Spatial data

Methods and identification

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Overview

- Boundary Discontinuity Design
- Natural experiments
- Spatial econometrics

Boundary Discontinuity Design

Regression discontinuity design

Pioneered by Thistlewaite, Campbell (1960) (https://doi.org/10.1037/h0044319).
Fundmental idea:

- there is some measurable characteristics x
- exist rhreshold t where $x > t$ implies treatment, otherwise not.
- we can compare groups around t:
    - just above is treatment group
    - just below is control group

Spatial discontinuities

Black (1999) (https://doi.org/10.1162/003355399556070) argues that administrative boundaries can be used as regression discontinuity

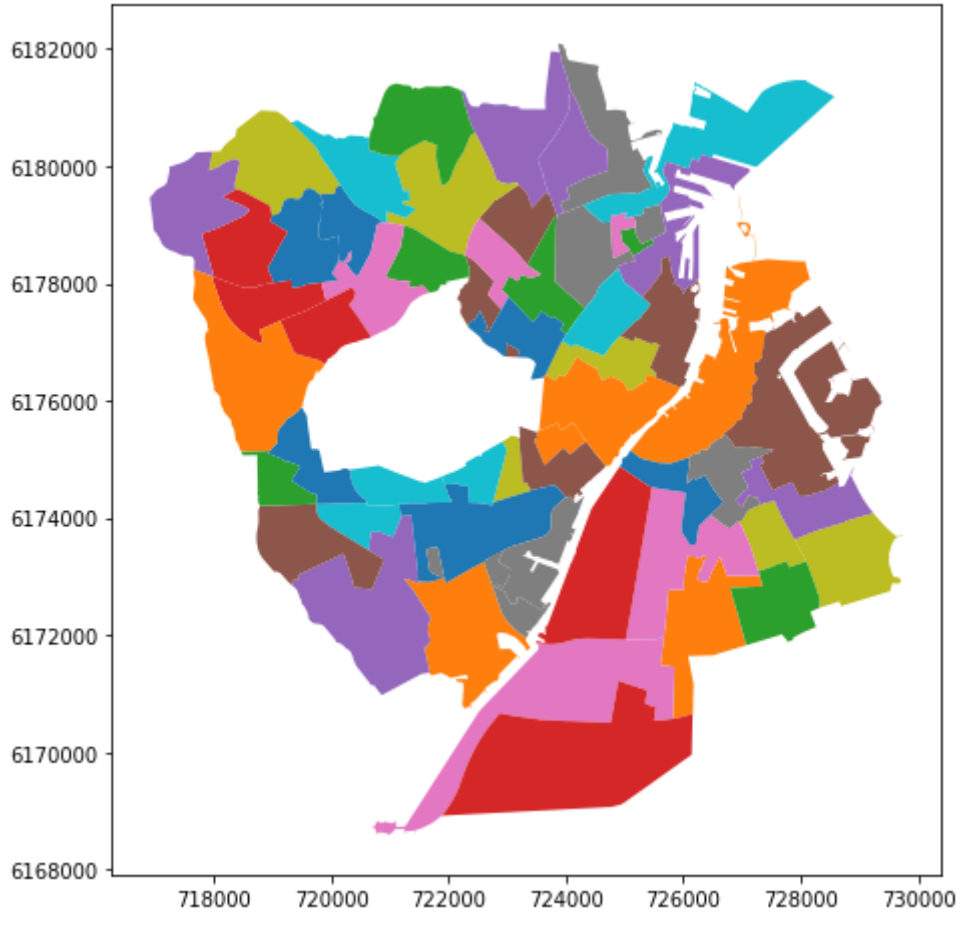
- Municipal borders affect residents which implies differences in taxes, services etc.
- School districts affect school guarantees.
    - Black finds strong effect on house prices from schools.
- Idea: unobserved selection is removed.

School districts in Copenhagen

We can repeat the analysis with data from Copenhagen (exercises).

In [3]:
```
gdf.plot(column='skolekode', figsize = (8,8))
```

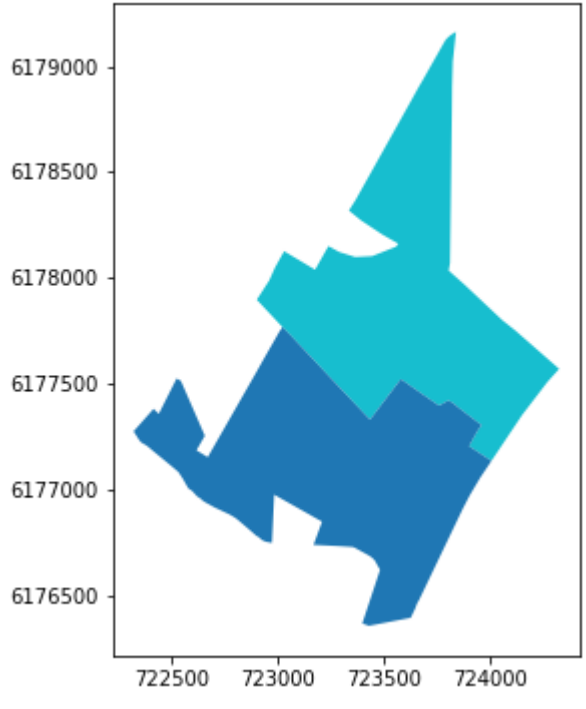
Out[3]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x138feced780>
```



School districts in Indre Nørrebro

In [4]:
```
gdf_in = gdf[gdf.skolekode.isin(['BLÅ','GUL'])]
gdf_in.plot(column='skolekode', figsize = (6,6))
```

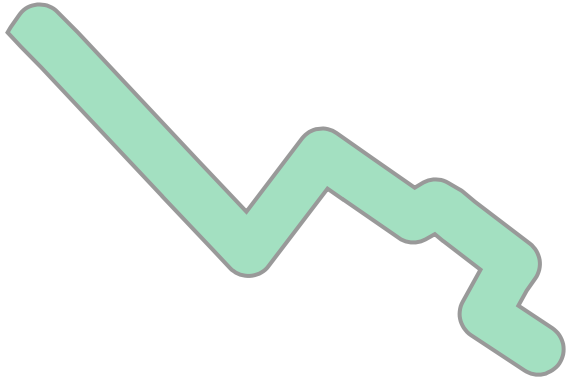
Out[4]: <matplotlib.axes._subplots.AxesSubplot at 0x138fb499a20>



School district boundaries in Copenhagen

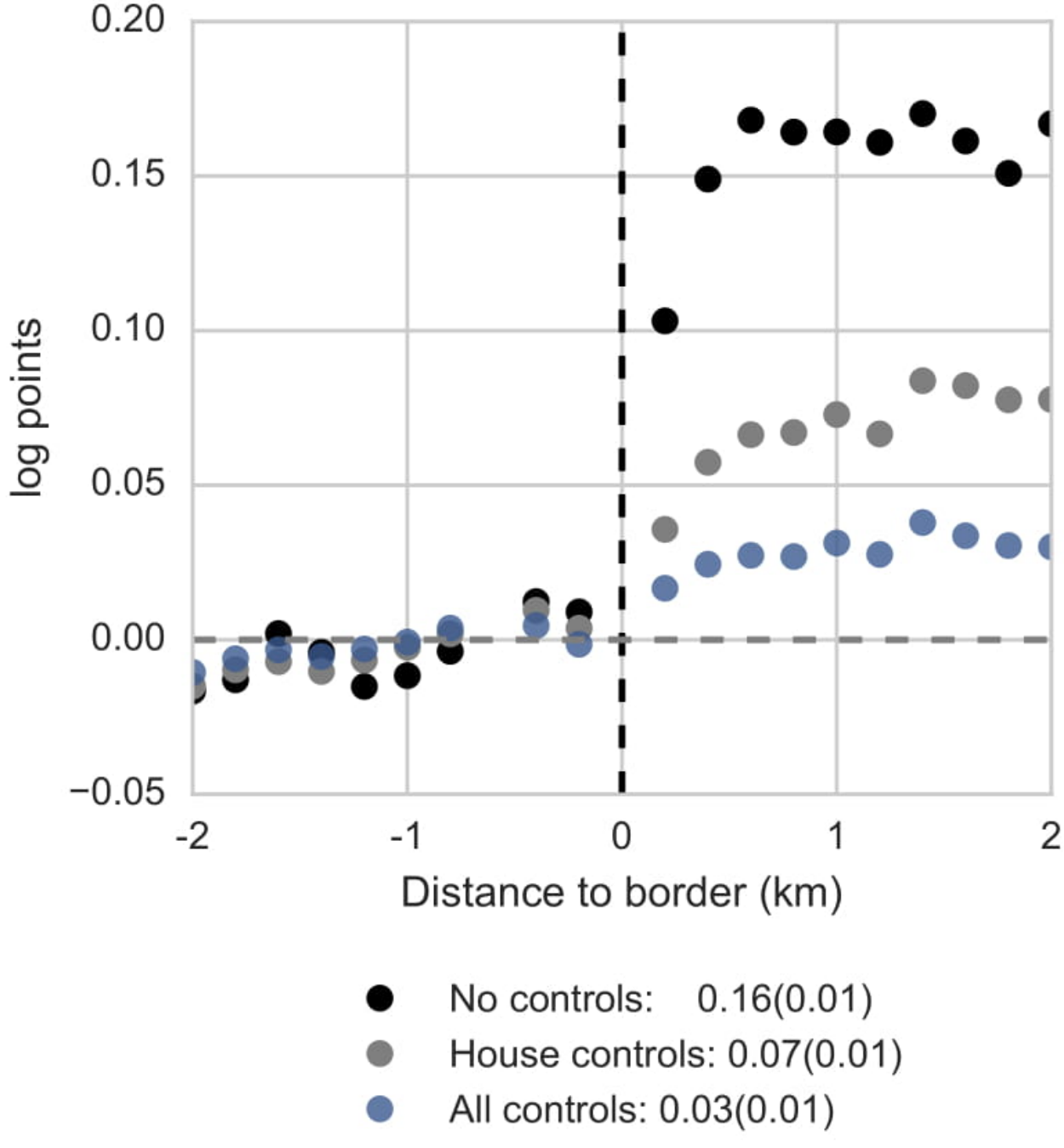
In [8]:
```
border_dist_m = 50
g,b = gdf_in.geometry.buffer(border_dist_m).tolist()
g.intersection(b)
```

Out[8]:



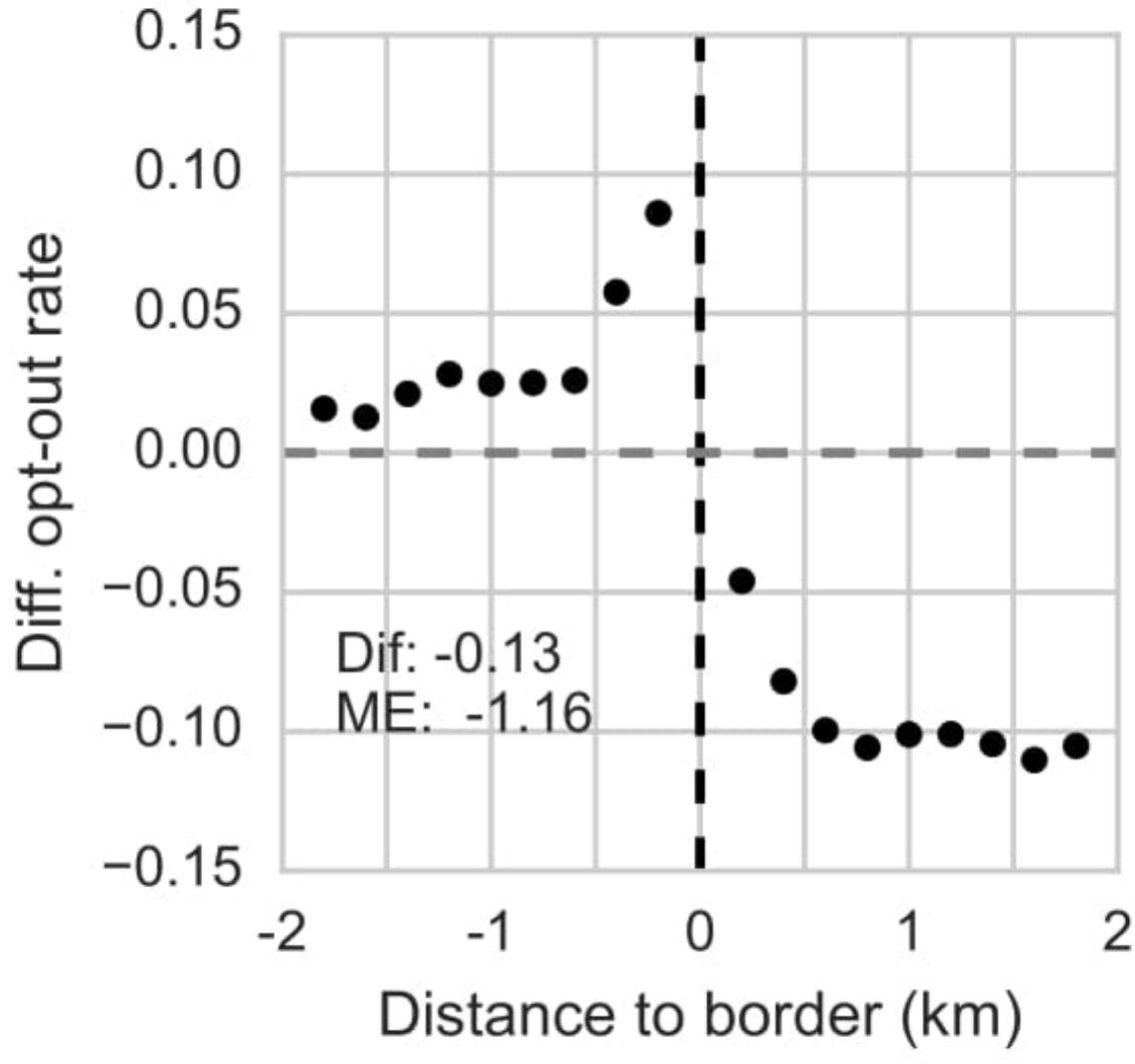
School districts impact on house prices

School boundary distance and house prices in Denmark


0.20
0.15
0.10
0.05
0.00
−0.05
log points
-2
-1
0
1
2
Distance to border (km)
No controls: 0.16(0.01)
House controls: 0.07(0.01)
All controls: 0.03(0.01)

School districts impact on enrollement

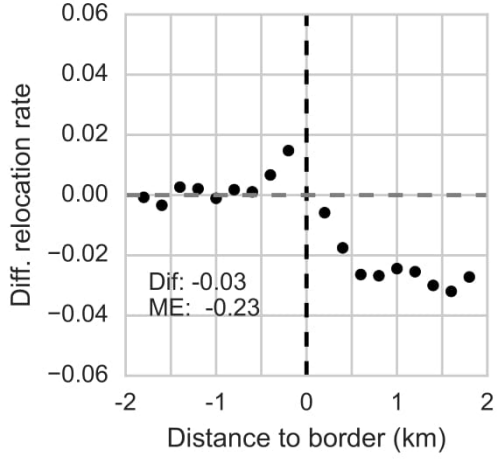
Bjerre-Nielsen, Gandil (2018) (https://www.dropbox.com/s/1buc3mnz9dot8zt/OptingOutOfPublicSchools.pdf?dl=0) analyzes local school avoidance across school boundaries


0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
Diff. opt-out rate
Dif: -0.13
ME: -1.16
-2
-1
0
1
2
Distance to border (km)

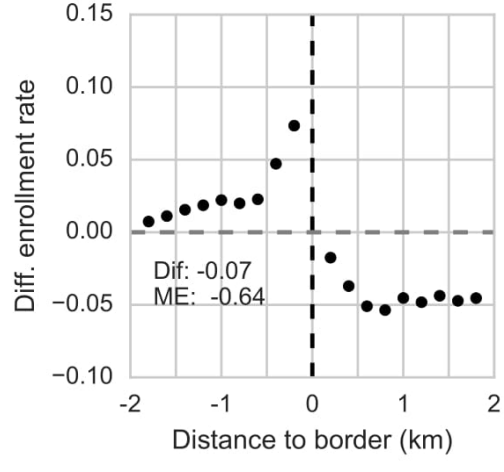
School districts impact on enrollement

School boundary distance and breakdown of local school avoidance

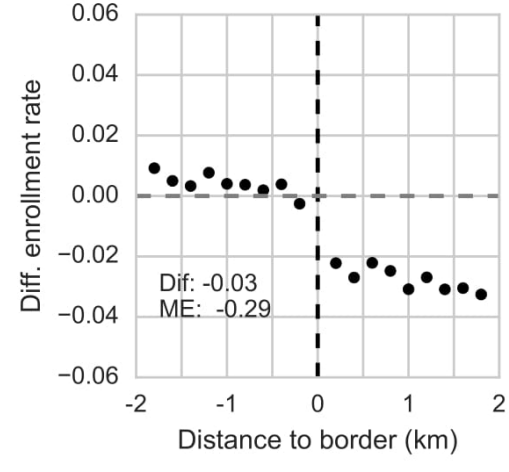
Moving district



Other public school



Private school



Newer studies

- Gibbons et al. (2013) (https://doi.org/10.1016/j.jue.2012.11.001) uses a matching approach and compare with similar houses across borders. Smart robusness:
    - control local spatial price trends within borders
    - removes border on large roads
- Fack, Grenet (2010) (https://doi.org/10.1016/j.jpubeco.2009.10.009) shows that the local availability of private schools decreases effects of school districts on house prices

Closing thoughts

- Remaining threats
    - are neighorhood controls bad?
        - these are co-determined by school districts
    - is there a discontinuity? risk of redrawing boundaries is larger near boundary
    - selection (unobservable differences)
- Proposed mechanism: school reputation
    - Figlio, Lucas (2004) (https://doi.org/10.1257/0002828041464489) show that differences across school districts are driven by long term changes in school grades
    - Fiva, Kirkebøen (2011) (https://doi.org/10.1111/j.1467-9442.2011.01651.x) exploits a natural change in information availability and find evidence of supply of information on price differences

Natural experiments

With a spatial component

Weather effects

Since early studies on weather economists have loved it, why?

- Weather is exogenous and there is LOTS of data.
- National Oceanic and Atmospheric Administration provides global weather data

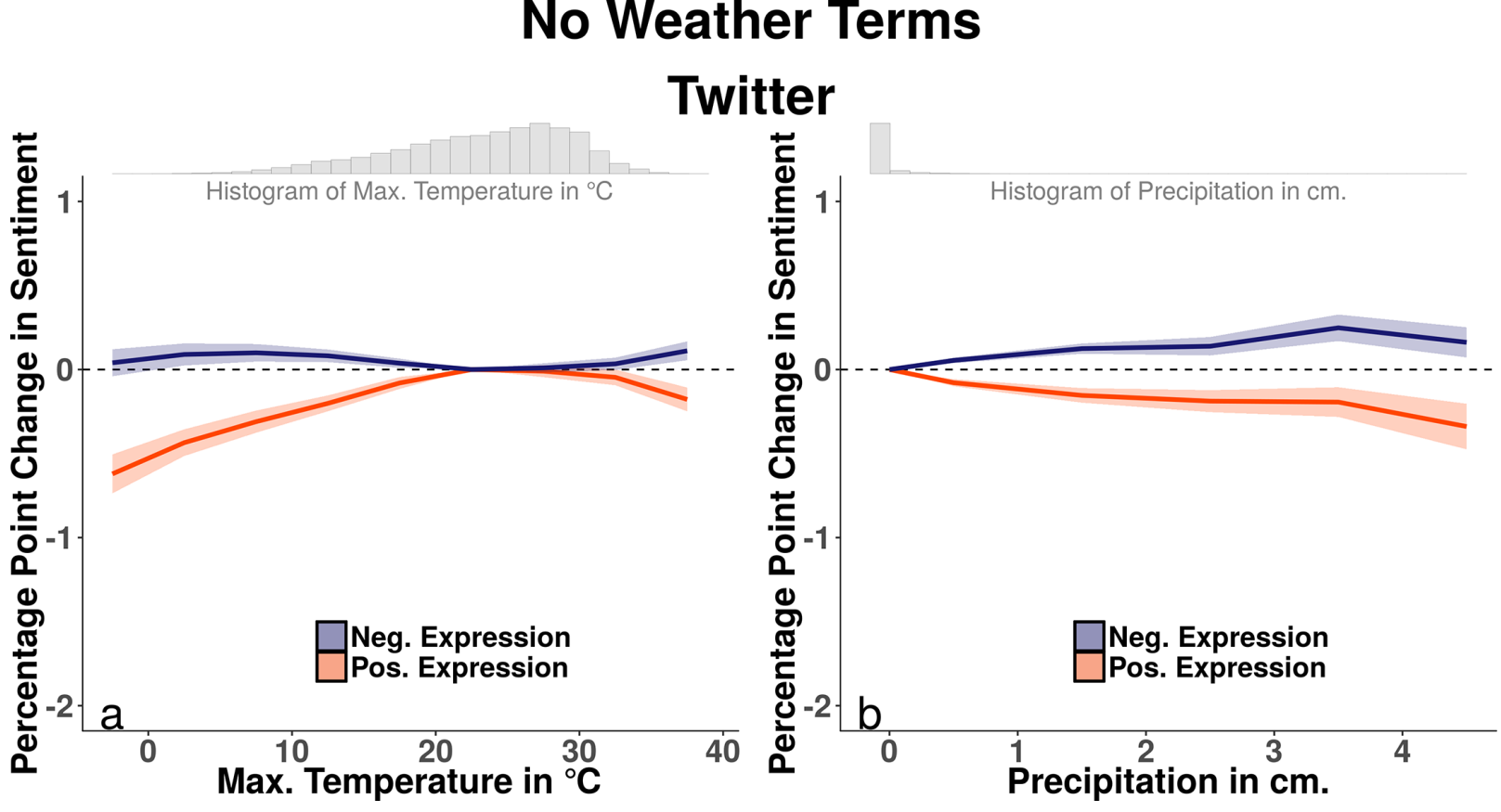
So what has been studied? Some macro effects:

- human conflicts Hsiang et al. (2013) (http://science.sciencemag.org/content/341/6151/1235367)
- economic growth Miguel et al. (2004) (https://doi.org/10.1086/421174)
- see literature review by Dell et al. (2014) (https://doi.org/10.3386/w19578)

Weather and ?

Newer have studies examined effect on individual behavior:

- sleep loss (Obradovich et al. (2017) (https://doi.org/10.1126/sciadv.1601555))
- sentiment (revealed mood) on social media (Baylis et al. (2018) (https://doi.org/10.1371/journal.pone.0195750))


No Weather Terms
Twitter
Histogram of Max. Temperature in °C
Percentage Point Change in Sentiment
1
0
-1
-2
Neg. Expression
Pos. Expression
a
0
10
20
30
40
Max. Temperature in °C
Histogram of Precipitation in cm.
Percentage Point Change in Sentiment
1
0
-1
-2
Neg. Expression
Pos. Expression
b
0
1
2
3
4
Precipitation in cm.

A note on instrumentation

In order to measure causal effect from A to B we can use instrument variables.

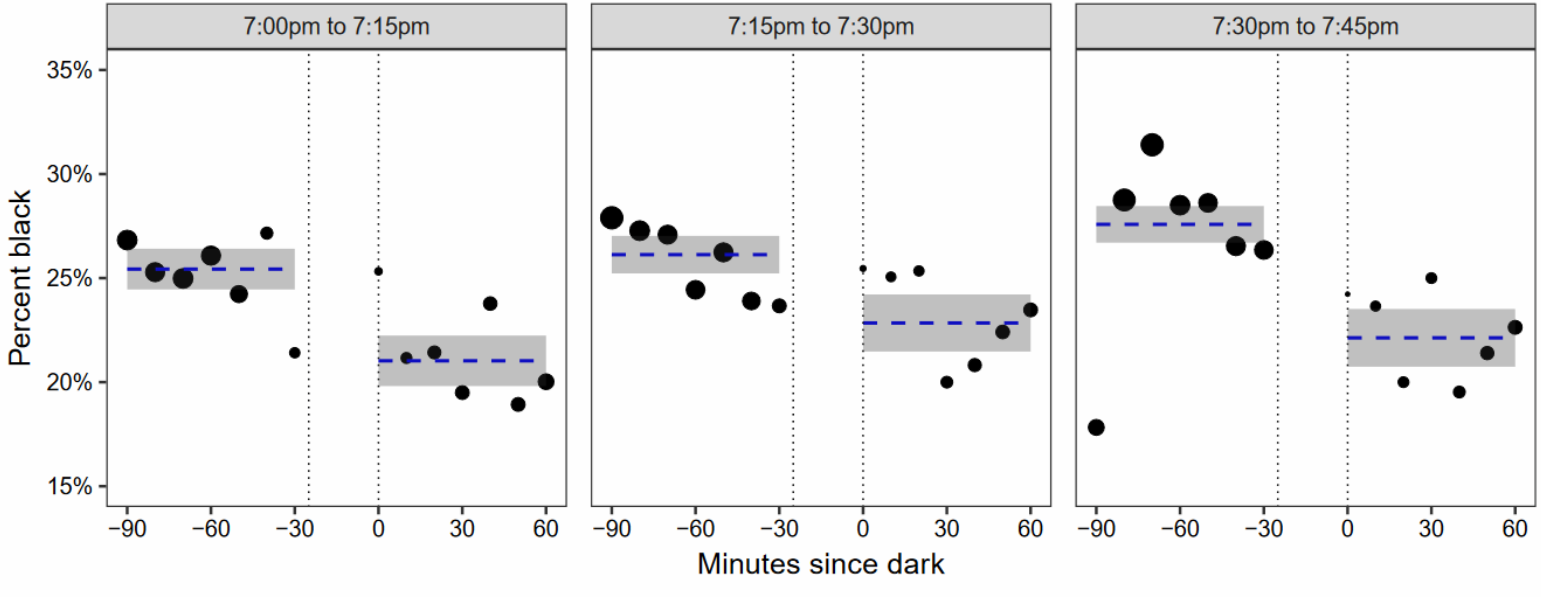
Is weather a valid instrument?

- Requires that there is only one causal path.
- Dell et al. (2014) (https://doi.org/10.3386/w19578) argues that it is still suffient to show reduced form effects (although these are not causal!)

Exploiting sunset variation

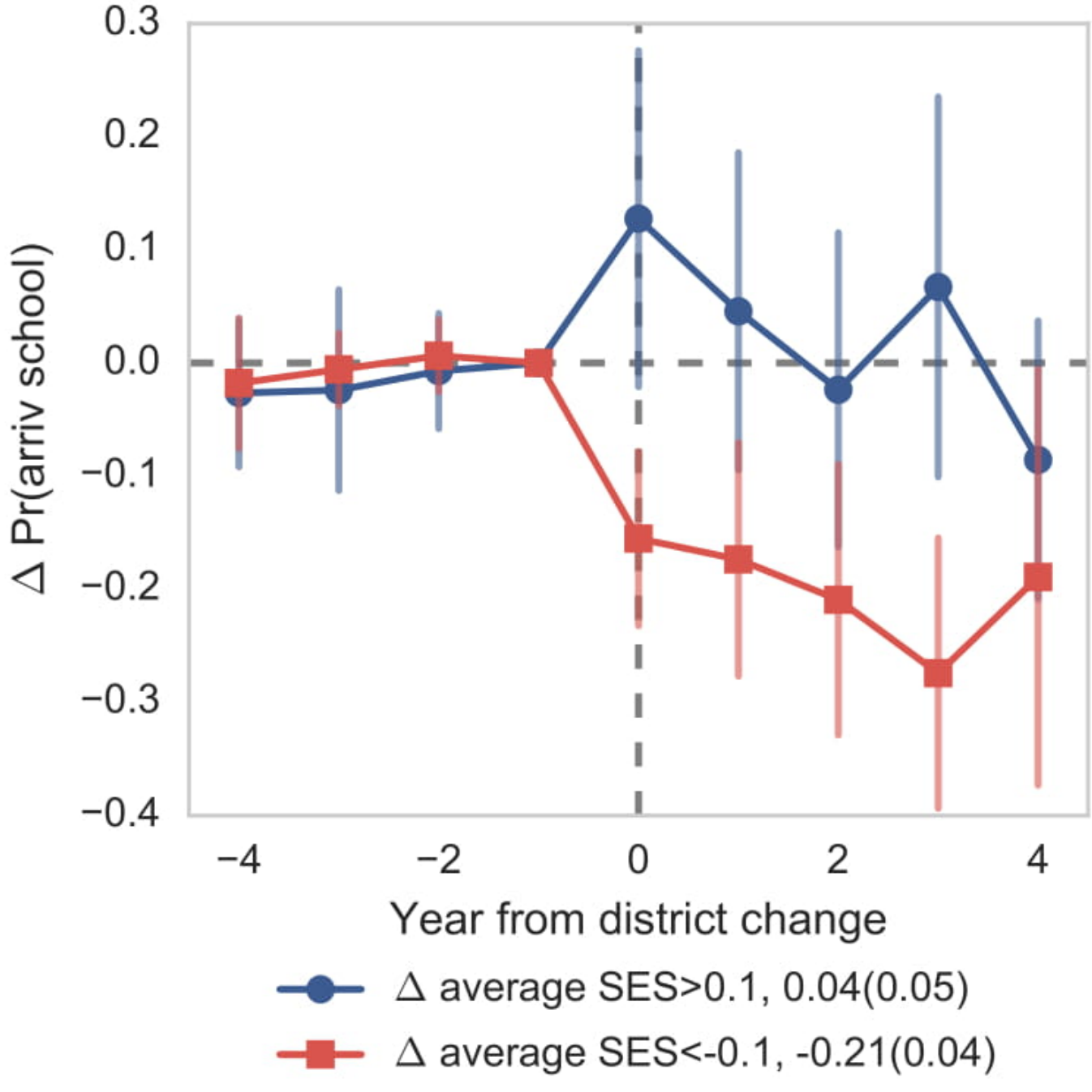
Establishing whether there is discrimination in police stops has been hard. What could be used?

After sunset discrimination is harder. [Pierson et al. (2019) (https://5harad.com/papers/100M-stops.pdf)](https://5harad.com/papers/100M-stops.pdf) uses variation in sunset times as a regression discontinuity (combines temporal and spatial knowledge!).



Changes to administrative boundaries

Bjerre-Nielsen, Gandil (2018) (https://www.dropbox.com/s/1buc3mnz9dot8zt/OptingOutOfPublicSchools.pdf?dl=0) address the selection issue by using changes in school boundaries. Avoidance of new local school:


0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
−0.4
Δ Pr(arriv school)
−4
−2
0
2
4
Year from district change
Δ average SES>0.1, 0.04(0.05)
Δ average SES<-0.1, -0.21(0.04)

Other programmes

- Urban renewal / revitalization:
    - Increases the value of nearby house prices Rossi-Hansberg et al. (2010) (https://doi.org/10.1086/653138)
- Refugee resettlement - random assignment to municipality or allow self-selection? (i.e. is sorting good)
    - Edin et al. (2003) (https://doi.org/10.1162/003355303360535225) finds that ethnic enclaves raises economic success

Spatial econometrics

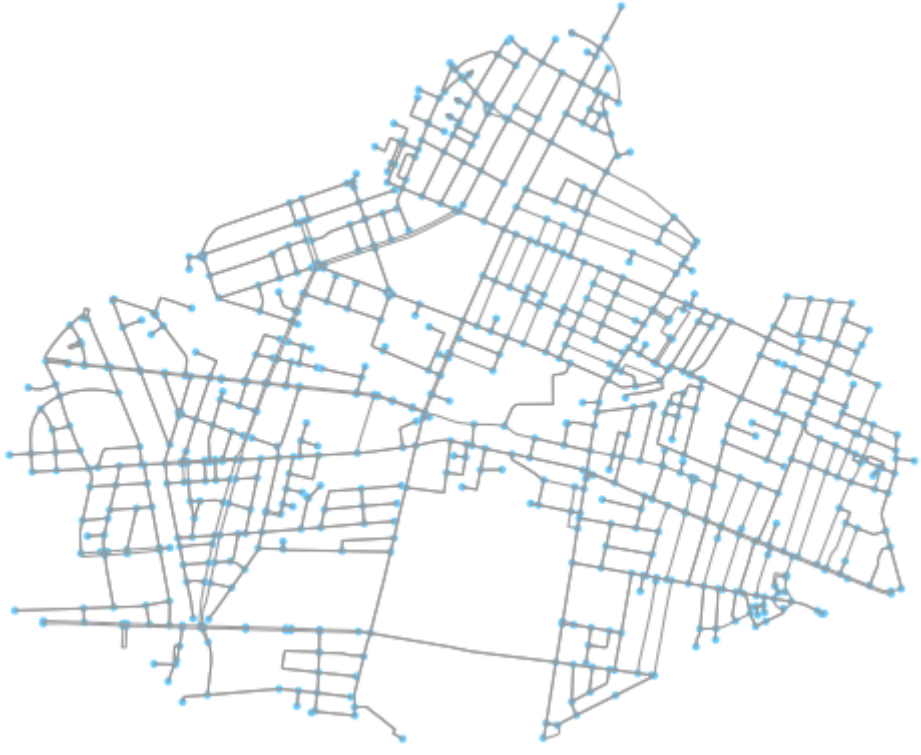
A noble goal

The goal of spatial econometrics is to identify spatial externalities. What could go wrong?

The connectivity in space implies that there is an underlying adjacency matrix.

- Frederiksberg road network

In [10]:
```
ox.plot_graph(g_frb, fig_height=7)
```



Out[10]:
```
(<Figure size 1102.99x504 with 1 Axes>,
 <matplotlib.axes._subplots.AxesSubplot at 0x1388218c438>)
```

The consequences

We can represent spatial locations as a network, e.g. within 500m of driving.

- Corrado, Fingleton (2012) (https://doi.org/10.1111/j.1467-9787.2011.00726.x) argues that network identification problems are inherited!

The problems in network identification are the same:

- selection (neighboring municipalities are similar)
- unobservable common shocks
- it is near impossible to isolate endogenous spillovers

Remedies for spatial econometrics

- Leverage spatial policies (boundaries, random allocation, timing)
    - Remember careful with structural modelling!
- Structural modelling as in Urban Economics

Summary

Today we have learned about

- boundary discontinuity design
- exogenous spatial variation
    - natural variation (e.g. weather) and policy implementation
- spatial econometrics