
Research Proposal - MY400

of Antonio Ávila. A pilot study on a PhD research question

What was the effect of the application of Traffic Management Strategies (TMS) in London's local economy?

Literature review: 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 Questions:

Main question:

- What was the effect of the application of Traffic Management Strategies (TMS) in London's local economy?

Complementary questions:

- What are the main transmission mechanisms that drive this effect and how much they influence the final economic output?
- Which industries and professions does it affect more?
- How different TMZ perform relatively?
- How can spill-over effects be studied and estimated?

Research Design: To answer the main question on the effect of London's 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 pollution¹) 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 demographics². Furthermore, the UK has more detailed data allowing for a deeper analysis of transmission mechanisms (such as the Office of National Statistics' data on productivity.)

The model also needs assumptions that can be questioned such that the non-interference between units (Rosenbaum, 2007) and that the differences between cities with and without LEZ are not significant, apart from the environmental policy and independent of the application of the policy³.

Potential impact and relevance of the study: 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 London's TMS effect in the economy accounting for the heterogeneity of implementation formulas, spill-over effects and transmission mechanisms.

Furthermore, 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.

Limitations: Limitations of the results are derived from assumptions of the model. The In the best case scenario I can claim the effect but the mechanisms are missing for lack of more sectorial and micro data regarding businesses. Furthermore, even though an intuition on the ranges of effect size can be extracted from London's example, the results can only be interpreted for this specific case study.

¹Local 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.

²There 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.

³For major statistics such as regional GDP, data from non-european cities could be gathered to increase the pool of controls, reinforce, and test the argument of exogeneity of the treatment.

References

- Abadie, A., Diamond, A., & Hainmueller, J. (2010). Synthetic control methods for comparative case studies: Estimating the effect of california's tobacco control program. *Journal of the American Statistical Association*, 105(490), 493-505. Retrieved from <https://doi.org/10.1198/jasa.2009.ap08746> doi: 10.1198/jasa.2009.ap08746
- Abadie, A., & Gardeazabal, J. (2003, March). The economic costs of conflict: A case study of the basque country. *American Economic Review*, 93(1), 113-132. Retrieved from <http://www.aeaweb.org/articles?id=10.1257/000282803321455188> doi: 10.1257/000282803321455188
- Adhvaryu, A., Kala, N., & Nyshadham, A. (2014). Management and shocks to worker productivity: evidence from air pollution exposure in an indian garment factory. *Unpublished Working Paper, University of Michigan*.
- Cesaroni, G., Boogaard, H., Jonkers, S., Porta, D., Badaloni, C., Cattani, G., ... Hoek, G. (2012). Health benefits of traffic-related air pollution reduction in different socio-economic groups: the effect of low-emission zoning in rome. *Occupational and Environmental Medicine*, 69(2), 133-139. Retrieved from <https://oem.bmj.com/content/69/2/133> doi: 10.1136/oem.2010.063750
- Chang, T., Zivin, J. G., Gross, T., & Neidell, M. (2016, June). *The effect of pollution on worker productivity: Evidence from call-center workers in china* (Working Paper No. 22328). National Bureau of Economic Research. Retrieved from <http://www.nber.org/papers/w22328> doi: 10.3386/w22328
- Cohen, B. (2006). Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability. *Technology in Society*, 28(1), 63 - 80. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0160791X05000588> (Sustainable Cities) doi: <https://doi.org/10.1016/j.techsoc.2005.10.005>
- Dechezleprêtre, A. (May 18, 2018). The economic cost of air pollution: Evidence from Europe. Conference on Environmental regulation and industrial performance, TSE. Retrieved from <https://www.tse-fr.eu/publications/economic-cost-air-pollution-evidence-europe>
- Gehrsitz, M. (2017). The effect of low emission zones on air pollution and infant health. *Journal of Environmental Economics and Management*, 83, 121 - 144. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0095069617300736> doi: <https://doi.org/10.1016/j.jeem.2017.02.003>
- Gong, P., Liang, S., Carlton, E. J., Jiang, Q., Wu, J., & Wang, L. (2012, 03). Urbanisation and health in china. *The Lancet*, 379, 843-852. doi: 10.1016/S0140-6736(11)61878-3
- Graff Zivin, J., & Neidell, M. (2012, December). The impact of pollution on worker productivity. *American Economic Review*, 102(7), 3652-73. Retrieved from <http://www.aeaweb.org/articles?id=10.1257/aer.102.7.3652> doi: 10.1257/aer.102.7.3652
- Hanna, R., & Oliva, P. (2015). The effect of pollution on labor supply: Evidence from a natural experiment in mexico city. *Journal of Public Economics*, 122, 68 - 79. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0047272714002096> doi: <https://doi.org/10.1016/j.jpubeco.2014.10.004>
- Holman, C., Harrison, R., & Querol, X. (2015). Review of the efficacy of low emission zones to improve urban air quality in european cities. *Atmospheric Environment*, 111, 161 - 169. Retrieved from <http://www.sciencedirect.com/science/article/pii/S1352231015300145> doi: <https://doi.org/10.1016/j.atmosenv.2015.04.009>
- Kelly, F. J., & Kelly, J. (2009). London air quality: a real world experiment in progress. *Biomarkers*, 14(sup1), 5-11. Retrieved from <https://doi.org/10.1080/13547500902965252> doi: 10.1080/13547500902965252
- Morgenstern, R. D., Pizer, W. A., & Shih, J.-S. (2002). Jobs versus the environment: An industry-level perspective. *Journal of Environmental Economics and Management*, 43(3), 412 - 436. Retrieved from <http://www.sciencedirect.com/science/article/pii/S009506960191191X> doi: <https://doi.org/10.1006/jeem.2001.1191>
- Pucher, J., Korattyswaropam, N., Mittal, N., & Ittyerah, N. (2005, 05). Urban transport crisis in india. *Transport Policy*, 12, 185-198. doi: 10.1016/j.tranpol.2005.02.008

-
- Ransom, M. R., & Pope, C. A. (1992). Elementary school absences and pm10 pollution in utah valley. *Environmental Research*, 58(1), 204 - 219. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0013935105802166> doi: [https://doi.org/10.1016/S0013-9351\(05\)80216-6](https://doi.org/10.1016/S0013-9351(05)80216-6)
- Rosenbaum, P. R. (2007). Interference between units in randomized experiments. *Journal of the American Statistical Association*, 102(477), 191-200. Retrieved from <https://doi.org/10.1198/016214506000001112> doi: 10.1198/016214506000001112
- Shaddick, G., Thomas, M. L., Green, A., Brauer, M., van Donkelaar, A., Burnett, R., ... Prüss-Ustün, A. (2018). Data integration model for air quality: a hierarchical approach to the global estimation of exposures to ambient air pollution. *Journal of the Royal Statistical Society: Series C (Applied Statistics)*, 67(1), 231-253. Retrieved from <https://rss.onlinelibrary.wiley.com/doi/abs/10.1111/rssc.12227> doi: 10.1111/rssc.12227
- van Donkelaar, A., Martin, R. V., Brauer, M., Hsu, N. C., Kahn, R. A., Levy, R. C., ... Winker, D. M. (2016). Global estimates of fine particulate matter using a combined geophysical-statistical method with information from satellites, models, and monitors. *Environmental Science & Technology*, 50(7), 3762-3772. Retrieved from <https://doi.org/10.1021/acs.est.5b05833> (PMID: 26953851) doi: 10.1021/acs.est.5b05833
- Wolff, H. (2014, 03). Keep Your Clunker in the Suburb: Low-Emission Zones and Adoption of Green Vehicles. *The Economic Journal*, 124(578), F481-F512. Retrieved from <https://doi.org/10.1111/econj.12091> doi: 10.1111/econj.12091
- Xie, Y., Dai, H., Dong, H., Hanaoka, T., & Masui, T. (2016). Economic impacts from pm2.5 pollution-related health effects in china: A provincial-level analysis. *Environmental Science & Technology*, 50(9), 4836-4843. Retrieved from <https://doi.org/10.1021/acs.est.5b05576> (PMID: 27063584) doi: 10.1021/acs.est.5b05576

Appendices



(a) London

(b) Paris

(c) Budapest



(d) Benelux zone



(e) Main coverage of NUTS 3 zones

Figure 1: Main coverage, with examples, NUTS zones across Europe.
Source: Eurostat and own work

Table 1: Potential variables to use with their source, geographic and time coverage

Variable	Coverage	Geography	Start	End	Delta	Source
GDP	UK	NUTS 3	1998	2017	1 year	ONS
GVA/industry	UK	NUTS 3	1998	2017	1 year	ONS
Productivity	UK	Cities	2004	2017	1 year	ONS
Business Demographics and Survival Rates	London	Borough	2002	2018	1 year	ONS
VAT enterprices by tuover	London	Borough	2003	2019	1 year	ONS
Real labour productivity	UK	LEPs	2004	2017	1 year	ONS
Household income	UK	MSOA	2011	2016	2 years	ONS
Agriculture stats	EU	NUTS 3	2000	2012	1 year	Eurostat
Demographic stats	EU	NUTS 3			1 year	Eurostat
Live births	EU	NUTS 3	1990	2017	1 year	Eurostat
Area	EU	NUTS 3	1990	2015	1 year	Eurostat
Population / age, sex	EU	NUTS 3	1990	2018	1 year	Eurostat
Deaths	EU	NUTS 3	1990	2017	1 year	Eurostat
(total)						
Live births / age mother	EU	NUTS 3	1990	2017	1 year	Eurostat
Fertility rate	EU	NUTS 3	1990	2017	1 year	Eurostat
Population change	EU	NUTS 3	2000	2018	1 year	Eurostat
Deaths / age, sex	EU	NUTS 3	1990	2017	1 year	Eurostat
Economic Accounts						
Employment ('000 persons) by NACE	EU	NUTS 3	1995	2017	1 year	Eurostat
Gross domestic product (GDP), multiple stats	EU	NUTS 3	2000	2017	1 year	Eurostat
Gross value added at basic prices / NACE activites	EU	NUTS 3	1995	2017	1 year	Eurostat
Business Demography by NACE Rev. 2 and size	EU	NUTS 3	2008	2016	1 year	Eurostat
Transport Statistics	EU	NUTS 3	2003	2016	1 year	Eurostat
Science and Tech statistics	EU	NUTS 3	2003	2016	1 year	Eurostat