on leisure trips somewhat underestimated
- Increased transit demand OK
- Data on exempted traffic (surprisingly) inaccurate
  - Mainly affects revenues
- Effects on travel times vastly underestimated

- If modellers are aware of model limitatations – then conclusions are trustworthy, and useful for system design
  - No major design changes if we had had access to ”perfect forecast”

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Determinants of public opinion

Political vs. public acceptability

- *Political* acceptability is a question of power –
  - revenues, scheme design, infrastructure negotiations…
- *Public* acceptability is neither necessary nor sufficient for political acceptability!
- … but without it, implementation is more difficult
- So, good to understand what affects public acceptability

Factors affecting public acceptability

- System effects [*engineers, traditional economists*]
  - Does it work?
  - Are there alternative measures to reduce congestion?
- Self-interest – winning and losing [*political economists*]
- Attitudes to… [*psychologists, sociologists*]
  - Pricing as an allocation mechanism
  - Government, taxes and public interventions in general
  - Environmental problems

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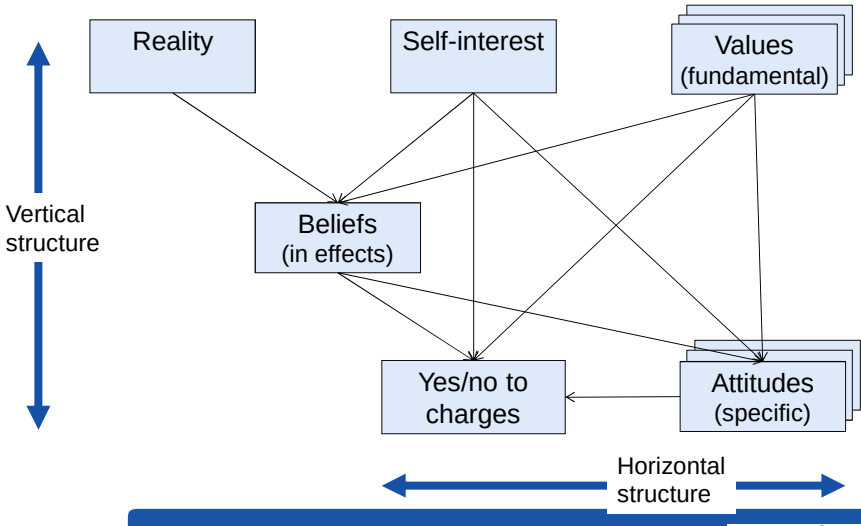
Self-interest, beliefs, values, attitudes



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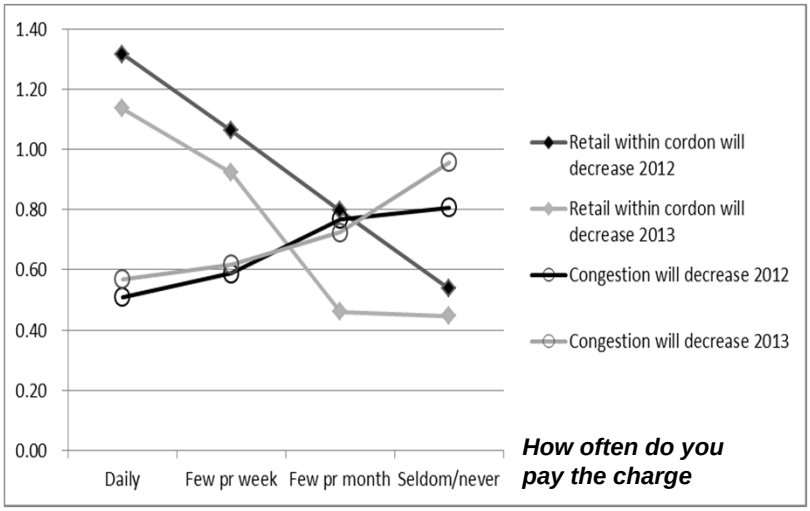
Self-interest influence beliefs in effects



How often do you pay the charge

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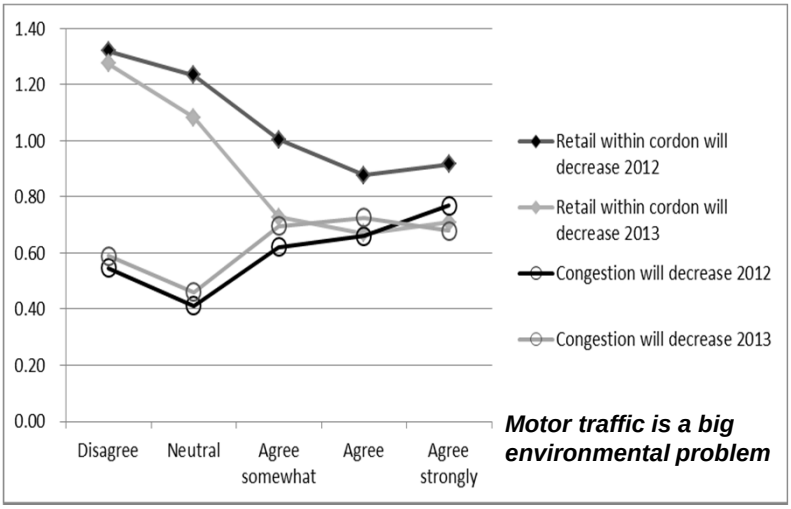
Attitudes influence beliefs in effects



Motor traffic is a big environmental problem

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The ExpAcc comparative study

- Identical surveys in Stockholm, Lyon, Helsinki in spring 2011
  - Gothenburg Dec 2012 and Dec 2013
- Questions about travel behaviour, socioeconomics, and attitudes to transport pricing, fairness, and congestion pricing in particular

- Stockholm: congestion pricing since 2006, large public support
- Helsinki: discussed congestion pricing 2010-2011, abolished plans recently, some resistance against idea
- Lyon: tried urban road pricing in 2003, abolished the system after public resistance, fierce resistance against the idea

Hamilton, C., J. Eliasson, K. Brundell-Freij, C. Raux, S. Souche, K. Kiiskilää, J. Tervonen (2014) Determinants of congestion pricing acceptability. CTS Working paper.

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Self-interest affects support for CC

Respondents support congestion pricing less…

- … the more they travel by car
- … the less satisfied they are with public transport
- … the more cars they own
- … the more they anticipate to pay

- … and the higher value of time they have!
  - *Not* an income effect!

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Higher value of time => stronger support

”A bridge you use for your morning car commute has broken down, and you have to choose between a ferry or a 20 minutes detour. How much would you pay (maximum) for the ferry, to avoid the detour?”

	All		Stockholm		Helsinki		Lyon	
	Value	*t-stat*	Value	*t-stat*	Value	*t-stat*	Value	*t-stat*
1 €	0.34	*4.4*	0.34	*2.3*	0.44	*2.8*	0.28	*2.3*
2 €	0.85	*10.7*	0.75	*5.2*	1.14	*7.3*	0.75	*5.9*
3 €	1.11	*10.3*	1.09	*6.2*	1.21	*5.7*	1.1	*5.6*
4 €	1.19	*6.7*	1.01	*4.1*	1.41	*3.7*	1.4	*3.8*
5 €	1.35	*8.2*	1.87	*6.5*	1.21	*4.3*	1.1	*3.5*
More	1.43	*5.0*	1.37	*4.0*	1.68	*3.0*	1.2	*1.6*

(controlled for income and driving frequency)

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Attitude to allocation mechanisms

”The ferry gets very full every morning. How should the ferry capacity be allocated ?

I think it’s fair to use…”

- **Pricing** – set a fare to make supply meet demand
- **Queuing** – first come, first served (excess demand take detour)
- **Judgment of ”need”** – transport administration allocates tickets based on their judgment of travellers’ ”need”
- **Lottery**

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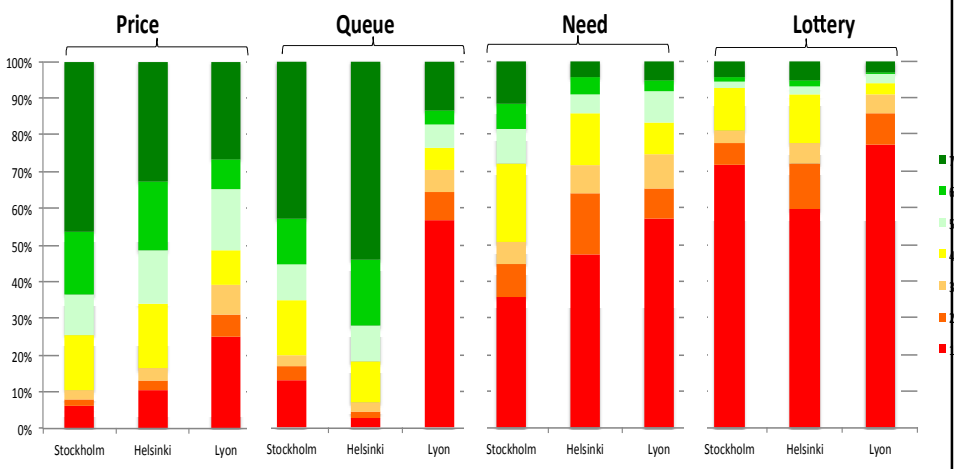
Perceived fairness of allocation mechanisms



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Support for CC increases if a) pricing is ”fair” allocation mechanism b) trust adm:s judgment

	All			Stockholm			Helsinki			Lyon		
	Value	Std. Error	t value	Value	Std. Error	t value	Value	Std. Error	t value	Value	Std. Error	t value
City (compared to Stockholm)												
Helsinki	-1.13576	0.07353	-15.4464									
Lyon	-1.12831	0.07743	-14.5728									
Price (compared to Not Fair)												
No opinion	0.52022	0.09773	5.3232	0.19751	0.1765	1.1191	0.2374	0.1948	1.2187	0.89011	0.167	5.3286
Fair	0.96049	0.07597	12.6429	0.59315	0.1511	3.9256	0.8305	0.1637	5.0729	1.11826	0.1076	10.3929
Queue (compared to Not Fair)												
No opinion	0.05687	0.09875	0.5759	-0.10461	0.1479	-0.7072	-0.4709	0.2615	-1.8008	0.40343	0.177	2.2787
Fair	-0.02302	0.07451	-0.3089	-0.22342	0.1143	-1.9542	-0.339	0.2146	-1.5796	0.17774	0.1201	1.4798
Need (compared to Not Fair)												
No opinion	0.24641	0.07988	3.0849	0.1925	0.114	1.6883	0.1164	0.1562	0.7452	0.4436	0.1668	2.66
Fair	0.57917	0.07523	7.6982	0.3955	0.1108	3.5691	0.5619	0.164	3.4263	0.78578	0.134	5.8625
Lottery (compared to Not Fair)												
No opinion	0.01576	0.08787	0.1793	-0.06596	0.122	-0.5408	0.3417	0.1555	2.198	-0.17968	0.2314	-0.7766
Fair	0.23269	0.1113	2.0906	-0.01865	0.1805	-0.1033	0.6827	0.1978	3.4513	-0.07307	0.2057	-0.3552

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Summary – determinants of support

Factors that increase support:

- Self-interest – ”winner”
- Environmental concerns
- Trust in government, positive to public interventions
- Pricing viewed as ”fair” allocation mechanism

- *Not* whether congestion is seen as great problem
  - Increases suppport for ”increase road capacity” though!
- *Not* equity concerns

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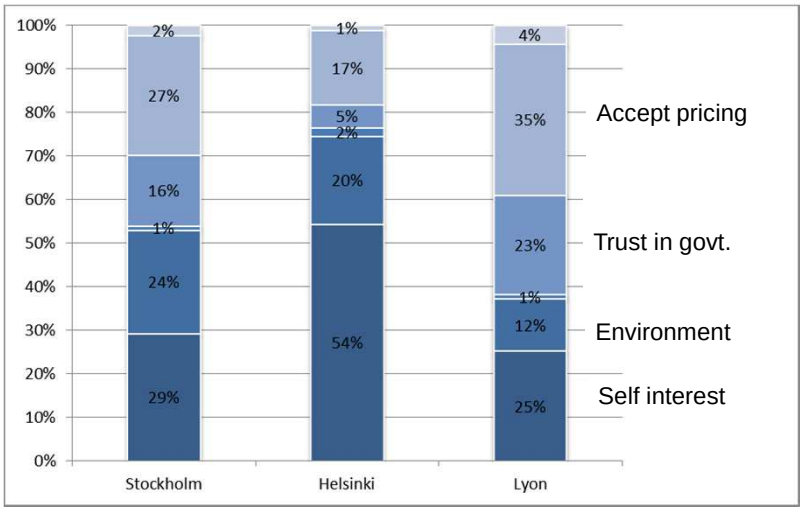
Relative sizes of determinants



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Achieving acceptability

- Create many winners, few losers
  - Smart scheme design => large congestion relief
  - Good and many alternatives => easy to avoid (*not just PT!*)
  - Earmark revenues (self-interest + reduce ”black hole” concerns)
- Build ”trust for the government”
  - Transparent revenue use, system costs, process for deciding charge levels
- Pricing should be viewed as a ”natural” mechanism
  - Scarce resources have to be allocated somehow, right?
  - Not just a ”tax” – an allocation mechanism
  - Frame it like a ”fare” or a ”user pays” charge ?
- Play the environment card
  - Many burn for the environment – few burn for ”efficient use of road space”

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Attitudes change after introduction

”Charges heading for the ditch”

”Bypass threatened by chaos”

”Charging chaos continues”

”Stockholm loves the charges”

”Charges a success”

”Thumbs up for the charges”

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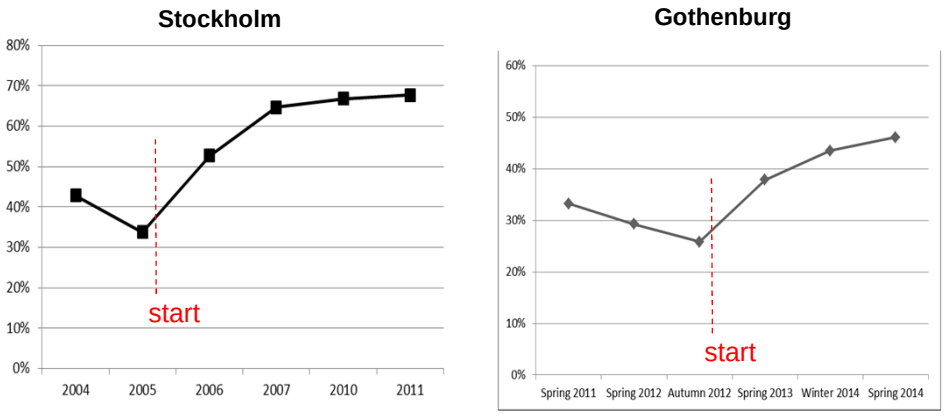
The valley of political death



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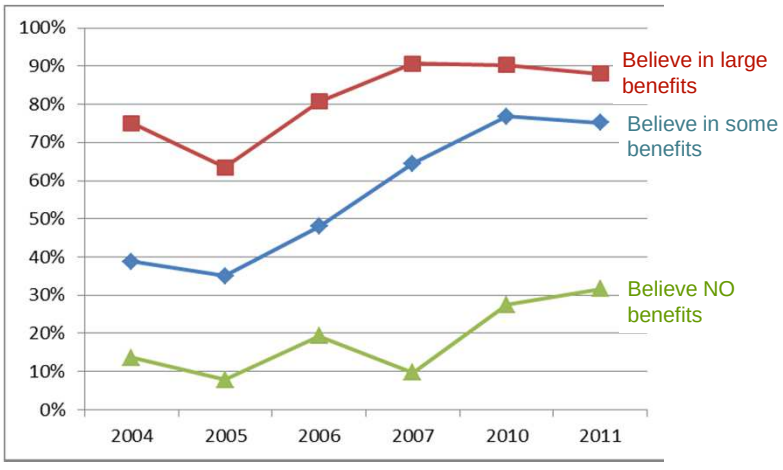
Support for CC – beliefs in benefits



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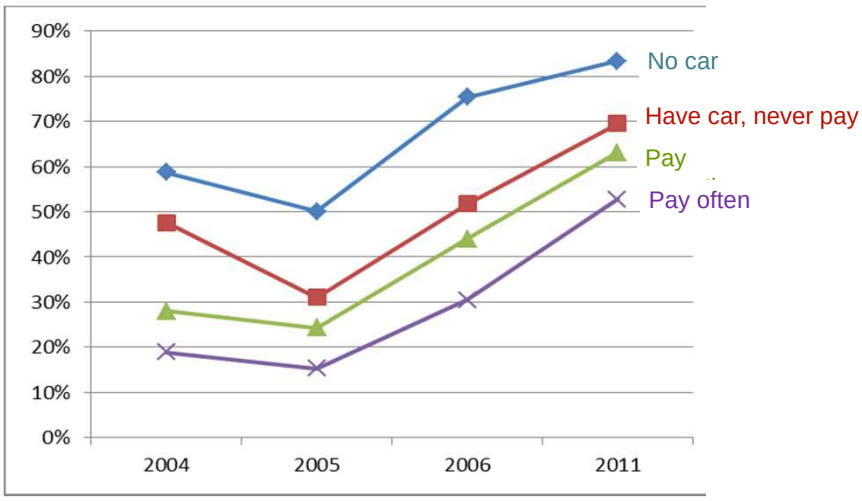
Support for CC – how much you pay



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Reasons for attitude change in Gothenburg (*short run change*)

Two surveys - one right before start, one a year later

1. Larger benefits than expected? No, beliefs in benefits *decreased*
2. Less negative effects than expected? Some effect (12%). Causality?
3. Complementary measures? Small effect (3%). Causality?
4. Changes in influencing attitudes? Some effect (11%). Cause?
5. Changes in how attitudes influence (reframing)? No!
6. Loss aversion No!
7. Status quo bias **Yes**, most (or all) of the effect (>67%).

Börjesson, M, Eliasson, J., Hamilton, C. (2014) Why experience changes attitudes to congestion pricing: the case of Gothenburg. CTS Working paper 2014:…

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Attitude formation (*long run*)

- New attitudes formed by associating to attitudes to ”similar” issues
- What is ”similar” depends on **framing**
- New attitudes are less stable – can be re-associated
- … especially if re-framed

- Politics often a **battle of framing**
  - which existing attitudes and values should a new issue associate to
  - Gaining political ground often requires re-framing of issues

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Framing congestion charges in Stockholm: A story in 4 acts

Act 1 (1970-1995):

”Congestion charges gives efficient resource allocation”

- Few have strong attitude to ”efficient resource allocation”
- Little emotion => little political upside
- CC looks more similar to ”tax” or ”restriction of freedom”

- **Noone cares except some transport economists**

Eliasson, J. (2014) The role of attitude structures, direct experience and framing for successful congestion pricing. *Transportation Research A* 67, 81-95.

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Act 2 (1995-2002):

"Congestion charges is an environmental measure"

- Many have strong attitudes to environmental issues
- Strong emotions => potentially large political upside
- CC looks similar to other such measures => easy to associate to existing environmental attitudes

- **Enters agenda of Green party, environmental NGOs etc.**

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Act 3 (2002-2007):

The battle for moral high ground

- Opponents try to associate to "*tax*", "*harm the poor*", "*unfair*" "*restriction of freedom*"
  - Preferred term: "congestion tax" or "road toll"
- Proponents try to associate to "*environment*", "*user pays*", to some extent "*anti-rich*" and "*anti-car*"
  - Preferred term: "environmental charge"

- Results in polarization – e.g. alienation of car drivers
  - The less affected people are, the less developed are their attitudes, and the more volatile their attitudes are
  - Unaffected car owners decreased their support the most

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Act 4 (2007-):

Reframing and emotional discharging

- Small majority in favour of charges in referendum 2006
- New government keeps CC – but earmarks revenues to multi-billion bypass motorway tunnel

- Reframing from ”anti-car” to ”efficiency” and ”revenue source”
  - ”It’s OK to be a car driver, but drive less in the city in rush hours”
- Less emotions
- From moral domain back to technical-rational domain
  - The latter less emotional => less political interest

Additional complications

Procuring a system

Equity

Labour market interactions

Thinking about equity

- Travel patterns in specific city matters
  - US cities vs. European cities vs. Asian cities…
- Revenue use matters
- Design matters
- ”What happens otherwise” matters
- Absolute numbers or relative to income?
  - ”Fiscal measure”: % of income logical
  - ”Price correction”: absolute number, but equity effects less relevant!
- Traditional ”equity” analysis explains less than half of people’s attitude to CC!

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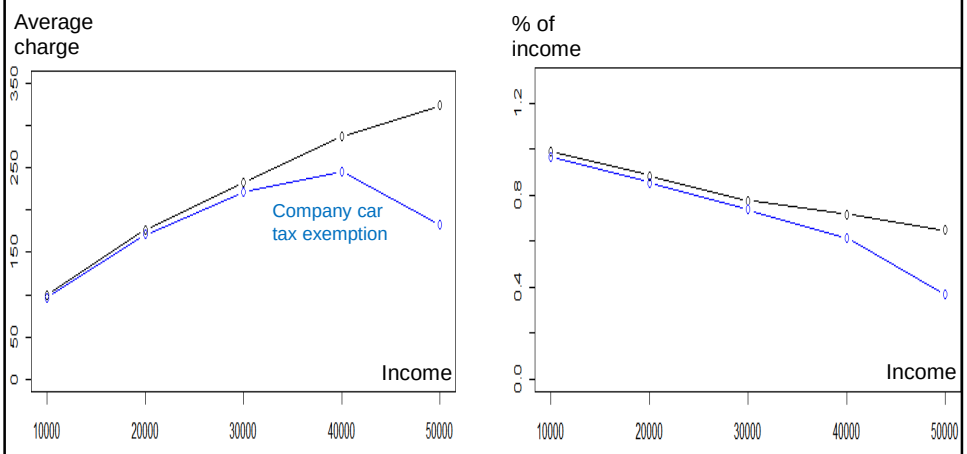
Example: Gothenburg



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Risk is the main cost driver

"The Lib/Cons opposition thought this was the biggest political suicide in history – and they could just stand back and watch the Left/Green majority commit it" (Gunnar Söderholm, Stockholm City)

"I told IBM several times: 'It is fully possible that this all goes to hell. But if it does, I will make sure that you are going down with me." (Birger Höök, Road Administration)

"IBM's future as a player in the international road user charging arena was at stake. If we had failed in Stockholm, we would not have been able to compete for any road charging bids in the future. (Gunnar Johansson, IBM)

Political risk => Administration's risk => Commercial risk

Commercial risk => Risk premium + technical redundancies

Reduce risks (and time pressure) => possible to reduce costs

Hamilton, C. (2011) Revisiting the cost of the Stockholm congestion charging system. *Transport Policy* 18, p. 836-847

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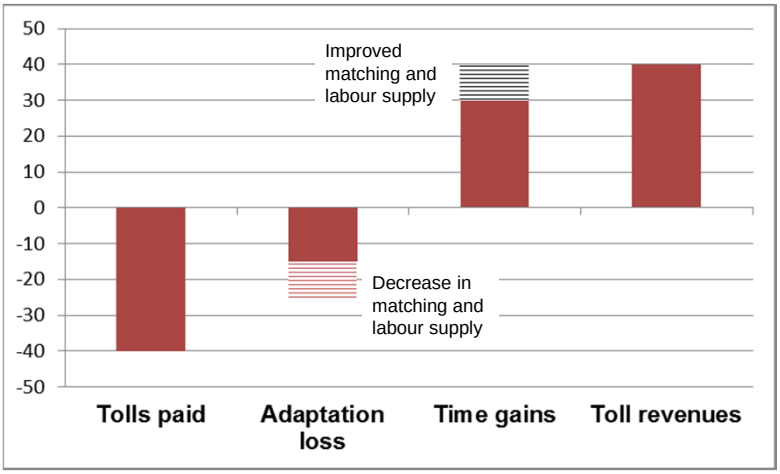
When consumer surplus isn't enough: Distortive taxes (and other external benefits)



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Quick summary of labour market effects

- Some gain travel time=> more working hours => more tax revenues
- Some lose travel time (slower modes) => less working hours => less tax revenues
- High-value-of-time commuters get *lower* generalized travel cost => better labour market matching and higher labour supply
- Low-value-of-time commuters get *higher* generalized travel cost => worse labour market matching and lower labour supply

- Net effect is uncertain – empirical matter

Parry, I.W.H., Bento, A., 2001. Revenue Recycling and the Welfare Effects of Road Pricing. Scandinavian Journal of Economics 103, 645–671.
Anderstig, C., Berglund, S., Eliasson, J., Andersson, M., Pyddoke, R. (2014) Congestion charges and labour market imperfections. CTS Working paper.

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Quick summary of Stockholm calculations

Estimated model accessibility => wages:
Income change 1993-2002:

	Low VoT	Medium VoT	High VoT
Log Income 1993	0.67	0.82	0.95
Log Δaccessibility	(0.025)	0.029	0.062
(…)			

Calculate change in accessibility per VoT group, area etc. due to CC

Multiply this with wage elasticity (above).

Sum over all groups, and…

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Calculated income effects of Stockholm charges

Municipality	Effect on wage sum by VTT category					
	Low		Medium		High	
	Total MSEK	Per capita 1000 SEK	Total MSEK	Per capita 1000 SEK	Total MSEK	Per capita 1000 SEK
Danderyd	-3.3	-0.9	-3.6	-0.8	39.0	7.5
Stockholm	-14.7	-0.1	-31.3	-0.2	481.1	3.3
Nacka	-7.6	-0.7	-12.5	-0.9	42.5	2.9
Lidingö	-2.5	-0.4	-0.4	-0.1	18.0	2.6
Täby	-3.7	-0.4	-0.6	-0.1	24.5	2.2
(…)						
Nykvarn	0.0	0.0	0.2	0.1	0.1	0.1
Total	**-54.0**		**-69.0**		**741.9**	

Total 60 M€/year

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The Dark Side of Congestion Pricing: The lure of the revenues

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The lure of the dark side

- Stockholm 2006 – reduce congestion and improve urban environment
- Later – revenues used as leverage for national grants

- Gothenburg 2010:
  - Govt. pushes regional co-funding
  - Gbg sees chance to unlock and leverage funds
  - Voilà: congestion charges!
  - … partly paid by non-Gothenburgers…
  - Alliance of interests: reduce cars, get revenues
  - ”Package” deal – no parts can be changed

- State-leveraged revenues and ”free money” makes local politicians forget ”value for money” for ”big shiny things”

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Summary: Success factors if you want to do it right

- Design it right

- Use efficient, not-too-expensive technology

- Associate to positive values
  - Environment & fairness rather than taxes/revenues

- Be honest:
  - Consistency design&purpose
  - Independent evaluation and publication of effects
  - Trial, or some possibility to roll back or change

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Selected references

CTS WP:s are available at http:/swopec.hhs.se/ctswps

- Eliasson, J. (2014) The Stockholm congestion charges: an overview. CTS Working Paper 2014:7. (*summary of several earlier papers*)
- Hamilton, C., J. Eliasson, K. Brundell-Freij, C. Raux, S. Souche, K. Kiiskilää, J. Tervonen (2014) Determinants of congestion pricing acceptability. CTS Working Paper 2014:x
- Hamilton, C. (2011) Revisiting the cost of the Stockholm congestion charging system. Transport Policy 18, p. 836-847
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