Road Pricing and Vehicle Usage: Evidence from the Gothenburg Congestion Charge

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Introduction

- The current car-centered personal transport has imposed substantial burdens on society. Growing road passenger transport is a significant contributor to air pollution, congestion, and accident externalities.
- A handful of cities around the world have adopted congestion pricing schemes to allocate limited roadway capacity to the highest-valued users to reduce traffic congestion and local pollution.
- Studies exist on the effects of transport taxes such as vehicular taxes and gasoline tax on households' demand for cars and driving. However, the impact of other transport levies such as congestion charges remains understudied.

Objectives

- To understand the possible effect of a policy shock on demand for private vehicles and driving, we propose to examine the results of the implementation of the congestion charges in Gothenburg as a proximate measure.
- We aim to investigate the causal impact of a congestion charge on households' car-owning and usage decisions in Gothenburg.

Research Design

- Congestion charges in Stockholm and Gothenburg were implemented in August 2007 and January 2013, respectively, to reduce emissions and traffic congestion in the two most populous cities in Sweden.
- The Gothenburg congestion charge imposes fees on vehicles used within the catchment areas during working hours with charges ranging from SEK 9 and SEK 22 depending on the time of the day with the maximum levy of SEK 60 per day.
- Our study builds upon the fact that a new congestion charge is established in Gothenburg while the road pricing policy remains unchanged in Stockholm during the same period between 2008 and 2015.
- We employ a sample constructed from the Swedish private passenger car register and the vehicle mileage register. Using observations in Stockholm as the control group, we apply difference-in-differences (DID) estimators to citywide cross-section data between 2008 and 2015 to examine the causal effect of the Gothenburg congestion charge.

Data Descriptions

- Table 1 reports car-owning and usage during the pre- and post-Gothenburg congestion charge periods, which are 2008-2012 and 2013-2015, respectively.
- Trends in both car-owning rate and car usage are different across the two cities, but further analyses are required to determine the driver of observed patterns.

	Gothenburg	Stockholm
A: car-owning rate (in %)		
2008-2012	41.74	35.00
2013-2015	40.80	34.61
Difference	-0.94	-0.39
B: annual mileage per car-owning household (in 1,000 km)		
2008-2012	13.49	12.56
2013-2015	12.95	12.13
Difference	-0.54	-0.43

Table 1: Car-owning rate in Panel A tells the proportion of households that own at least one private vehicle. The sample is restricted to car-owning households with non-idle cars when computing the average annual mileage in Panel B.

The Aggregate Effects of the Gothenburg Congestion Charge

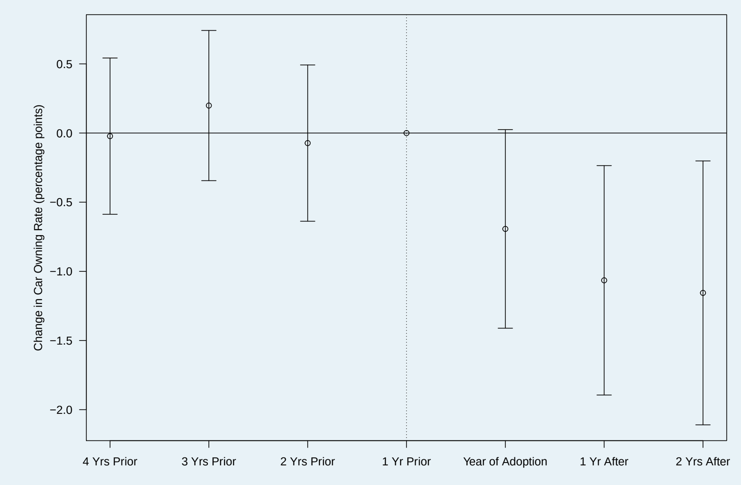
- DID results reported in columns (3) and (6) suggest that, during the first three years after implementing the Gothenburg congestion charge, the average car-owning rate reduces by 0.82 percentage points, and the average annual household car usage decreases by about 130 km.

Dependent Variable:	car-owning rate (in %)			annual mileage (in 1,000 km)		
	(1)	(2)	(3)	(4)	(5)	(6)
Gbg × *Post*	-0.74	-0.69	-0.82	-0.10	-0.12	-0.13
	(0.27)	(0.32)	(0.31)	(0.02)	(0.03)	(0.03)
Two-way Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
City-specific Trends	No	Yes	Yes	No	Yes	Yes
Additional Controls	No	No	Yes	No	No	Yes

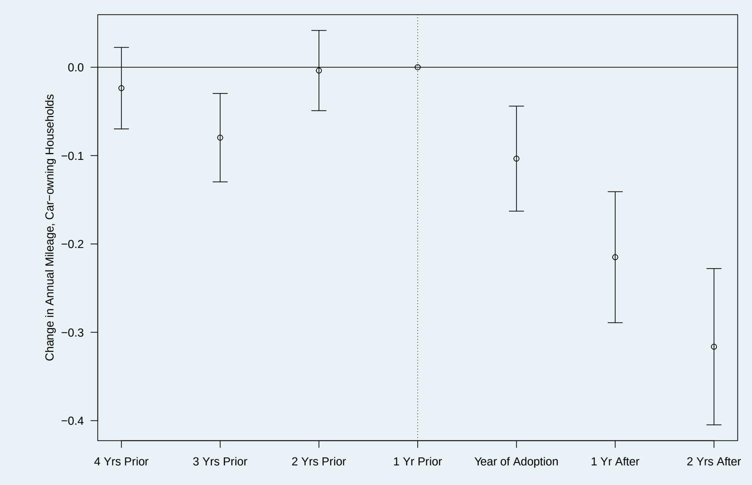
Table 2: A postal number area-level panel is constructed to produce the car-owning rate results. Car-usage results are obtained using individual-level repeated cross-section observations. $Gbg = 1$ if an observation is in Gothenburg, 0 otherwise; $Post = 1$ if $year \geq 2013$, 0 otherwise. Robust standard errors reported in parentheses are clustered by postal number area.

The Dynamics of Changes in Car-owning Rate and Usage

- Figure 1 shows the estimated impact of the Gothenburg Congestion Charge on car-owning rate and car usage for years before, during, and after implementation. Each point estimate measures the difference in the outcome between Gothenburg and Stockholm in a specific year, relative to the reference year 2012.



(a) changes in car-owning rate (in %)



(b) changes in annual mileage (in 1,000 km)

Figure 1: Vertical bands represent ± 1.96 times the standard error of each point estimate.

The Distributional Impacts of the Gothenburg Congestion Charge

- Results reported in column (3) indicate that the gap in annual mileage between car-owning households with the highest and lowest disposable income increases by 2,830 km when the congestion charge is in place.

Dependent Variable:	annual mileage (in 1,000 km)		
	(1)	(2)	(3)
Gbg × *Post*	-3.53	-0.28	-1.79
	(0.37)	(0.04)	(0.21)
Disposable Income	20.81	2.13	6.54
	(0.36)	(0.03)	(0.17)
Gbg × *Post* × *Disp. Inc.*	5.90	0.45	2.83
	(0.64)	(0.06)	(0.36)
City and Year Fixed Effects	Yes	Yes	Yes
City-specific Trends	No	Yes	Yes
Additional Controls	No	No	Yes

Table 3: In the specification $\text{Annual Mileage}_{ijt} = \beta_1 \times \text{Gbg} \times \text{Post} + \beta_2 \times \text{Disp. Inc.} + \beta_3 \times \text{Gbg} \times \text{Post} \times \text{Disp. Inc.} + \text{City}_j + \text{Year}_t + \epsilon_{ijt}$, *Disposable Income* is coded such that zero represents the lowest annual household disposable income in the sample and one the highest. Robust standard errors reported in parentheses are clustered by postal number area.