Research Proposal - Draft

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Do Traffic Management Strategies (TMS), such as Low Emissions Zones (LEZ), affect economic activity? And, if they indeed have an effect, through which mechanisms does this happen?

Introduction: Around 3 billion people - virtually half of the world's total population - now live in urban settlements, a number that has greatly increased during the last 20 years (Cohen, 2006). This fast urbanization has resulted in increases of congestion and pollution and related health and economic costs, especially on regions such as China and India (Gong et al., 2012; Pucher, Korattyswaropam, Mittal, & Ittyerah, 2005). Strikingly, recent research estimates that 92% of the world's population resides in areas exceeding the World Health Organization's air quality guidelines, resulting in 3 million attributable deaths to ambient air pollution in 2012. Shaddick et al. (2018). In order to minimise these costs, substantial policy initiatives aimed at improving air quality have been implemented in cities around the world.

In European cities, TMS have proven popular to improve air quality and comply with increasingly strict European regulation on air quality (Holman, Harrison, & Querol, 2015), but are usually seen as a trade-off between imposing costs to the economy and improving the natural environment (Morgenstern, Pizer, & Shih, 2002). From classic economic theory we would expect these policies to have a negative effect in the city's GDP as it involves taxes and prohibitions on movement for certain vehicles. Nevertheless, the effects of reducing congestion and pollution can offset other economic costs.

This hypothesis is based on recent research on the effect of LEZ on increasing mobility within the city (Kelly & Kelly, 2009), pollution reduction (Gehrsitz, 2017; Wolff, 2014), and health costs and mortality reductions (Cesaroni et al., 2012). Furthermore, increasing literature suggest that there is a causal effect of pollution concentration and economic output (Dechezleprêtre, May 18, 2018; Xie, Dai, Dong, Hanaoka, & Masui, 2016) by reducing mortality, productivity (Adhvaryu, Kala, & Nyshadham, 2014; Chang, Zivin, Gross, & Neidell, 2016; Graff Zivin & Neidell, 2012) or increasing absenteeism (Hanna & Oliva, 2015; Ransom & Pope, 1992).

Research Aim: The research aim of this research would be to quantify the effect of TMS, such as LEZ, in the local macroeconomic performance. This would be studied in different dimensions such as the effects on the different economic sectors, business growth, productivity, unemployment, and science and technology, having a more comprehensive picture of the different transmission mechanisms at play. Furthermore, I intend to quantify the effects of pollution in business performance such as growth and employment for the different industries in the US to improve the understanding of these potentially important transmission mechanism.

Research Design: To answer the main question on the effect of TMS on various economic outputs I intend to use a synthetic control approach in which the individual effect of the TMS applied to each treated region can be quantified by constructing a synthetic control from all untreated regions. This method was introduced in Abadie and Gardeazabal (2003) to look at the effect of conflict in the Basque Country' macroeconomic performance and is extensively described in Abadie, Diamond, and Hainmueller (2010). Even if, to the best of my knowledge, the synthetic control method has not yet been applied to cities' TMS, previous research has used similar methods to study LEZ effects such as Wolff (2014) and Gehrsitz (2017) who apply differences-in-differences to estimate the causal effect of LEZ in air quality.

The data used would be Eurostat' collection of regional statistics available for NUTS regions (from 2000 to 2017) and public information on the implementation of TMS in European regions. The strength of this methodology is based on its ability to give estimates for each region on each statistic available (including non-economic variables such as pollution[1]) as long as there is a pool of untreated regions from where to construct the synthetic control. Potentially, and for large cities such as London where different TMS are in place and the NUTS regions give sufficient resolution, a study of the relative impact of different TMS in economic output is possible as well as a study on spill-over effects by comparing regions where the application differs or comparing areas that surround treated and non-treated urban areas.

Most of the data from transmission mechanisms is directly available in Eurostat such as GDP, GVA per sector, unemployment, science and technology statistics (trademarks and patents), business outputs and demographics[2]. Furthermore, some countries have more detailed data could allow for a deeper analysis of transmission mechanisms such as the Office of National Statistics' data on productivity.

One of the most relevant transmission mechanisms is the effect of pollution in local economic activity mentioned previously. Dechezleprêtre (May 18, 2018) shows how air pollution causes economy-wide reductions in productivity and economic activity by using wind direction and thermal inversions as instruments in an IV specification for every NUTS3 region in the EU. He concludes that air pollution abatement costs would be two orders of magnitude smaller than the associated economy-wide reductions in productivity. To better understand this crucial transmission mechanism, I intend to build on his research to provide estimates of air pollution effect on US businesses by sector and location (inside and outside cities). The sources of the data are yearly data on business patterns (2004-2017) for every zip code in the US (available from the US census), yearly mean $PM_{2.5}$ from van Donkelaar et al. (2016) and wind and thermal inversions data from NOAA and NASA.

Research contribution: This research can provide a concrete answer to an already pressing question for local authorities, academics and the broad public. The study results can be used to have a better understanding of the policy's effects by providing specific estimates for Europe's TMS effect in the economy accounting for the heterogeneity of implementation formulas, city-specific characteristics and transmission mechanisms. Furthermore, the study on the effect of pollution in US businesses, would provide highly relevant estimates on how pollutants can affect business growth and employment of the world's 1^{st} economy .

This research could be a significant and novel contribution when concluded that contributes to pressing public policy regarding the effect of TMS and pollution in the economy. It could also promote further research looking at the potential effect of TMS in developing urban settlements in low and middle income countries, where the costs of pollution appear to be higher and policy advice is much needed.

[1]Local air quality data can be gathered from van Donkelaar et al. (2016), the AirBase of European air quality e-reporting (link), NASA's MERRA-2, CAMS or others.

[2]There is a vast amount of regional economic, demographic and environmental data at this geographical definition. Even if the information mentioned is enough to achieve the research aim of this proposal, I am confident that further data can be found that further increases the research ability to understand the transmission mechanisms at play. Additionally, for major statistics such as regional GDP data from non-european cities could be gathered to increase the pool of controls and reinforce the argument of exogeneity of the treatment.

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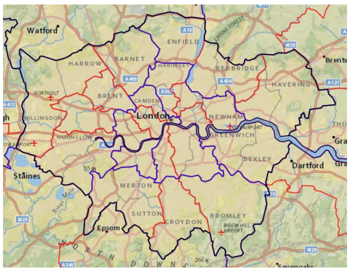
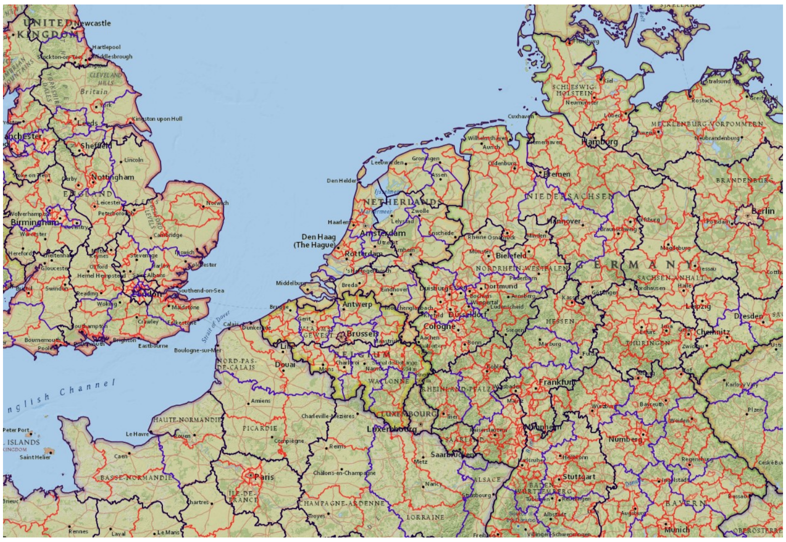
Appendices



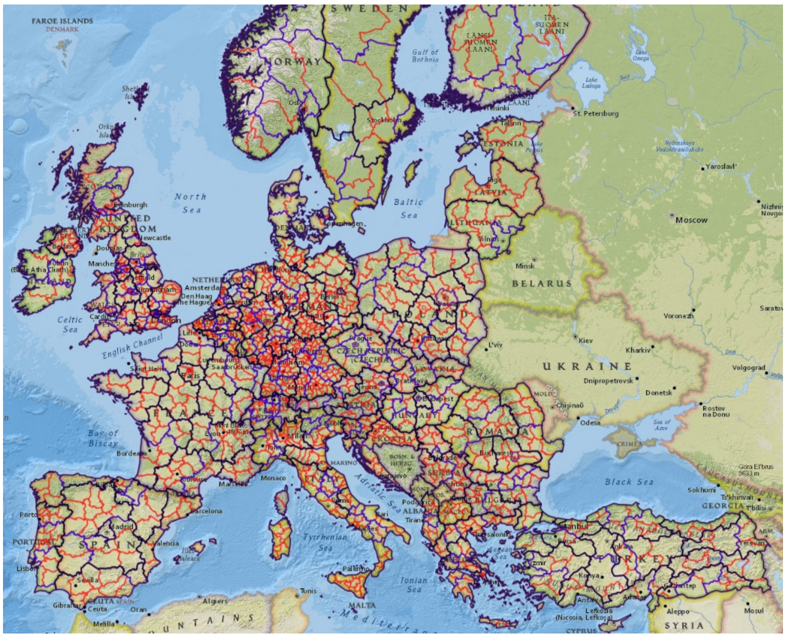
(a) London

(b) Paris

(c) Budapest



(d) Benelux zone



(e) Whole coverage of NUTS 3 zones

Figure 1: Coverage and examples of the coverage of NUTS zones across Europe.
Source: Eurostat and own work