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Urban Transport Externalities

> “An additional highway displaced on average approximately 9% of the central city population to the suburbs in Europe's cities”

One of the main reasons that cities exists and thrive is that high population density yields certain economic benefits. However, high densities require transportation, and transport infrastructure, especially highways, are expensive. In addition, when you travel by car, you impose a cost to the rest of the society. Such costs can be congestion costs, like traffic congestion, noise or environmental pollution. If such external costs or externalities "do not have a price" in the market, then society's welfare is not maximized. My PhD dissertation "Urban Transport Externalities" estimates such externalities, and the interactions between them with its main focus being placed on highways in European cities.

The "Side Effects" of Highways in European Cities

The highway network in Europe grew immensely during the second half of the 20th century, from 259 km in 1955 to 67,779 km in 2011, with much of this development being financed by the EU Regional and Cohesion Funds. At the same time, EU policies have sought to mitigate the problems that the literature has identified as potential externalities of highway construction, namely, suburbanization (Baum-Snow, 2007), traffic congestion (Duranton and Turner, 2011), air pollution, CO2 emissions, energy inefficiency (Glaeser and Kahn, 2010) and social segregation (Glaeser and Kahn, 2004).

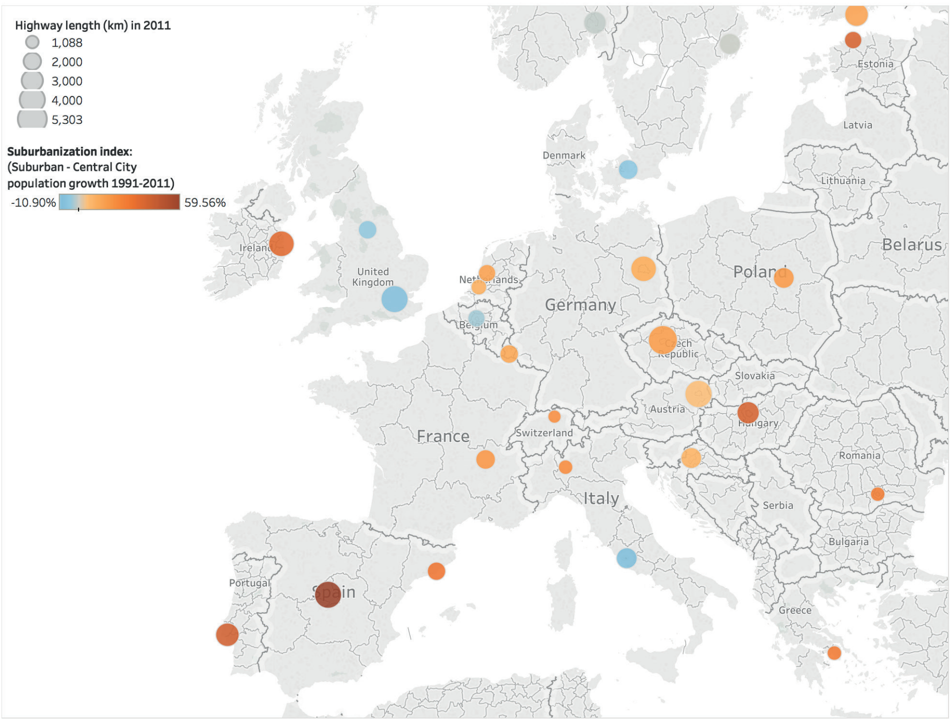
The uniqueness of the European landscape provides fertile ground to study the effect of transport infrastructure investments on the city level. Using Geographical Information Systems (GIS) to extract information from historic maps, I use historic networks such as the Roman roads and the post routes in 18th century to address endogeneity concerns and estimate a causal effect. Based on my thesis, an additional highway displaced on average approximately 9% of the central city population to the suburbs in Europe's cities. However, historic cities, like important cities in the Roman and Medieval eras, appear to be more resilient to this process. Based on my findings, people "fly less to the suburbs" of such cities because of the historic and other amenities found in their centres.

In addition, I find that the vast amounts of EU resources allocated to highway construction in recent decades have been ineffectual in reducing traffic congestion. The idea behind this finding is that more highways bring more cars (Downs, 1962). In a second stage, I estimate the effect of the increase in highway traffic on the emissions of some of the most harmful air pollutants. I find evidence of a considerable positive effect of highway traffic on emissions of nitrogen oxides and some tentative evidence for sulphur dioxide and fine particulate matter. Finally, my heterogeneous analysis shows that the increase in traffic congestion and emissions is higher in cities without tolls — a finding that substantiates congestion pricing — and in cities without subways — a finding that corroborates rapid transit policies.

Accidents and Congestion Using 'Big Data'

I also analyse the relationship between highway accidents and highway congestion and vice

Map of suburbanization and highway length



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versa. In order to capture the micro scale of these events, I use dynamic panel techniques adapted in such a way that they can exploit spatial 'Big Data' for the highways of England. The results of this analysis suggest that the journey time increases by around 27% when an accident occurs. This effect declines very rapidly after the first quarter of an hour while in regularly congested segments it is substantially higher. Finally, for the reverse effect, I find that more congestion is associated with a reduction in the probability of an accident, probably because of the lower speeds when congestion is present. These results suggest that policies that aim to reduce the probability and the number of accidents can be expected to have multiplicative benefits, while policies that seek a reduction in congestion are not expected to reduce accidents considerably.

"Emissions are higher in cities without tolls and in cities without subways — a finding that corroborates rapid transit policies"

Shopping and Walking

When you visit several shops during the same shopping trip ('trip-chain') you benefit from reductions in transport (walking) and search costs (browsing). This cost reduction for the consumers imply a shopping externality for shops when shop density increases. In my fifth chapter I use footfall — i.e., the daily number of pedestrians that pass by a shop — as a novel measure for this externality and I compare the rents of shops located in close distance but in "different corners" of a street intersection. My estimates imply a very high positive externality suggesting that the benefits of retail agglomeration are much higher than in other sectors. The chapter concludes with a back-of-the-envelope calculation suggesting that an average annual subsidy of about 10% of the rent would be welfare improving. Alternative policies could subsidize public transportation or parking spaces to facilitate the accessibility to these shopping streets (e.g. pedestrianizations).

Highway traffic and transport emissions in 2011

Country	City name	avg AADT	avg SO2	avg NOx	avg PM10
AT	Wien	68.7	16.5	64.9	53.7
BE	Bruxelles	176.3	28.0	115.2	97.2
CH	Zürich	123.0	44.8	96.2	63.2
CZ	Praha	43.4	139.0	36.8	45.4
DE	Berlin	97.5	9.4	26.8	22.9
DK	København	78.8	23.5	97.7	63.0
EE	Tallinn	17.9	27.2	11.6	6.2
EL	Athens	80.4	46.0	129.8	247.2
ES	Barcelona	174.9	471.5	408.2	492.3
	Madrid	141.0	189.8	165.4	196.5
FI	Helsinki	54.3	12.3	47.8	41.7
FR	Lyon	127.7	97.4	55.6	70.4
HR	Zagreb	44.1	42.6	17.1	25.3
HU	Budapest	61.9	192.5	49.2	39.1
IE	Dublin	49.2	13.4	39.5	34.8
IT	Milano	206.2	333.6	284.2	311.4
	Roma	136.7	81.4	70.4	75.2
LU	Luxembourg	48.3	42.0	168.6	165.0
NL	Amsterdam	215.9	28.6	126.0	90.0
	Rotterdam	177.1	16.9	75.1	53.3
NO	Oslo	50.2	4.8	14.4	14.2
PL	Warszawa	43.9	96.6	36.7	22.6
PT	Lisboa	50.7	21.8	94.8	117.5
RO	Bucuresti	28.4	353.6	172.1	175.9
SE	Stockholm	47.6	10.5	26.7	17.7
UK	Leeds	113.7	102.0	82.8	44.5
	London	242.3	254.5	186.2	114.0

The averages are calculated for a selection of Eurostat's Large Urban Zones. All measures are normalised with 100 being the average of each measure for these cities. AADT stands for Annual Average Daily Traffic, SO2 is sulphur dioxide, NOx is nitrogen oxides and PM10 is fine particulate matter (less than 10mm in diameter).

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