

**Feedback:**

This is a technically-impressive and ambitious Generalised Synthetic Control Method-based study of the local economic impacts of the introduction of Low Emission Zones (LEZs) in German cities. As well as seek to estimate the effects of LEZs on measures of local economic performance, the study also strives to estimate these effects in German cities that have not yet introduced LEZs using a methodology specified by the author (the 'Synthetic Treated Method'). The capstone has a clear research problem and its empirical strategy is consistent with it. Overall, the dissertation is well written and has a logical flow of ideas.

The capstone opens with a well-written introductory section setting out the real-world context of the proposed study and key contradiction motivating the present study (namely contradictory and competing claims about the effects of LEZs on local economic performance). The case for the study set out in this section is compelling, and the author demonstrates a wide and critical awareness of the literature (both academic and policy literature) in setting out this case and in situating the present study (both substantively and methodologically) in relation to existing research.

The author covers a wide range of literature to argue and demonstrate that air pollution has effects on aggregate economic output including through the mechanism of direct effects on labour as a unit of production (esp. Section 1.3). Again this part of the review is compelling. Section 1.3 is, however, labelled 'potential economic benefits of LEZ' and yet for the most part describes the effects of air pollution on labour/worker productivity. This points to a wider issue in the capstone whereby the discussion of mechanisms through which LEZs have economic effects is not as clear as it could be. Some sort of theory of change, or fuller discussion of the theoretical assumptions underpinning this relationship (substantiated by the empirical literature reviewed) would have been welcome in this respect.

Related to this observation, the capstone also lacks a sufficiently detailed discussion of the intervention/s of interest (i.e. the LEZs introduced in German cities in recent years). There is some rather sporadic discussion of why and how these were introduced, but more contextual understanding of these interventions would have been helpful both for the reader's understanding of the case and for when it comes to interpreting the study results. For instance, at the end of the study the author notes (p.40) the role of a potential mechanism of selection into treatment, and earlier on they note that '[m]ost regional and national governments have been either threatened by fines or strongly incentivised to pursue decisive policy action by European regulation' (p.4). A clearer account of such issues – i.e. why German cities chose to introduce LEZs, if indeed they did chose – and a more detailed understanding of the context/s of LEZ implementation in Germany would have been very welcome, especially given the finding about importance of cities' characteristics to the magnitude and sign of the effect of the LEZ on local economic performance.

The description of the collection (and sourcing) of data is very good, and the research questions are clearly stated. The questions are broad ones, however, and some further narrowing of the scope of the capstone may have been worthwhile. Specifically, while supplementing the study of the economic effects of LEZs (RQs 1

and 2) with a study of the effect of LEZs in cities that had not yet applied it is commendably ambitious, it results in the author being less able to explore and address RQs 1 and 2 in great depth. As a trade-off, I think dedicating more space to exploring RQs 1 and 2 would have been preferable. Given the heterogeneity of the results found in relation to those questions, some more detailed (theoretically and contextually-informed) discussion and interpretation of that variation would have been very welcome. There are hints at this – e.g. on p.39 the author notes that in terms of the measure of GVA used '[c]ities that were surrounded by already-implemented LEZ had positive effects' – but unpacking these further would have strengthened the capstone overall.

Relatedly, the claims made about external validity feel rather unconvincing as we have so little sense of the causal mechanisms linking the intervention to the economic outcomes for a given city – again, more detail about the LEZs, the contexts of their implementation, potential confounders...could have shed some light on potential causal mechanisms and so strengthened the generalisability of the study findings. Likewise, with more depth of discussion a stronger case for the comparability of the treated and control groups across the domains of interest could have been made. The distributions of these measures are not always the same, which raises questions about of how comparable they are.

In a similar vein, while the discussion of 'assumptions and identifying requirements' is very well-written and an important part of the capstone, it feels rather constrained. The reader is told that the German scrappage program is the most important source of possible bias for the study which is a highly-plausible claim, but we have now sense of how this conclusion was reached – were other possible sources of bias explored? If so, how? Again, dedicating more of the capstone to addressing the first two research questions would have freed-up space for a more detailed discussion of the assumptions underpinning the analysis. The attention given to dealing with potential 'spillover effects' is also welcome, though such effects are rather narrowly conceived. For instance, given the timing of policy adoption differed between cities, it could be possible that some economic activities relocated to other cities (without LEZs). Likewise, even if an LEZ has not been announced for a given city, the prospect of such an announcement (in light of national policy and developments in other cities) may already have relevant effects to the study (e.g. on decisions that influence local economic development).

The discussion and presentation of the results themselves is very good, and the presentation throughout the thesis is extremely good (Tables, Figures, appendices, supplementary online materials, footnotes... are very well-handled and -presented and the author makes very good use of them, and clearly references them, in the text). Referencing is also excellent (though in the reference list providing translations of the titles of non-English language citations is advisable). The author generally does a very good job of explaining relatively complex procedures in an accessible manner, and discusses additional measures taken (e.g. robustness and diagnostic checks) to enhance the rigor of the study findings.

Overall, this is a very well-presented study, and one that is commendably ambitious. However, the desire to explore three relatively broad research questions comes at a cost, namely that there is a loss of depth and detail in the text that would help to strengthen the capstone overall (and the interpretation of the heterogeneous findings about the effects of LEZs on local economic performance specifically). The method proposed by the author shows great promise, however, and I hope the author is able to develop these ideas further somehow.