

Local price competition: Evidence from the Czech retail gasoline market

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Goal

Explore how local competition affects the retail gasoline prices in the Czech Republic.

Results:

- ▶ the spatial clustering of gas stations of the same brand increases the equilibrium prices
- ▶ the number of competing stations in the proximity of a station reduces its price
 - ▶ the effect fades out with the distance
 - ▶ driving distance measures it much better than great-circle distance

Literature review

Literature exploring local competition and price dispersion in gasoline markets—survey by Eckert (2013).

We follow on Pennerstorfer and Weiss (2013).

Data

Data from Pumpdroid (crowdsourcing app, more than 100,000 users on Android, other on iOS).

Number of gas stations covered: 2,657 out of 2,782 (MPO 2014) gas stations serving Natural 95.

Only Natural 95.

Time period: October 2014 (no takeovers or other ownership changes).

Data provided by Pumpdroid

Provides following variables:

- ▶ gas station's identification number assigned internally by Pumpdroid
- ▶ gas station's brand name
- ▶ gas station's location (latitude and longitude)
- ▶ date of observation
- ▶ type of fuel (we use only Natural 95 within the present study)
- ▶ price of gasoline in CZK per liter

Explained variable

Average prices of Natural 95 in October 2014 on individual gas stations in the Czech Republic.

Reasons:

- ▶ various brands may not react to changes in the gasoline wholesale price simultaneously
- ▶ most Pumpdroid users submit new information about prices only after the price changes \Rightarrow gaps in data \Rightarrow we cannot be certain that timing of each price change is recorded accurately in our data
- ▶ the resulting data are cross-sectional

We substitute the missing data with the last available information when computing the price averages.

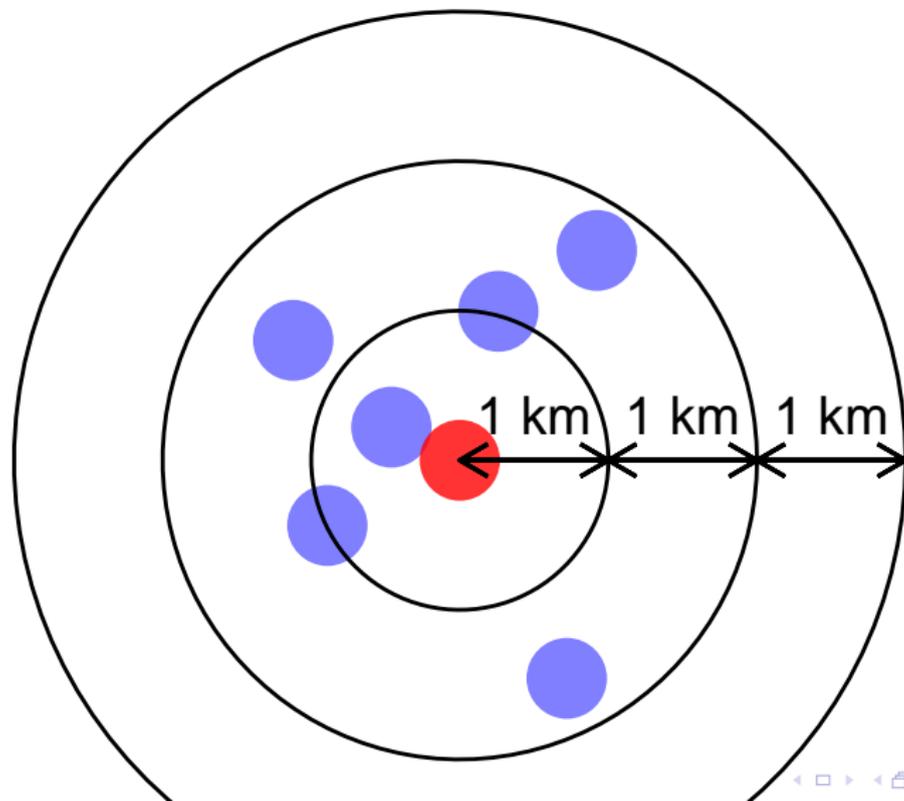
Measures of local competition

- ▶ number of neighbors within some great-circle distance
- ▶ number of neighbors within some driving distance
- ▶ great-circle distance to the closest competitor
- ▶ spatial clustering

Neighbors within some great-circle distance

Number of competitors within concentric annuli.

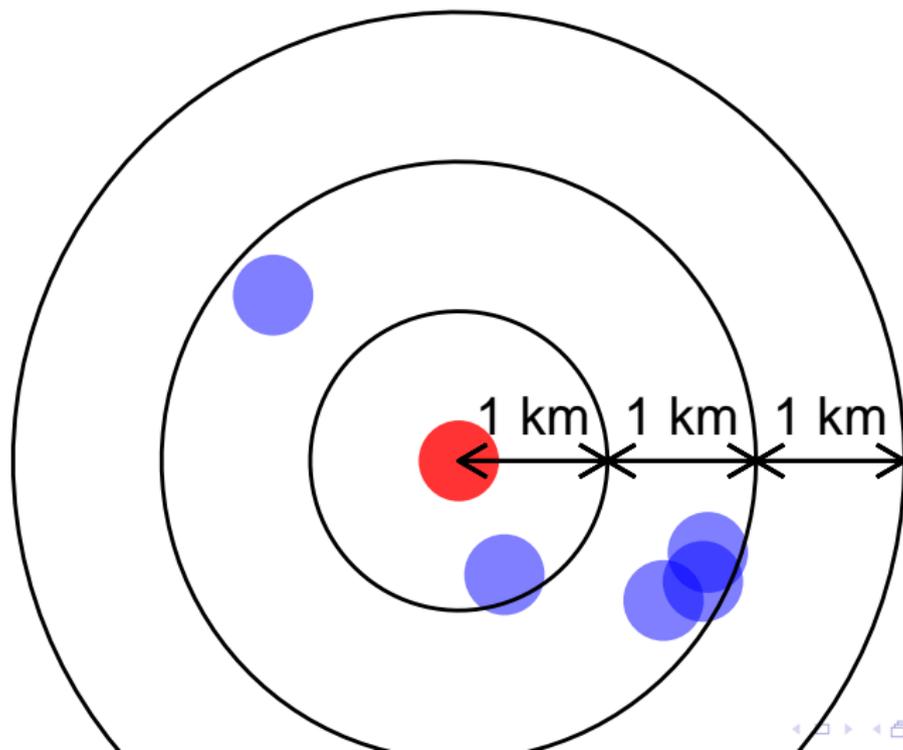
Distance measure: greater-circle distance (as the crow flies).



Neighbors within some driving distance

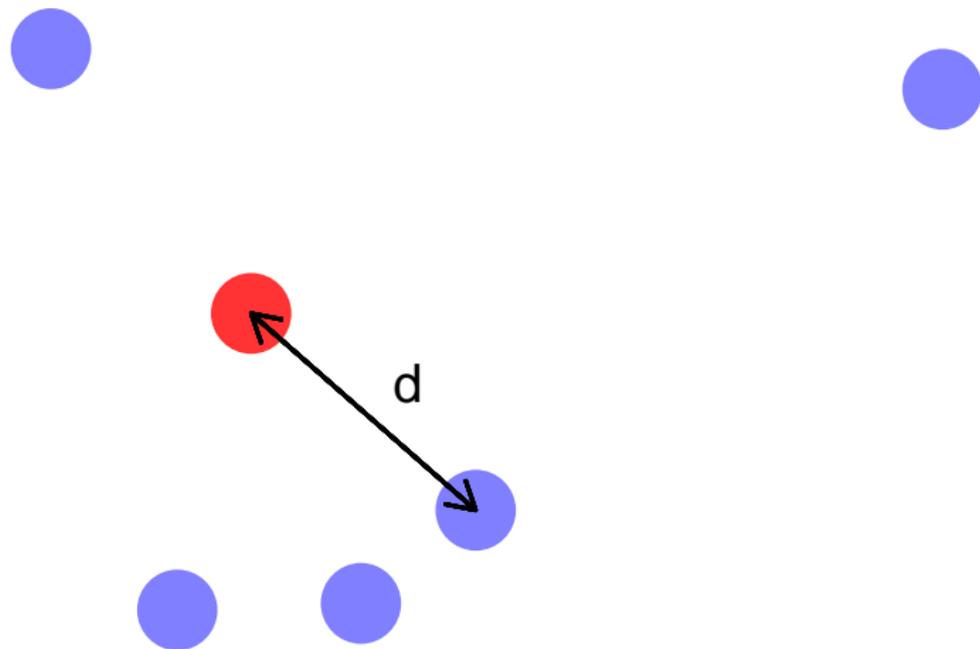
Number of competitors within concentric annuli.

Distance measure: driving distance (fastest routes from Google Maps).



Great-circle distance to the closest competitor

Great-circle distance to the closest competitor.



Spatial clustering

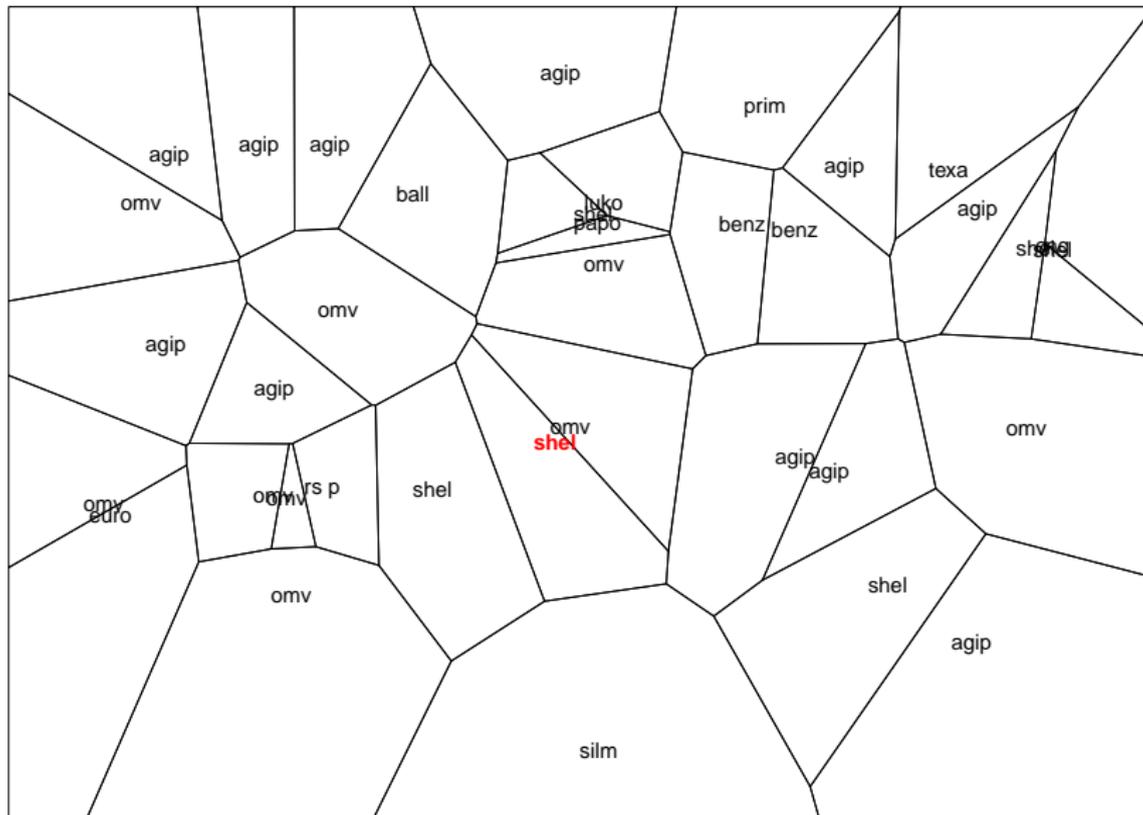
Spatial clustering (Pennerstorfer—Weiss, 2013)

Motivated by intuition of the Salop model:

- ▶ a firm in a spatial context can be somewhat protected from its competitors if its immediate neighbors are branches of the same company
- ▶ the firm, its neighbors, and their neighbors can raise their prices

Spatial clustering: example

Shell, Prague, Jižní spojka, SC = 0.5



Spatial clustering: calculation

For station i

- ▶ N_i ... number of all stations whose polygon has a common border with the polygon of station i including station i itself
- ▶ M_i ... number of clusters that touch the station i 's polygon including the cluster of the station i itself
- ▶ k_{m_i} ... number of stations in each cluster m_i

Spatial clustering of station i :

$$SC_i = \sum_{m_i} \frac{k_{m_i}}{M_i} / N_i$$

Estimation

Moran test indicates spatial effects \Rightarrow spatial error models.

The spatial weights for pair of stations i and j :

$$w_{ij} = \begin{cases} 1/d_{ij} & \text{if } d_{ij} < 20 \text{ km, or} \\ 0 & \text{if } d_{ij} \geq 20 \text{ km.} \end{cases}$$

The dependent variable: average price of Natural 95 (10/2014).

Explanatory variables: measures of local competition.

Controls:

- ▶ brand names (27 brands with at least 10 stations, and other)
- ▶ city size (Prag., Brno, Ostr., 20–50, 50–100, and 100–300 K)
- ▶ highways and expressways

Results: greater-circle distance

Table 1:

NGCDC(0,1)	-0.040**	-0.040**		
NGCDC(1,2)	-0.014			
NGCDC(2,3)	-0.010			
NGCDC(3,4)	-0.003			
NGCDC(4,5)	0.002			
NGCDC(1,3)		-0.012**		
NGCDC(3,5)		-0.0004		
log2 NGCDC(0,1)			-0.073***	
log2 NGCDC(1,3)			-0.042**	
log2 NGCDC(3,5)			-0.008	
sqrt NGCDC(0,1)				-0.079***
sqrt NGCDC(1,3)				-0.052**
sqrt NGCDC(3,5)				-0.008
GCDCC	0.013*	0.013*	0.005	0.004
SC	0.668***	0.665***	0.686***	0.685***
σ^2	0.319	0.319	0.319	0.319
Akaike Inf. Crit.	3,777.336	3,773.582	3,774.878	3,773.607

Results: driving distance 1

Table 2:

NDDC(0,1)	-0.062**
NDDC(1,2)	-0.079***
NDDC(2,3)	-0.050**
NDDC(3,4)	-0.047**
NDDC(4,5)	-0.035
NDDC(5,6)	-0.018
NDDC(6,7)	0.018
NDDC(7,8)	-0.024
NDDC(8,9)	-0.023
GCDCC	0.005
SC	0.660***
σ^2	0.316
Akaike Inf. Crit.	3,769.182

Results: driving distance 2

Table 3:

NDDC(0,2)	-0.074***		
NDDC(2,4)	-0.049***		
NDDC(4,9)	-0.025**		
log2 NDDC(0,2)		-0.111***	
log2 NDDC(2,4)		-0.085***	
log2 NDDC(4,9)		-0.053***	
sqrt NDDC(0,2)			-0.126***
sqrt NDDC(2,4)			-0.100***
sqrt NDDC(4,9)			-0.062***
GCDCC	0.005	-0.004	-0.006
SC	0.660***	0.660***	0.657***
σ^2	0.316	0.315	0.314
Akaike Inf. Crit.	3,758.609	3,748.315	3,745.548

Results: controls

From models with driving distances:

Table 4:

highways and expressways	0.432***	0.429***	0.413***	0.407***
Praha	0.441***	0.444***	0.449***	0.447***
Brno	0.753***	0.756***	0.762***	0.761***
Ostrava	0.236*	0.239*	0.253*	0.254*
cities 100–300	0.020	0.020	0.033	0.035
towns 50–100	0.105	0.105	0.116	0.115
towns 20–50	0.085	0.083	0.095	0.096
σ^2	0.316	0.316	0.315	0.314
Akaike Inf. Crit.	3,769.182	3,758.609	3,748.315	3,745.548

Summary (1)

- ▶ the number of competing stations in the proximity of a station reduces its price
 - ▶ the effect fades out with the distance
 - ▶ driving distance measures it much better than great-circle distance
 - ▶ the absolute values of the parameters of the former models are higher
 - ▶ their statistical significance is better of the same
 - ▶ they are significant for a longer distance
 - ▶ the model fit is better
 - ▶ the great-circle distance to the closest competitor is much worse

Summary (2)

- ▶ the spatial clustering of gas stations of the same brand increases the equilibrium prices
 - ▶ SC measure is robust—almost the same in all models
 - ▶ it measures something different from the competition density measures
- ▶ stations on highways and express ways are more expensive
- ▶ stations in big cities are more expensive
 - ▶ especially in Brno!

Use: merger simulation

We can simulate impact on

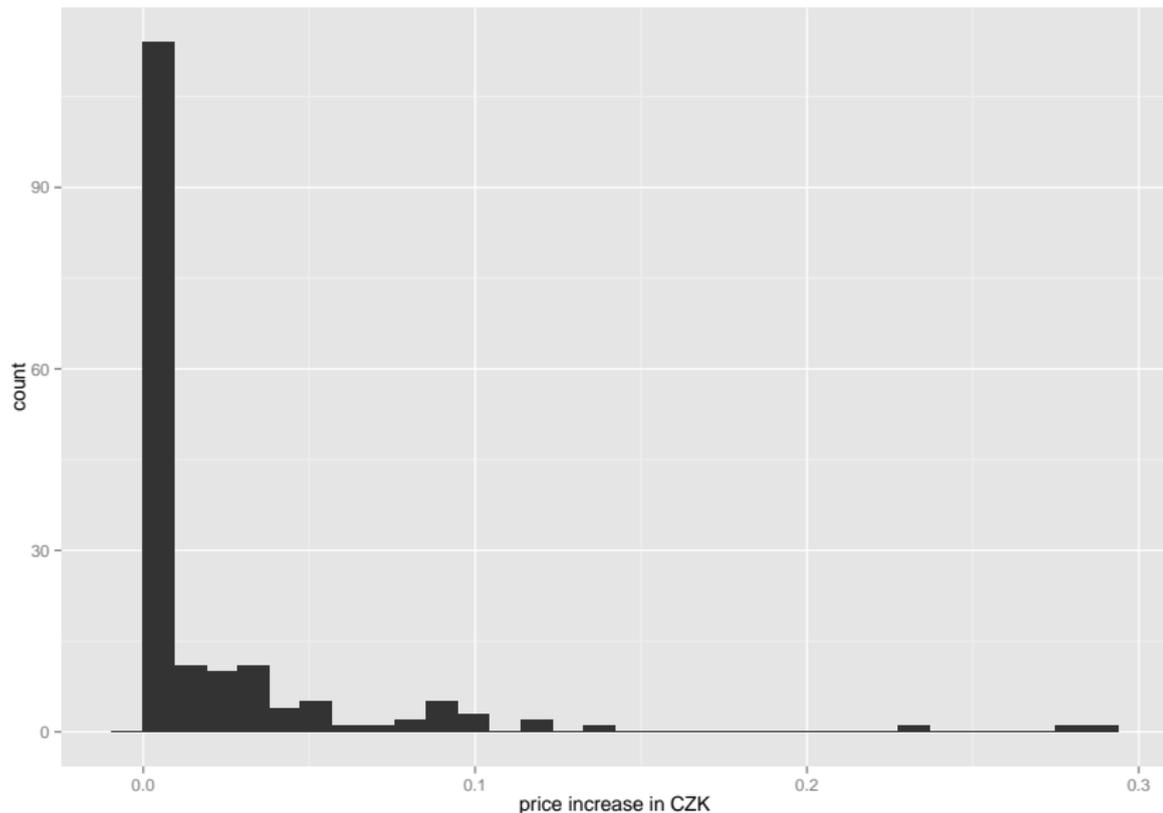
- ▶ the merged stations under assumption
 - ▶ they keep their intercept
 - ▶ they get a new intercept
- ▶ the other stations

It could be useful to

- ▶ evaluate the impact of mergers
- ▶ evaluate the impact of merger remedies

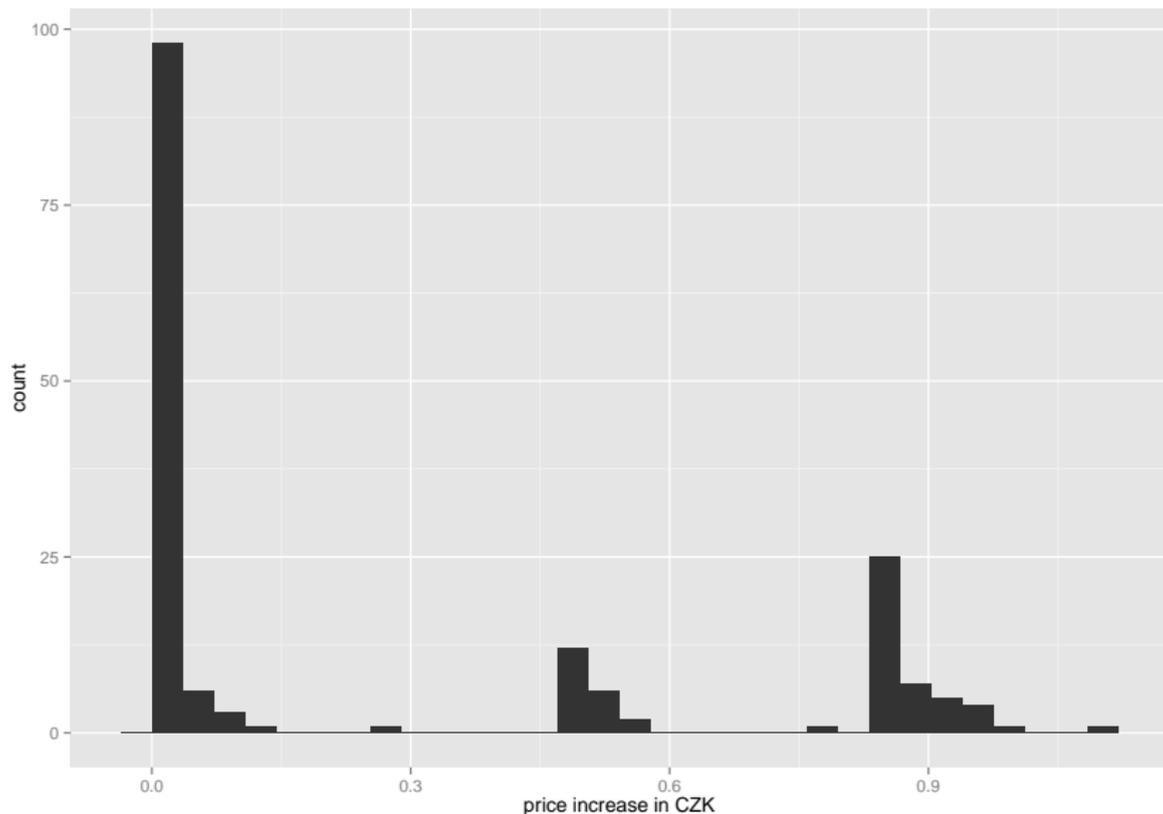
Merger Agip—Lukoil—Slovnaft (1)

The merged stations. They keep their original intercept.



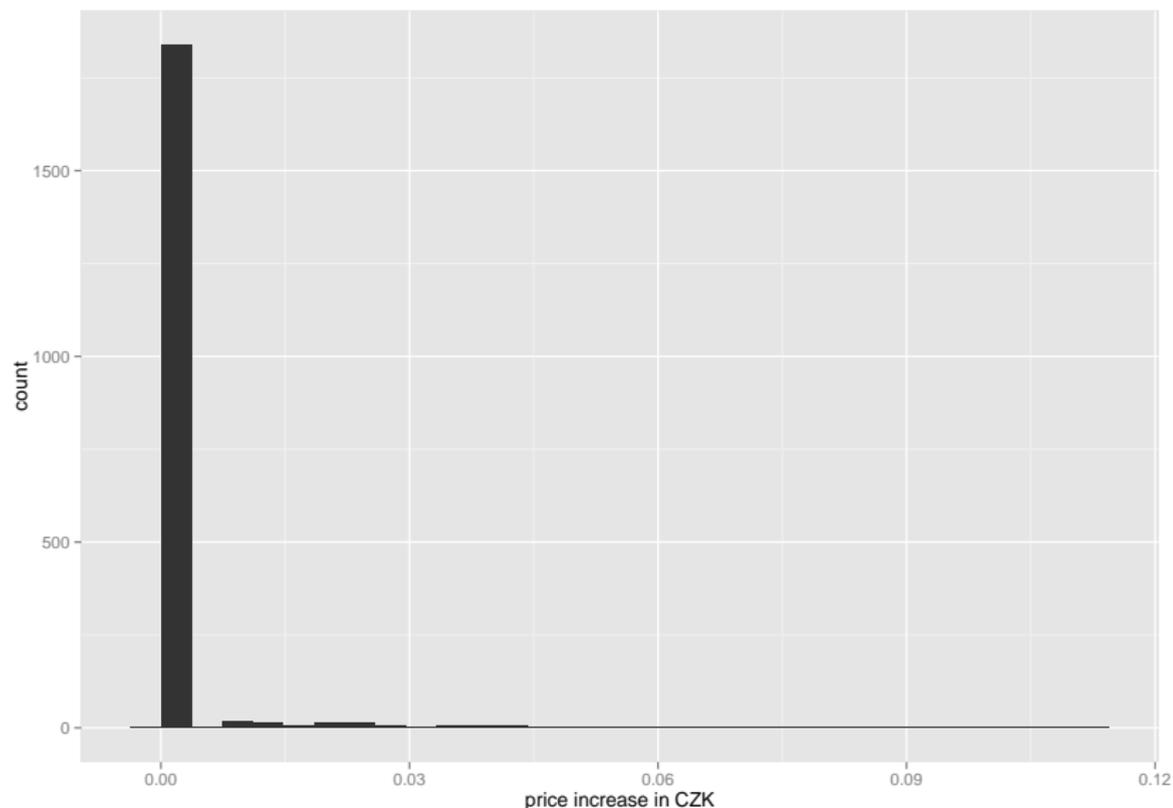
Merger Agip—Lukoil—Slovnaft (2)

The merged stations. They get the intercept of Agip.



Merger Agip—Lukoil—Slovnaft (3)

The stations outside the merger.



To Do

- ▶ calculate more competition density measures (average distance to Voronoi neighbors, ...)
- ▶ test whether the impact of spatial clustering is the same in cities and in country
- ▶ check that all competitor stations sell Natural 95
- ▶ correct ownership of about 10 gas stations
- ▶ perform robustness tests (other months, ...)
- ▶ perform the same analysis for Diesel
- ▶ test for heteroskedasticity
- ▶ SAR
- ▶ perform the analysis on merger data (panel)