

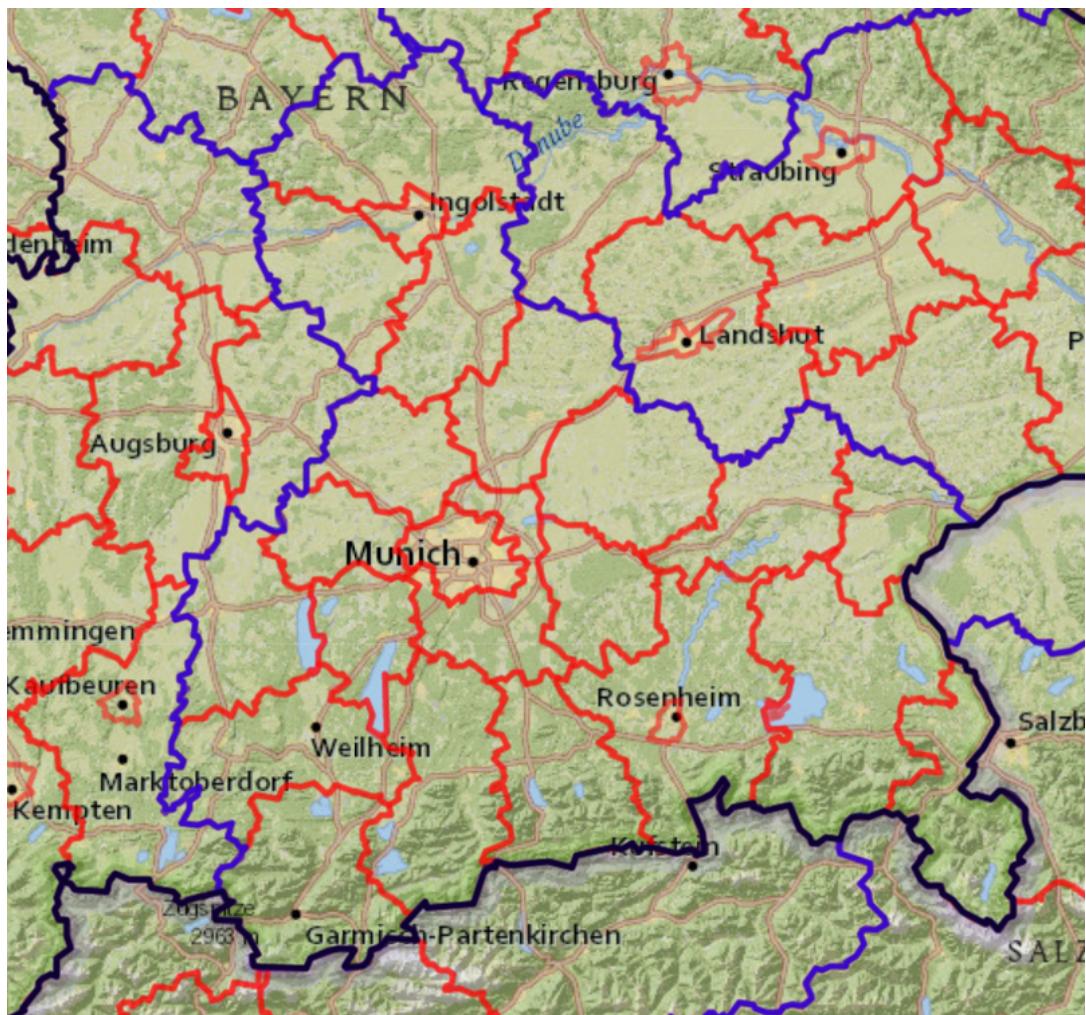
# Present situation of the MSc final project

## What I planned to do, current situation and plans for project submission

### What I planned to do:

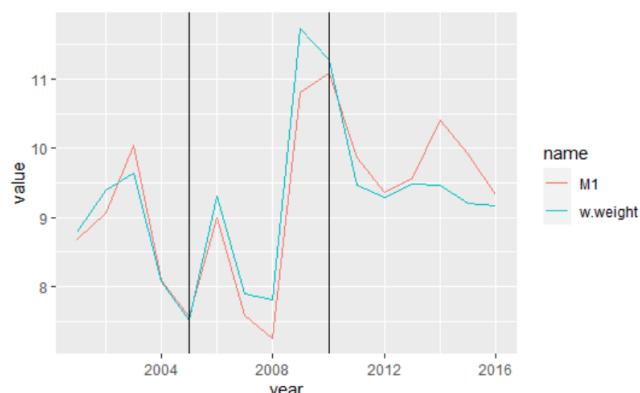
- Look how the announcement and implementation of Low Emission Zones affected local GDP and labour outcomes in each German city that applied it (represented by a NUTS 3 region) see how pollution mediated these effects. Use a large set of European controls to create a synthetic control for each city and estimate the treatment effects and ATE. Complement this with the effect labor outcomes for NUTS 2 regions.
- Local GDP was highly affected in the financial crisis and had an important confounder:
  - The German "Scrapage" program of vehicle substitution. It was the biggest in the world (5billion€, **61€** - 0.15% of GDP - per capita) and lasted from January 2009 to September 2009. It most probably was unequally distributed between cities that had announced a LEZ and those who had not.
- So I focused in Labor outcomes that would be less affected by this program (with lower spatial definition). This greatly limited my number of treated units as many NUTS 2 regions include more than one treated or are too big to really consider them as a good representation of the city's outcomes. From 58 LEZ I end up having 7 large cities that I could study, with **only 5** that have a strong dominance of their region.

Münich NUTS 3 (red) and NUTS 2 (blue)



- I planned to use MASC, a method being developed by Giovanni Mellace, Alessandra Pasquini to estimate the mediating effect of the reduction of pollution caused by LEZ in labor outcomes. Alessandra nicely provided me with the R code and I had to modify it for my purposes.
- **Pollution estimates** (derived from satellite data and weighted by population and GDP rasters) **were too noisy to perform MASC**. Without mediators, there is no added value on performing MASC over other Synthetic Control methods. I decided to leave MASC for this project and the idea of having an estimation of the mediator effect.

*Example of values for pollution for a Treated city (M1) and its synthetic control (w.weight). The high variability does not allow to create a meaningful synthetic control. Announcement in 2005, implementation in 2010.*



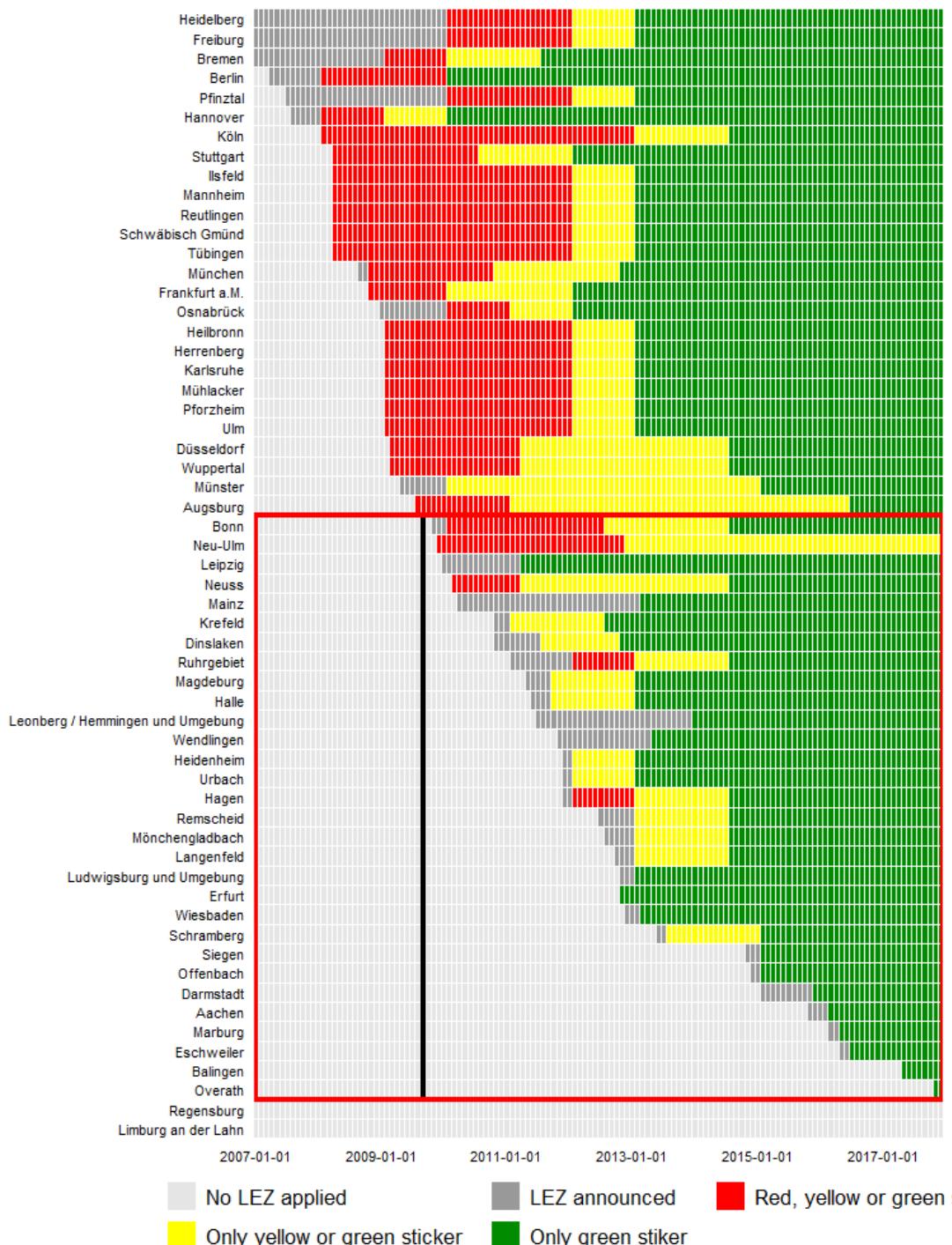
Note: A separate section at the end shows some results in MASC. I continue to think the method and research question are relevant but I don't feel I have the time to get data from a different source.

With that in mind, **there was a clear change in sample, outcomes and methodology**:

- **Methodology:**
  - I started to use the *Generalized Synthetic Control Method* (Gsynth) to estimate the effect of LEZ in labor outcomes given it allows for additional controls that the classical SC lacks such as:
    - Unit and time fixed effects,
    - Confidence intervals of treatment effects calculated by a bootstrap procedure.
    - Joint calculation (all treated at once) of the influence of unobserved factors in the outcome, and a Cross-validation procedure to choose how many to include.
    - Weights of control regions can be negative and don't have to add to 1 (less interpretability but more flexibility)
- **Sample:** To review it I checked the possible sources of endogeneity: There are 3 main limitations to get the causal effect of the policy on the treated (from less to more difficult to control). All of them are documented by previous research.
  - **(1) Anticipation to the policy**
    - which is fixed using the announcement date.
  - **(2) Partial spillovers of the policy** (cars go in and out of each city and the policy affects surrounding areas too)
    - Which I control by excluding NUTS regions that have any space in a 30 and 60km radius of a treated city. This highly reduces the number of controls in Germany, Netherlands and Belgium.
  - **(3) Time-variant confounders that act after the announcement of the LEZ** (2006, 2007, 2008, 2009 for my sample). For example when comparing German cities unemployment with some other European cities, the effect of the financial crisis is clear.
    - I try to control for the unequal effects of the financial crisis on growth trends by taking only cities from Germany, Netherlands and Belgium (and maybe Austria) as possible controls.
    - It's still **impossible** to control for the "Scrapage" program mentioned before for values of growth as some cities received a strong fiscal stimulus, for that reason I restrict the sample to cities that were **announced after** the end of the scrapage program.
      - For that I already researched the announcement dates of most of LEZ and 29+ are after September 2009 (*black line below*) and looks like a good treated pool.
      - They are usually small cities that do have sufficient similar-sized controls inside and outside Germany

and I have 9+ years of pre intervention period to give confidence that the the pre-intervention paths are parallel.

- Provisional estimates are usually non-significant until the application of the LEZ. After they show an ATE of 5% decrease in GDP/capita



## Current situation

**Title:** The effect of Low Emission Zones in the local economy: A synthetic control approach to German cities.

**Questions:**

Main question:

- What was the effect of the application of Low Emission Zones (LEZ) on German cities economic outcomes and labour market indicators?

Complementary questions: (subject to the adequacy of methods and time constraints)

- Which sectors are more affected by the policy?
- Has it improved labour outcomes for women?
- What would be the effect of a “German” LEZ in other German or European cities that have not applied it? (*probably won't have time but I think it could be of great value*)

**Outcomes:**

1. The effect of LEZ in small cities' aggregate output (after the end of the Scrappage program)
  - Selection criteria for treated and control
  - Justify why I believe a causal effect can be derived from this estimates (no major shocks + over 7 years of pre-treatment period)
  - GDP per capita
  - GDP per worker
  - Proportion of GDP of selected sectors
    - Retail
    - Transport
    - Public
2. The effect of large LEZ on Labor outcomes (big cities, with outcomes that should not be affected by the scrappage program, and based on NUTS2 regions)
  - Selection criteria for treated and control
  - $\frac{\text{Woman in active population}}{\text{Men in active population}}$  (*any positive effect for women?*)
  - Employment proportion of relevant sectors
    - Retail sector (*does it decrease?*)
    - Transport sector (*does it decrease?*)
    - Public sector (*does it increase?*)
3. The potential effect of a LEZ in cities that have not applied it

**Structure (*This is just a tentative index*):**

1. Introduction
  1. Reasons for LEZ (Pollution -> health -> legislation -> objective is to reduce pollution)
    - Explain prevalence of pollution, sources and relation with road traffic

- Explain the institutional background of LEZ, why are they applied and how they are applied in Germany

## 2. Economic critiques of LEZ (Economy, Investment, )

- Economic theory of suboptimal allocation and externalities
- Examples of critiques (studies and opinions from newspapers)

## 3. Why and how (literature) a LEZ can improve the economy? (theory of change)

- (1) Less congestion, less pollution, less health costs creates...
- Less mortality, more productivity, better cognitive performance, less absenteeism.
  - Less absenteeism especially in women

## 4. My question, does this apply to LEZ? Which effect prevails?

- Explain the major confounding factor: the application of the scrappage program

## 2. Data Sources

1. Y, X: Eurostat
2. Treatment status of every European city: Ministry of environment, historical documents and scrapped webpages.

## 3. Analysis techniques

### 1. Generalized Synthetic Control Method

1. Characteristics, reasons to choose model and how do I control for confounders
2. The effect of LEZ in small cities' aggregate output (after the end of the Scrappage program)
  - Selection criteria for treated and control
  - Justify why I believe a causal effect can be derived from this estimates (no major shocks + over 7 years of pre-treatment period)
  - GDP per capita
  - GDP per worker
  - Proportion of GDP of selected sectors
    - Retail
    - Transport
    - Public

### 3. The effect of large LEZ on Labor outcomes (big cities, with outcomes that should not be affected by the scrappage program)

- Selection criteria for treated and control
- $\frac{\text{Woman in active population}}{\text{Men in active population}}$  (*any positive effect for women?*)
- Employment proportion of relevant sectors
  - Retail sector (*does it decrease?*)
  - Transport sector (*does it decrease?*)
  - Public sector (*does it increase?*)

### 4. The potential effect of a LEZ in cities that have not applied it. (*if I have time*)

- My proposal for an "inverse synthetic control method"

#### 4. Results

- *Presented in such a way we the general ATE is the main result.*
- *We then see the specific treated and synthetic control for some regions that are of special importance or act as good examples.*
  - *The pre-intervention placebo*
  - *Treatment effect*
  - *Map of control regions by weight*
- 1. The effect of large LEZ on Labor outcomes
- 2. The effect of LEZ in small cities' aggregate output
  - Explain that  $GDP \neq$  aggregate utility and having less pollution is surely valuable
- 3. Results for the "inverse synthetic control method" for one or two example cities. (*if I have time*)

#### 5. Conclusions

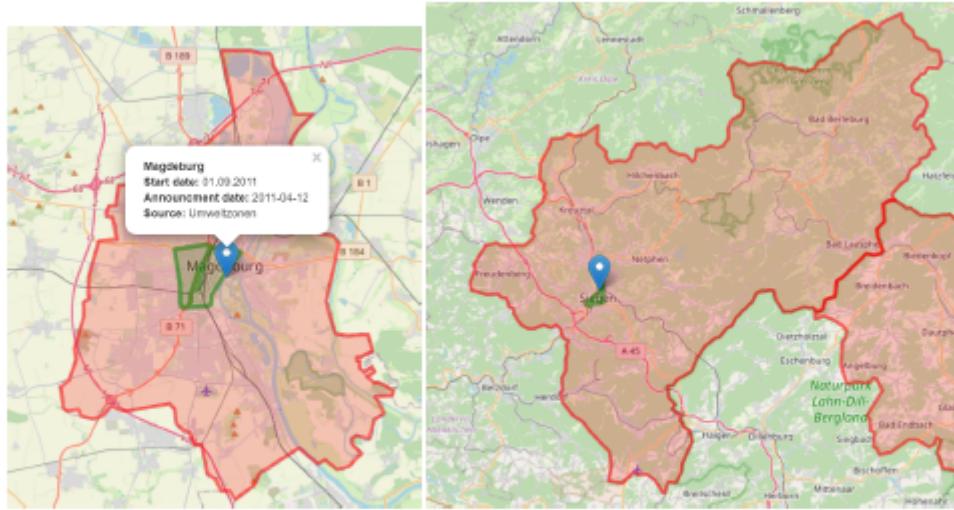
1. Summarize, conclude, further research (mention MASC and possibility of doing mediation analysis)

#### 6. Annexes:

1. Data sources
2. Results for specific cities
3. Implementation on LEZ in Germany (with announcement date)
4. NUTS2 and 3 regions for Germany and Europe

### **Example of presentation of results:**

For the cities of Magdeburg (eastern rural Germany with a very clear dominance on their NUTS 3 region) and Siegen (Western rural Germany, close to Köln and a very minor dominance over theirs). The outcome variable is local aggregate GDP/capita (€).



(a) Map of Magdeburg and NUTS 3 region

(b) Map of Siegen and NUTS 3 region

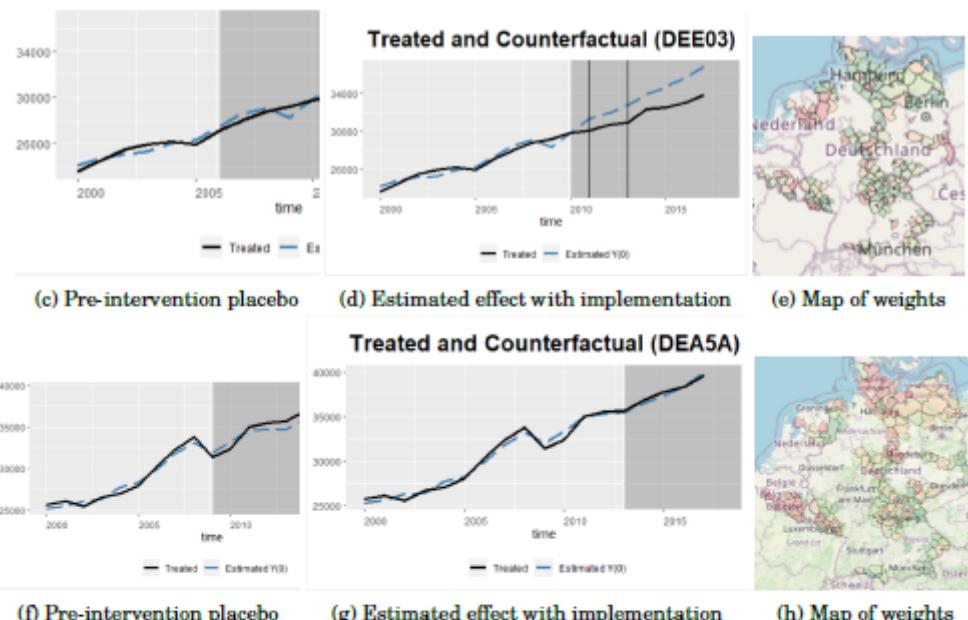


Figure 2: Example of results for the effect of GDP per capita for Magdeburg (first) and Stegen (second). Both correctly follow the same path before the announcement and while Stegen (small city relative to region) has no effect on GDP, we can see a 5% decrease in GDP after 5 years of the announcement of a LEZ in Magdeburg.

While Synthetic Magdeburg takes weights (green color) from eastern and northern Germany, synthetic Stegen is created with rural areas from western and southern Germany.

## Other topics to discuss:

1. For COVID and other issues an extension period was granted for 10 working days (so the submission date is the 20th of August and not the 6th. I plan to finish it on the weekends.

End