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Market Structure in Local Real Estate Market

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SCOPE

The aim of my research is to:

1. Analyze possible market structure on local real estate market

2. Test empirically what market structure exhibits the real estate market of particular city (Saint Petersburg)

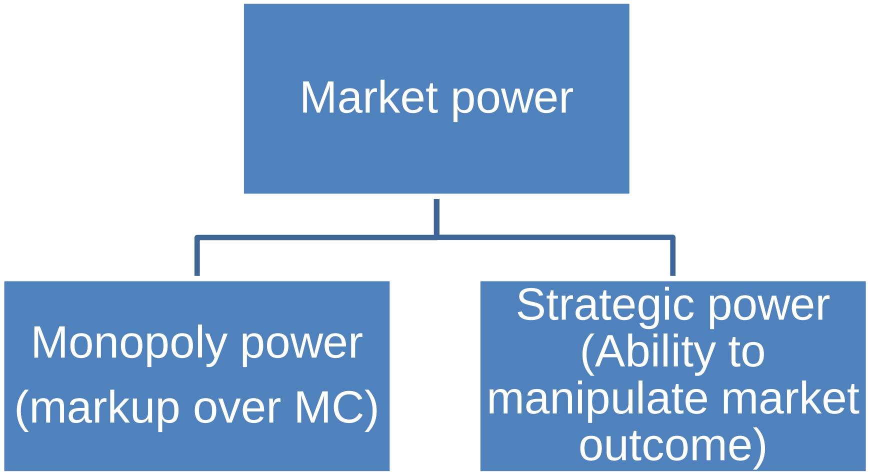
Existing studies

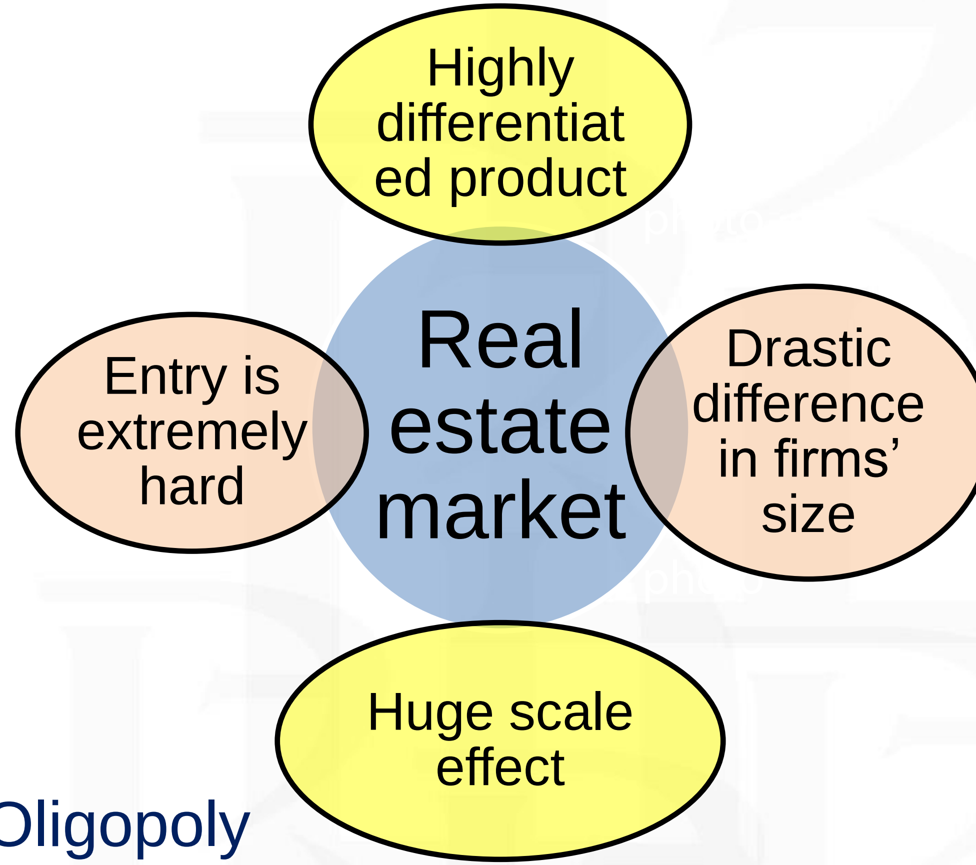
There exist a lot of literature studying how price of housing depends on:

- Its characteristics: from (Rosen, 1974) to (Goodman Jr., 1998)
- Ecology, air quality: (Kim, Phipps, & Anselin, 2003)
- Social infrastructure: (Brasington, 2009)
- Developer's status (foreign/local): (Hui, Liang, Wang, & Wang, 2015)

These studies take into account spatial structure of the market, but ignore strategic interactions among its participants

MARKET STRUCTURE





Monopoly + Strategic Power = Oligopoly

Monopoly power only = Monopolistic competition

(Thisse & Ushchev, 2018)

THE MODEL

By our definition small developer is presented near only one subway station.

Similar to (Eaton & Schmitt, 1994), given that subway station is basic product.

Linear demand for variety i:

$$Q_i = \begin{cases} \alpha_i - p_i + \gamma \sum_{j\epsilon S \setminus i} \omega_{i,j} p_j + \delta \sum_{k\epsilon B} \omega_{i,k} p_k \text{ , if } i \text{ is owned by Small} \\ \alpha_i - p_i + \Gamma \sum_{j\epsilon S} \omega_{i,j} p_j + \Delta \sum_{k\epsilon B \setminus I} \omega_{i,k} p_k + c \sum_{l\epsilon I \setminus i} \omega_{i,l} p_l \text{ , if } i \text{ is owned by Big} \end{cases}$$

Assuming zero marginal costs FOC is given by:

$$2p_i = \begin{cases} \alpha_i + \gamma \sum_{j\epsilon S \setminus i} \omega_{i,j} p_j + \delta \sum_{k\epsilon B} \omega_{i,k} p_k \text{ , if } i \text{ is owned by Small} \\ \alpha_i + \Gamma \sum_{j\epsilon S} \omega_{i,j} p_j + \Delta \sum_{k\epsilon B \setminus I} \omega_{i,k} p_k + c \sum_{l\epsilon I \setminus i} \omega_{i,l} p_l \text{ , if } i \text{ is owned by Big} \end{cases}$$

DATA

Prices and characteristics from real estate CRM system for Saint-Petersburg and Region (http://3bita.ru/).

Time period: August 2018 - December 2019 monthly

Coverage: ~95% of the market.

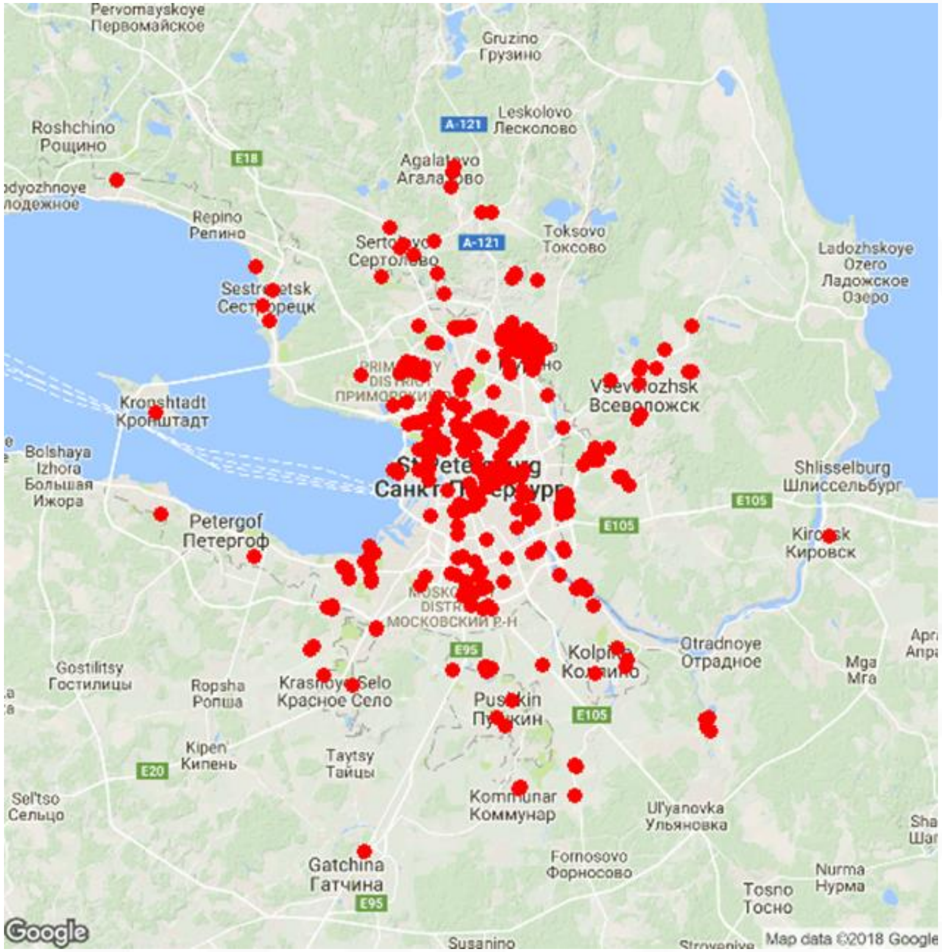
		aug18	sep18	oct18	nov18	dec18	jan19	feb19	mar19	apr19	may19	jun19	jul19	aug19	sep19	oct19	nov19	dec19	Total
Total	N appartments	75 249	73 986	72 638	70 040	68 875	67 429	67 642	70 437	75 031	76 128	68 533	66 497	67 844	64 221	66 257	64 899	63 679	
	Total stock, sq.m	3 647 760	3 600 920	3 562 138	3 449 659	3 396 130	3 324 340	3 327 902	3 494 125	3 742 130	3 771 654	3 460 080	3 346 898	3 419 282	3 238 868	3 370 252	3 305 890	3 244 982	
	N projects	308	312	313	312	308	306	307	309	302	299	302	303	303	293	292	295	289	379
	N developers	96	96	94	91	90	92	93	94	91	90	90	89	88	88	86	86	86	103
small	N appartments	11 540	11 456	12 372	12 768	11 616	11 513	11 512	11 891	12 396	13 239	11 470	10 494	11 014	9 332	10 888	10 377	10 230	
	Total stock, sq.m	623 403	617 700	653 091	667 671	622 708	624 799	624 518	655 235	679 315	695 476	616 348	578 553	609 705	522 875	592 117	568 588	560 792	
	N projects	60	59	57	55	57	60	61	63	60	59	60	61	62	61	59	58	58	76
	N developers	50	50	48	46	47	49	50	51	48	47	47	46	45	45	43	43	43	57
big	N appartments	63 709	62 530	60 266	57 272	57 259	55 916	56 130	58 546	62 635	62 889	57 063	56 003	56 830	54 889	55 369	54 522	53 449	
	Total stock, sq.m	3 024 357	2 983 220	2 909 046	2 781 989	2 773 422	2 699 541	2 703 383	2 838 890	3 062 814	3 076 177	2 843 732	2 768 345	2 809 577	2 715 993	2 778 135	2 737 302	2 684 190	
	N projects	248	253	256	257	251	246	246	246	242	240	242	242	241	232	233	237	231	303
	N developers	46	46	46	45	43	43	43	43	43	43	43	43	43	43	43	43	43	46

DATA

In order to compute spatial lags, data should be geocoded.

Each project contains one or several buildings.

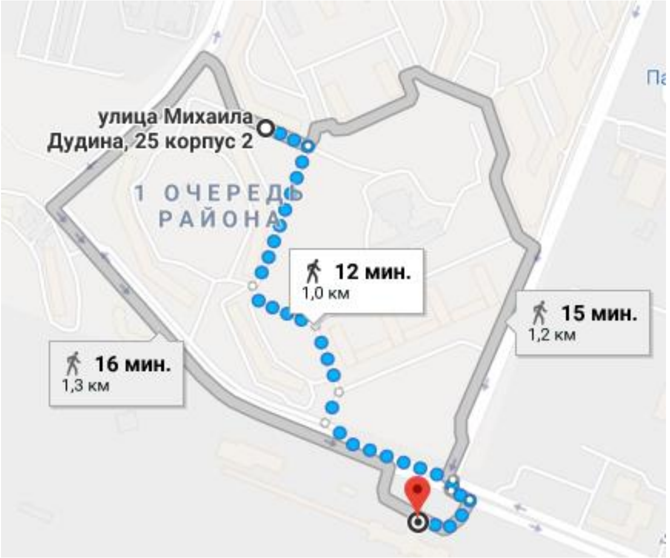
Each project is geocoded as single point on map.

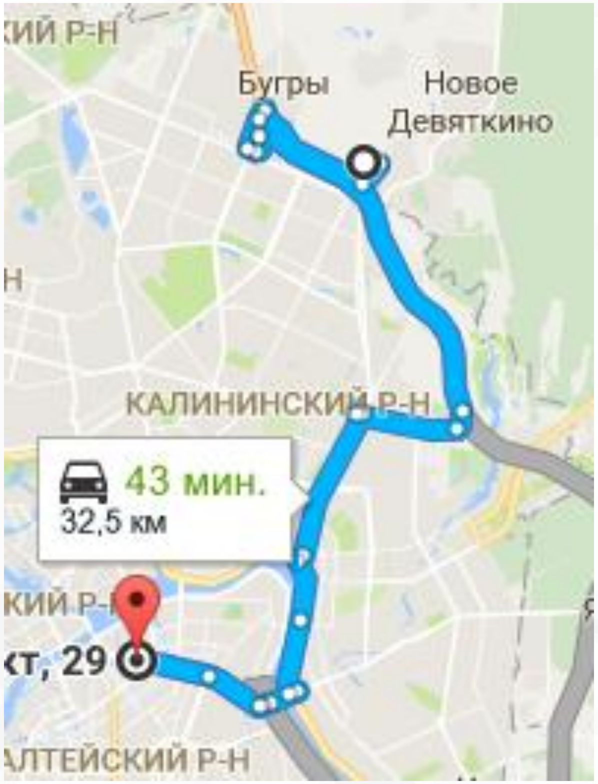


DATA

Google Maps API:

- Measure the distance to centre;
- Find a closest subway station;
- Measure the distance to it.





DATA

Small firm is presented only near one subway station.

55% developers are small.

They supply 18% of total stock.

N stations	N developers	N projects	Total stock, sq.m
1	57	76	614 865
2	13	38	499 061
3	14	54	342 210
4	3	13	113 901
5	5	33	287 662
6	2	17	198 425
7	1	10	107 999
8	2	16	199 718
9	1	11	69 151
10	1	17	125 815
12	1	20	278 195
17	2	45	498 812
18	1	29	117 304
Total	103	379	3 453 118

DATA

Compute weighted average price for each project:

$$pm = \frac{Total\ value\ of\ stock(RUR)}{Total\ stock(sq.m)}$$

Inverse Haversine distance matrix is spitted on 3 part and row normalized, price lags are:

$$Spm(i) = \sum_{j \epsilon S \backslash i} \omega_{i,j} p_j$$

$$Bpm(i) = \sum_{k \epsilon B \backslash I} \omega_{i,k} p_k$$

$$Cpm(i) = \sum_{l \epsilon I \backslash l} \omega_{i,k} p_l$$

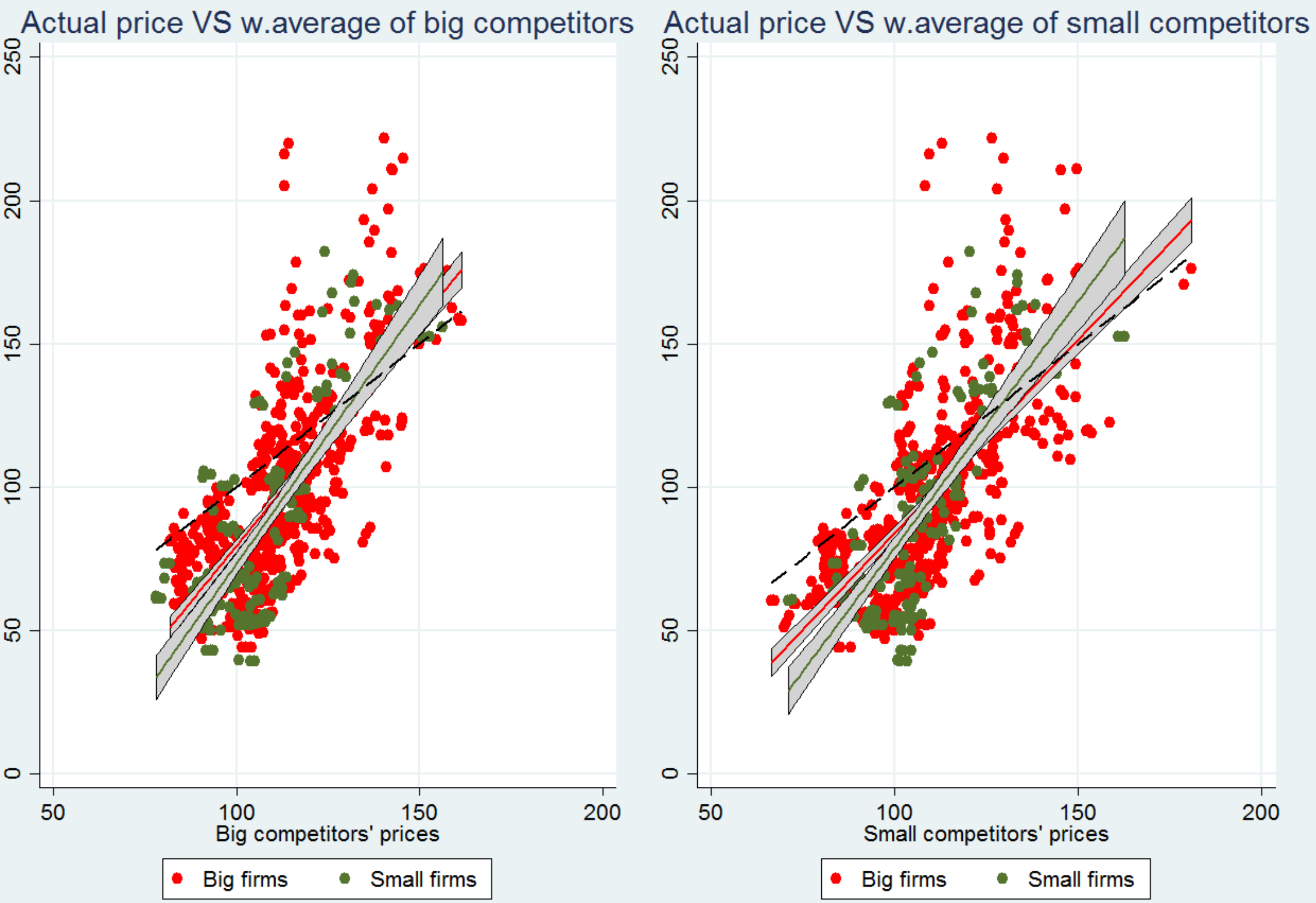
$$SS = \begin{cases} Spm(i)\ , if\ i\ is\ Small \\ 0, if\ i\ is\ Big \end{cases}$$

$$BS = \begin{cases} 0\ , if\ i\ is\ Small \\ Spm(i), , if\ i\ is\ Big \end{cases}$$

$$SB = \begin{cases} Bpm(i)\ , if\ i\ is\ Small \\ 0, if\ i\ is\ Big \end{cases}$$

$$BB = \begin{cases} 0\ , if\ i\ is\ Small \\ Bpm(i), if\ i\ is\ Big \end{cases}$$

DATA



Actual price VS w.average of big competitors
Actual price VS w.average of small competitors
0
50
100
150
200
250
50
100
150
200
Big competitors' prices
Small competitors' prices
Big firms
Small firms

THE MODEL

Specification to estimate:

$$pm = \beta_0 + \boldsymbol{\beta_1 SS} + \boldsymbol{\beta_2 SB} + \boldsymbol{\beta_3 BB} + \boldsymbol{\beta_4 BS} + \boldsymbol{\beta_5 C} + \beta_6 p\_secondary\_lag + \beta_7 big + \beta_8 months\_weight + \beta_9 metro\_min + \beta_{10} centre\_min + \beta_{11} ost + \beta_{12} ave_s + FE_{class} + FE_{period} + FE_{district} + \varepsilon$$

Bold variables are endogenous, similar to (Демидова, 2014) or (Liu,Patacchini,& Zenou, 2014)

Use 2SLS approach to get consistent estimates.
Instruments :

- Spatially lagged time varying exogenous variables;
- Time lagged endogenous variables

$$Q = [SX, SWX, SW^2X, BX, BWX, BW^2X, CX, CWX, CW^2X]$$

$$Q = [SS_{t-1}, SB_{t-1}, BB_{t-1}, BS_{t-1}, C_{t-1}]$$

THE MODEL

Specification to estimate:

$$pm = \beta_0 + \boldsymbol{\beta_1 SS} + \boldsymbol{\beta_2 SB} + \boldsymbol{\beta_3 BB} + \boldsymbol{\beta_4 BS} + \boldsymbol{\beta_5 C} + \beta_6 p\_secondary\_lag + \beta_7 big + \beta_8 months\_weight + \beta_9 metro\_min + \beta_{10} centre\_min + \beta_{11} ost + \beta_{12} ave_s + FE_{class} + FE_{period} + FE_{district} + \varepsilon$$

big – size dummy
p_secondary_lag – weighted average (on distance) asking price for secondary real estate in 2,5km vicinity in mln RUB (t-1 lag)
months_weight – weighted average (on square) months to completition
metro_min – distance to closest subway station in minutes of walking
centre_min – distance to center in minutes of automobile ride
ost – amount of unsold stock (in thousands of sq.m) (t-1 lag)
ave_s – average size of apartment in project

Only prices of big competitors are significant, being positive, indicating strategic complementarity

Control variables have expected signs

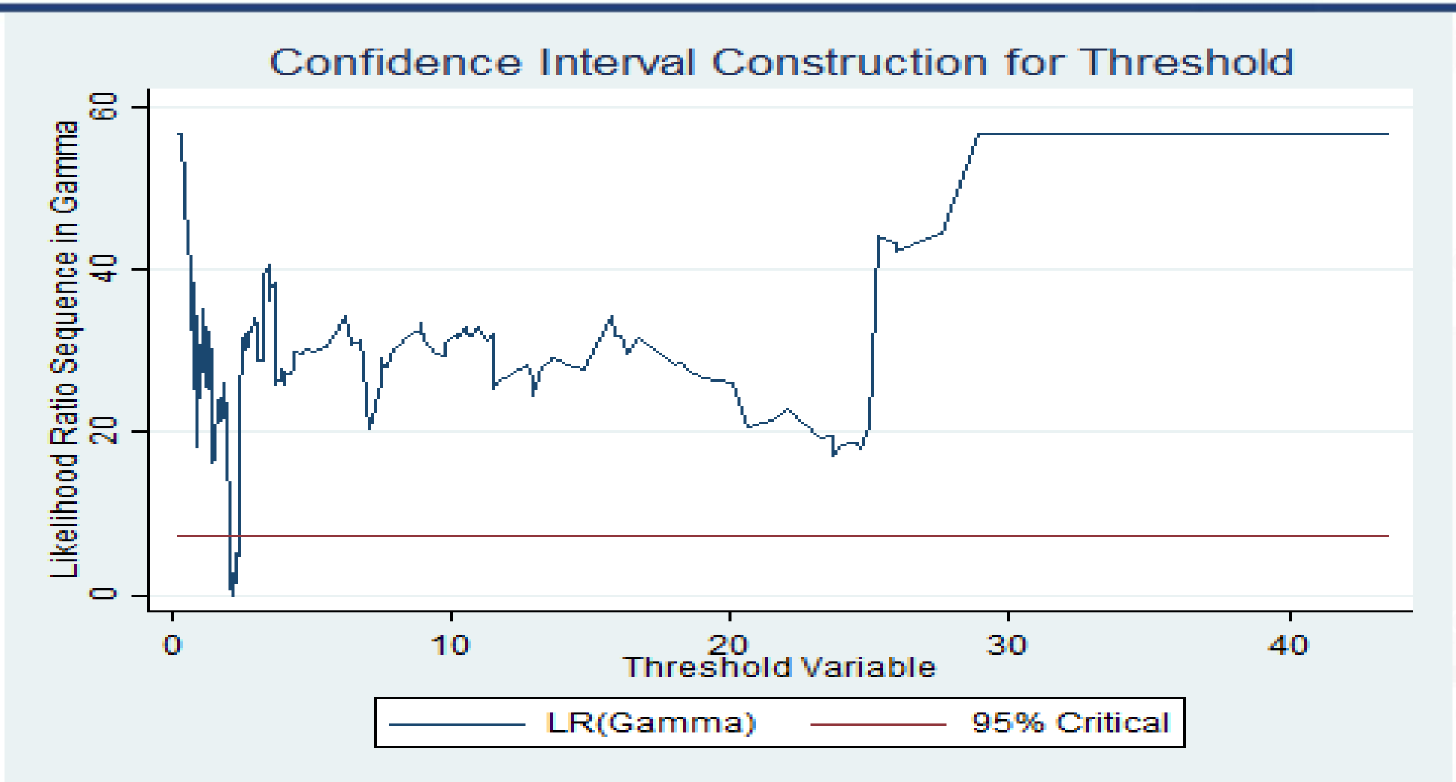
Instruments are relevant and exogenous

	pm
SS	**-0.205**
	(0.232)
SB	**0.785****
	(0.235)
BB	**0.414***
	(0.197)
BS	**0.214**
	(0.248)
C	**0.119**
	(0.0651)
secondary price	2.069***
	(0.453)
big	-11.01
	(26.78)
months weight	-0.528**
	(0.181)
centre min	-0.124
	(0.414)
subway min	-0.135***
	(0.03558)
ave_s	-0.00103
	(0.0803)
OST	-0.915
	(2.625)
FE	YES
Observation	4174
R^2	0.775
adj. R^2	0.772
OIR test p-value	**0.113**
F-test p-value	**0.000**

Standard errors (clustered) in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

RESULTS



- *Find a threshold and CI for it using only exogenous variables, following (Hansen, 2000, 2017).*
- *Threshold variable – distance to subway (in kilometers).*
- *95% CI for threshold: [1.27;1.74], split sample on 1.5.*

Close to subway no price lags are significant

Distance to subway is insignificant in less the 1,5 km

Instruments are relevant and exogenous

	(Together) pm	(Close) pm	(Far) pm
SS	**-0.205**	**0.242**	**-0.497**
	(0.232)	**(0.377)**	**(0.288)**
SB	**0.785****	**0.560**	**0.729****
	(0.235)	**(0.420)**	**(0.263)**
BB	**0.414***	**0.271**	**0.397***
	(0.197)	**(0.464)**	**(0.160)**
BS	**0.214**	**0.539**	**0.130**
	(0.248)	**(0.403)**	**(0.263)**
C	**0.119**	**0.0778**	**0.133***
	(0.0651)	**(0.117)**	**(0.0594)**
secondary price	2.069***	1.420	2.421***
	(0.453)	(1.076)	(0.502)
big	-11.01	-9.567	-38.23
	(26.78)	(58.18)	(31.84)
months weight	-0.528**	-0.209	-0.622**
	(0.181)	(0.210)	(0.216)
centre min	-0.124	0.0401	-0.211
	(0.414)	(0.855)	(0.355)
subway min	-0.135***	-0.5364	-0.1068**
	(0.03558)	(0.5718)	(0.03144)
ave_s	-0.00103	-0.0269	0.00593
	(0.0803)	(0.143)	(0.0955)
OST	-0.915	-7.367	1.126
	(2.625)	(4.100)	(2.905)
FE	YES	YES	YES
Observation	4174	1304	2870
R^2	0.775	0.678	0.796
adj. R^2	0.772	0.664	0.792
OIR test p-value	**0.113**	**0.074**	**0.122**
F-test p-value	**0.000**	**0.000**	**0.000**

Standard errors (clustered) in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

RESULTS

Cannibalization is significant only in remote from subway regions.

Prices of small firms are insignificant in all regions

All significant coefficients are less then 1, Indicating that firms do not overreact.

	Direction	Coeff.	p-value	95% confidence interval	
				low	high
Together	SS	-0.205	0.379	-0.666	0.256
	SB	0.785	0.001	0.318	1.252
	BB	0.414	0.039	0.022	0.805
	BS	0.214	0.389	-0.278	0.707
	C	0.119	0.070	-0.010	0.248
Close	SS	0.242	0.523	-0.515	0.999
	SB	0.560	0.189	-0.286	1.405
	BB	0.271	0.563	-0.663	1.204
	BS	0.539	0.188	-0.272	1.350
	C	0.078	0.508	-0.157	0.313
Far	SS	-0.497	0.088	-1.070	0.077
	SB	0.729	0.007	0.205	1.252
	BB	0.397	0.015	0.078	0.716
	BS	0.130	0.624	-0.396	0.655
	C	0.133	0.028	0.015	0.252

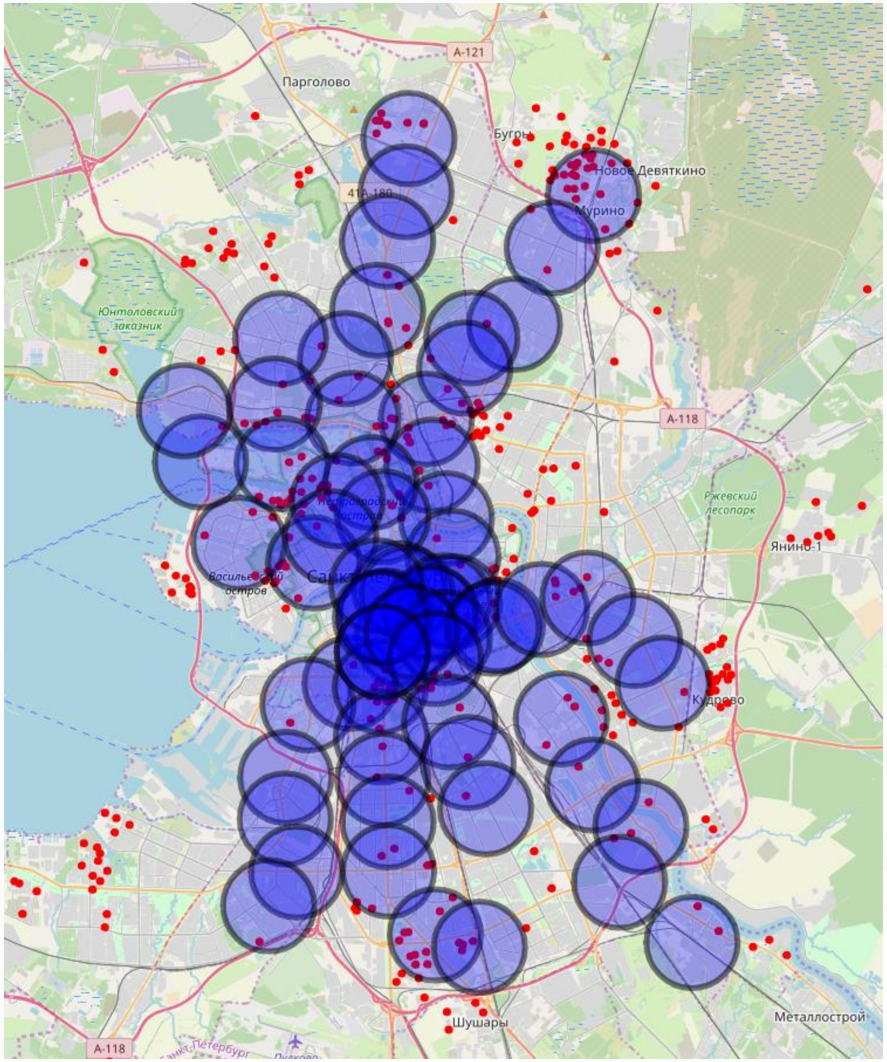
RESULTS

Blue regions – subway stations with localities

Red dots – projects

Outside blue areas – oligopoly.

Inside blue areas – MC.



CONCLUSION

- **Strategic interactions among firms on Saint-Petersburg market look like oligopoly far from subway with big firms being leaders.**
- **Big firms have more strategic power.**
- **However, in the vicinity of subway station strategic power of all firms vanishes and this look like monopolistic competition**

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