Agglomeration Effects in Russian Manufacturing

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Agglomeration effects

- Productivity is higher where economic activity is concentrated
  - Large cities, high population density, clusters
- Mechanisms?
  - First and second nature of geography (endogeniety!)
  - Pure agglomeration externalities (sharing, matching, learning)
  - Selection (firm survival and migration)
- Empirical evidence: Ciccone&Hall (1996), ..., Rosenthal &Strange (2008) Combes et al. (2010) - worker selection, (2012) - firm selection
  - Raw elasticity of productivity to city size = 4 to 10%
  - Instrumenting city size = 2 - 3% (history, geology)
  - Accounting for worker selection = 2 - 3%
  - Firm selection effect is weak and rare

More on geography of productivity and agglomeration

- First and second nature factors work independently of agglomeration
  - Geographical variance in productivity
- Central places and remote places
  - Agglomeration in central places is easier (Redding &Venables (2004), Combes et al. (2008))
- Access to markets and market extent
  - Agglomeration externalities, competition, selection work on different spatial scales (distance) (Rosenthal&Strange (2004, 2008))
  - Acceturo et al. (2013) - geo base for firm selection is wider
- Transport links change the definitions of proximity, centrality, agglomeration!

Why is this important for Russia?

- No prior measures of agglomeration benefits for Russian cities (except for Lobko (2010) - cement industry)
  - They might be larger than in OECD countries: land area = high transport cost = bigger benefits of proximity
  - They might be smaller: technology, resources, Soviet legacy, weak competition
- Collecting hard evidence to inform spatial (regional) policy
  - "Strategiya Prostranstvennogo Razvitiya" (Strategy of Spatial Development) - MEDT
- Studying the long-term effects of Soviet policy
  - "Old" and "new" cities - are agglomeration effects different?
  - Local industrial structure (mono-cities, effects inside and across industries)

What we do + plans and ideas

- Measure firm productivity
  - Take firm-level data, clean, analyze, estimate production function(s)
  - Many issues here...
  - Calculate firm-level TFP
- Analyze geographical structure of firm productivity
  - Measure agglomeration effects (elasticity to city size)
    - With historical instruments for city size
    - For different industries
    - Inside vs outside the industry (industry employment vs city size)
  - Look for the evidence of selection
    - Quantiles of productivity distribution
  - Spatial extent of agglomerations?
    - Productivity declines in agglomeration shadows
  - How do other measurable first and second nature features of geography (ports, transport, border, centrality, etc) affect productivity?

Data on Russian firms

- Source: RUSLANA (Bureau van Dijk) - up to 5 million firms, 2003-2014
- Manufacturing (primary OKVED 15-37) with $\geq$ 5 employed and non-zero revenue - 140 000 firms
- Good coverage from 2011 on, we look at 2007-2014
- Nonmissing data on revenue, costs, capital, labor, address
- Nonmissing data on investment, materials
- Sample size (what is left) = unbalanced panel, 9-12 thousand firms (!)

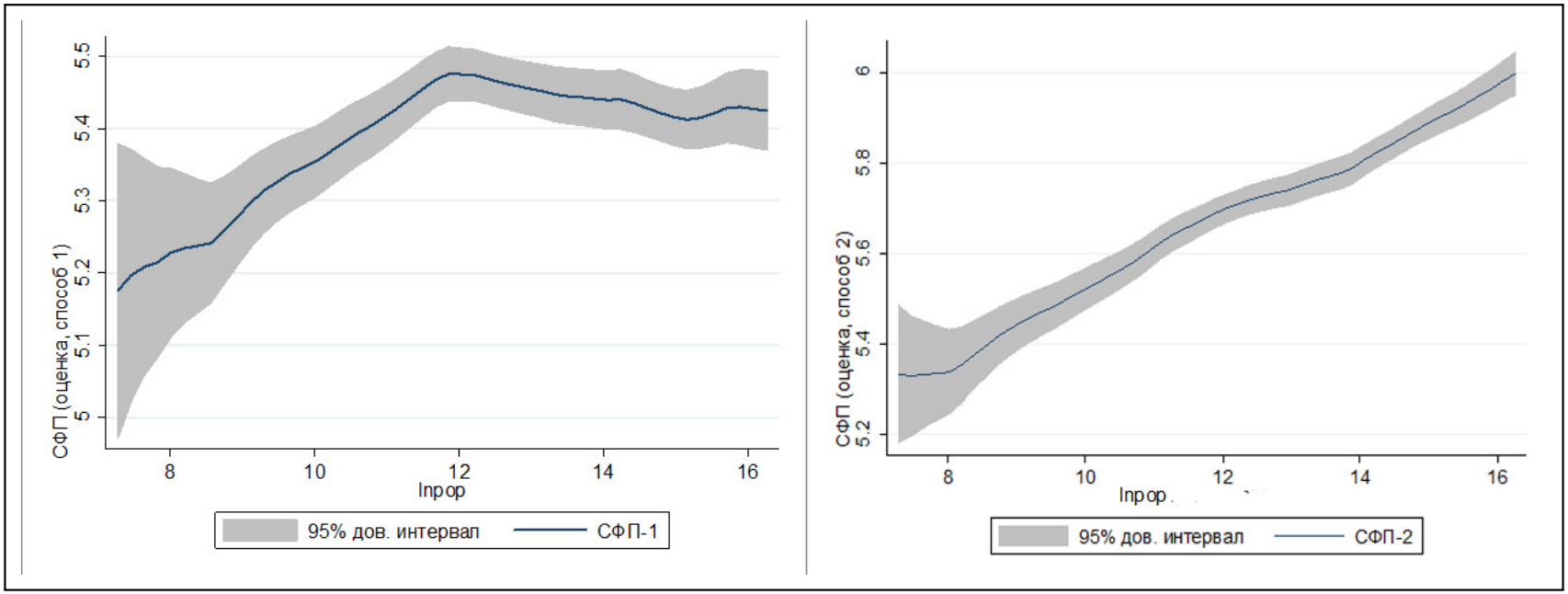
Production function

- Cobb-Douglas p.f. $\ln Y_{it} = a_t + w_i + \alpha \ln K_{it} + \beta \ln L_{it} + e_{it}$, estimating by different methods
  - Pooled OLS, FE, RE, Olley-Pakes, Levinson-Petrin
- Variables:
  - Labor = yearly average full-time employment
  - Capital = "osnovnye fondy" (rules for market valuation, depreciation vary)
  - Output = value added
    - Yearly revenues - declared costs + costs of labor
    - Yearly payments received - paid for materials and to contractors
  - Investment (1)declared, 2)recovered from capital data)
- Separately for 2-digit OKVED industries
- (?) Check for consistency against capital/labor shares of product

Most realistic estimates - RE

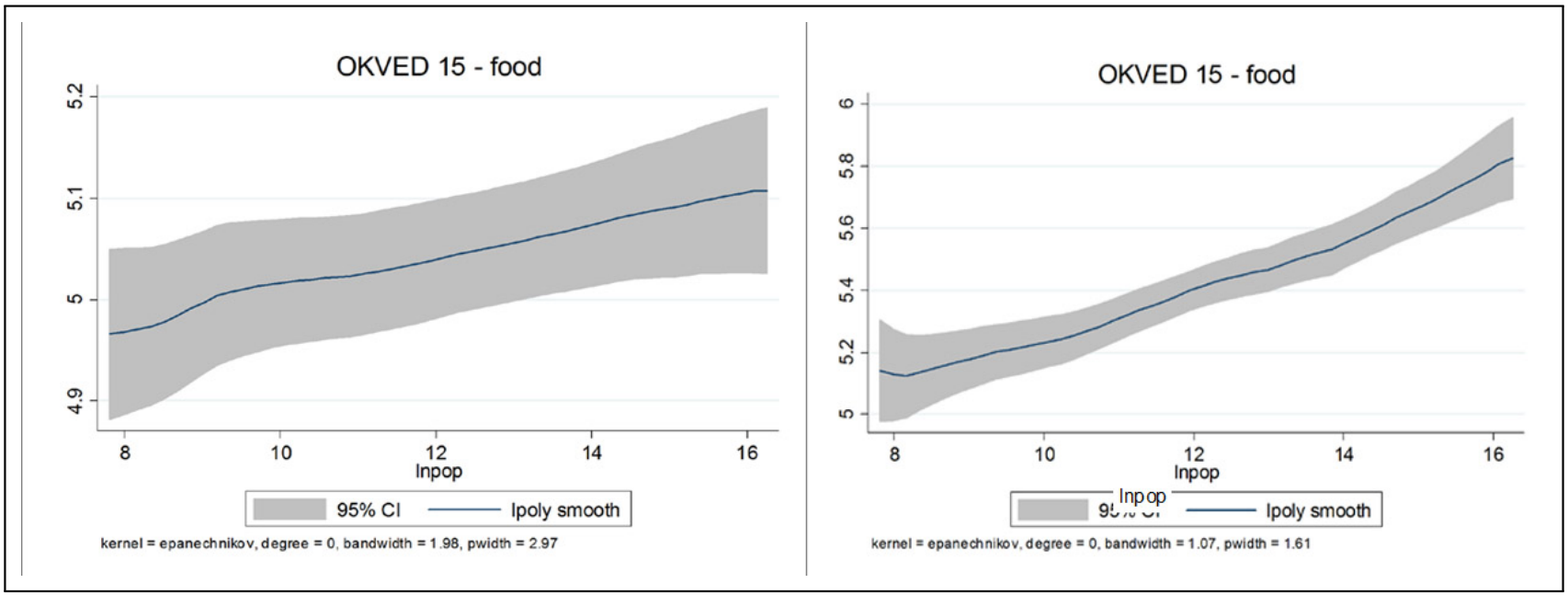
Definition of Y matters

1) - Payments, 2) Declared VA



Definition of Y matters, but not for all industries (OKVED 15 - food)

1) - Payments, 2) Declared VA



Definition of Y matters, but not for all industries (OKVED 20 - wood)

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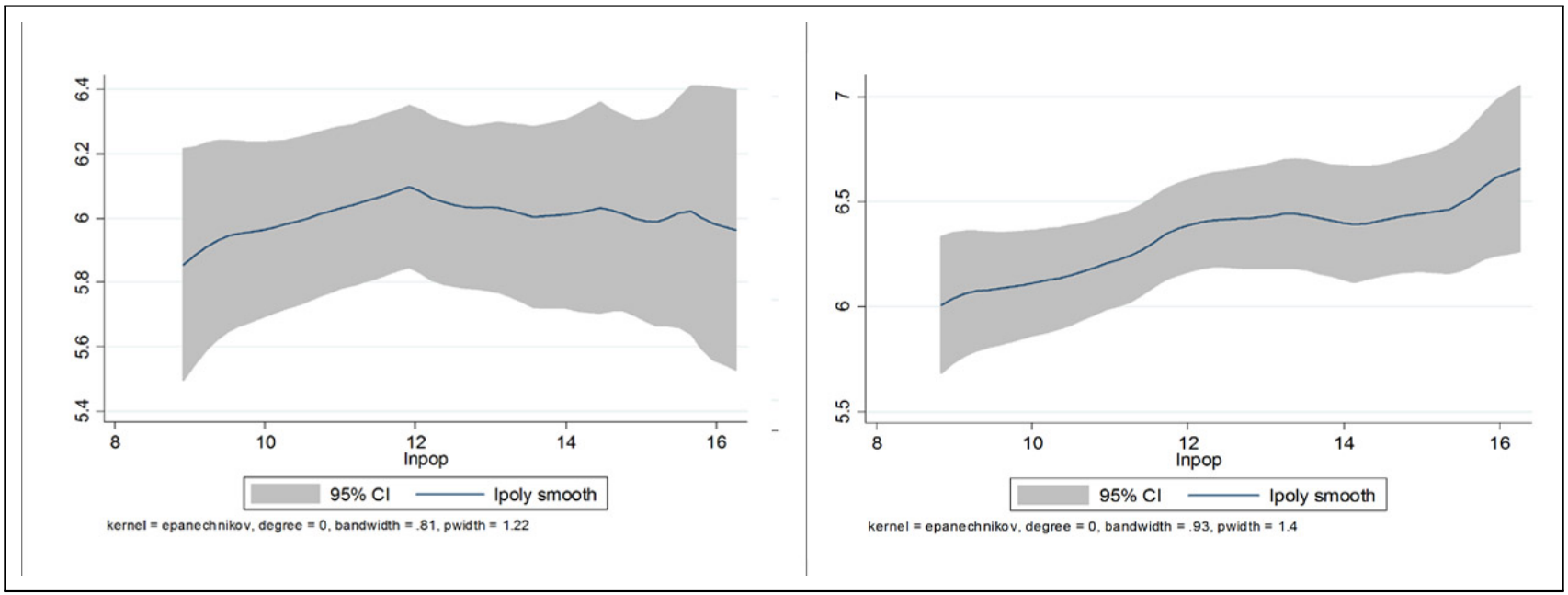


Estimation, OLS

Indep. Var	TFP-1 (payments)	TFP-1 (paymnts)	TFP-2 (declared)	TFP-2 (declared)
Ln (Pop 2010)	0.008	0.014	0.086	0.096
	(0.006)	(0.006)**	(0.006)***	(0.006)***
Industry dummies	-	+	-	+
N obs	12164	12164	12081	12081
R-sq	0.0001	0.21	0.02	0.21

Estimation, IV

Dep. var	Ln(Pop2010)	TFP-1 (payments)	Ln(Pop2010)	TFP-1 (payments)	TFP-2 (declared)	TFP-2 (declared)
Indep. var.	(1)	(2)	(3)	(4)	(5)	(6)
Ln(Pop1897)	-0.025 (0.005)**		0.855 (0.003)**			
Ln(Pop1959)	0.965 (0.005)**					
Ln(Pop2010)		0.025 (0.007)**		0.031 (0.008)**	0.120 (0.008)**	0.113 (0.007)**
N obs	9982	9982	9982	9982	9955	9949
R-sq	0.95	0.19	0.81	0.19	0.19	0.19
F-stat on instruments	1.4e+05		228.96			
Instruments, years		1959,1897		1897	1897	1959,1897

The effects are much stronger than in OECD countries!

Estimation, separately for industries

Examples:

Industry (OKVED-2)	Name	Elasticity TFP-1(s.e.) TFP-2(s.e.)	N. obs	R-sq
15	Food	0.028 (0.013)** 0.101 (0.130)**	1960 2017	0.003 0.02
22	Publishing	0.071 (0.017)** 0.211 (0.016)**	1045 1059	0.001 0.14
29	Machines & equipment	-0.0006 (0.016) 0.069 (0.016)**	1555 1537	0.00 0.01
23	Oil products	-0.073 (0.118) -0.065 (0.120)	77 76	0.005 0.004

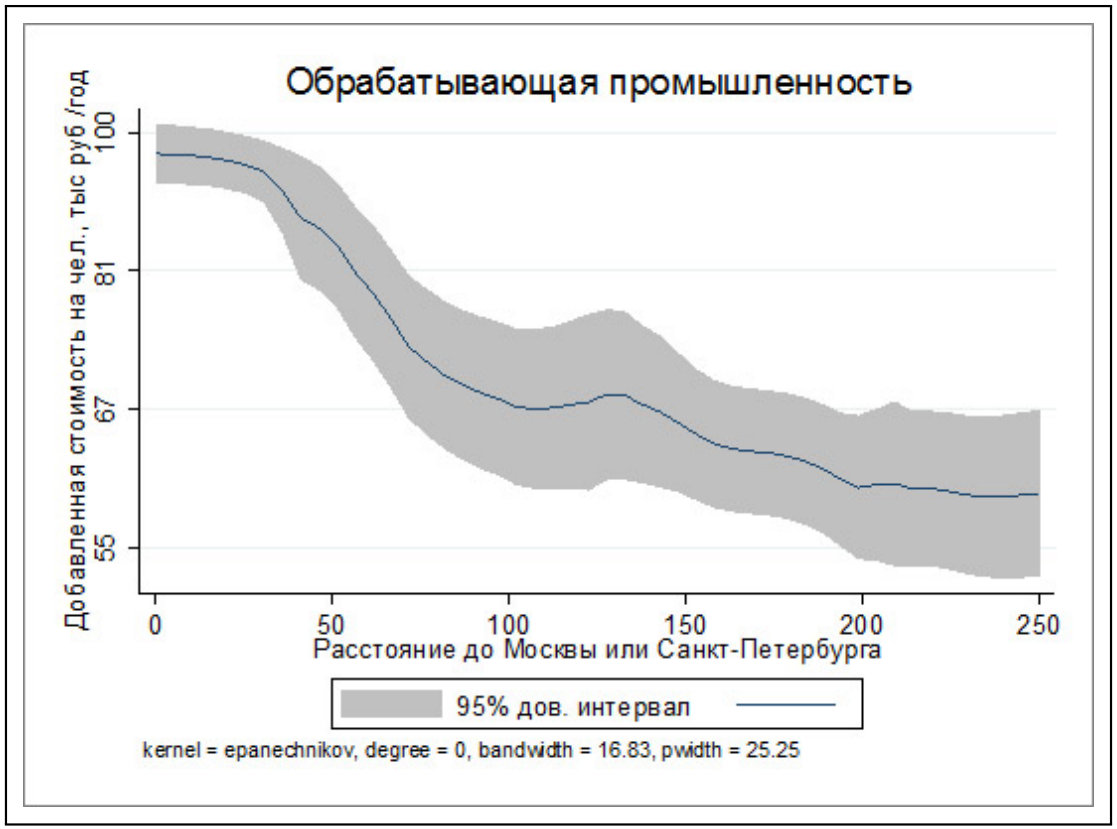
No agglomeration effects if returns to scale are internal
Stronger for consumer industries, weak or none for resource-based industries
Role of Soviet legacy (?) Old vs new firms (?)

Quantile regressions on city size

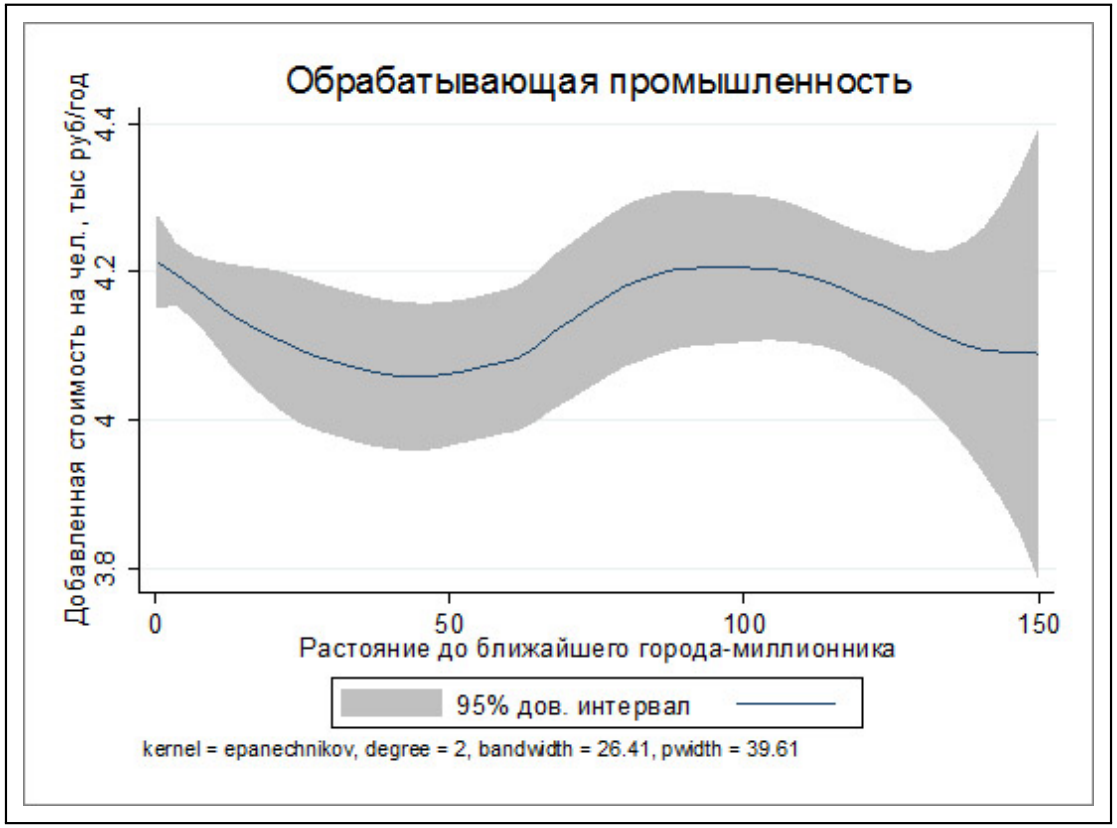
Quantile	Elasticity of TFP-1	Elasticity of TFP-2
5%	-0.057 (0.020)**	0.087 (0.018)**
25%	-0.015 (0.007)**	0.089 (0.008)**
50%	0.018 (0.006)**	0.089 (0.005)**
75%	0.043 (0.005)**	0.106 (0.006)**
95%	0.086 (0.010)**	0.124 (0.012)**

TFP-2: No selection at the bottom, dilation at the top (leaders emerge in large agglomerations) TFP-1: Dialation at the bottom (!) - inefficient firms survive in large city?
Both: no evidence of competitive selection

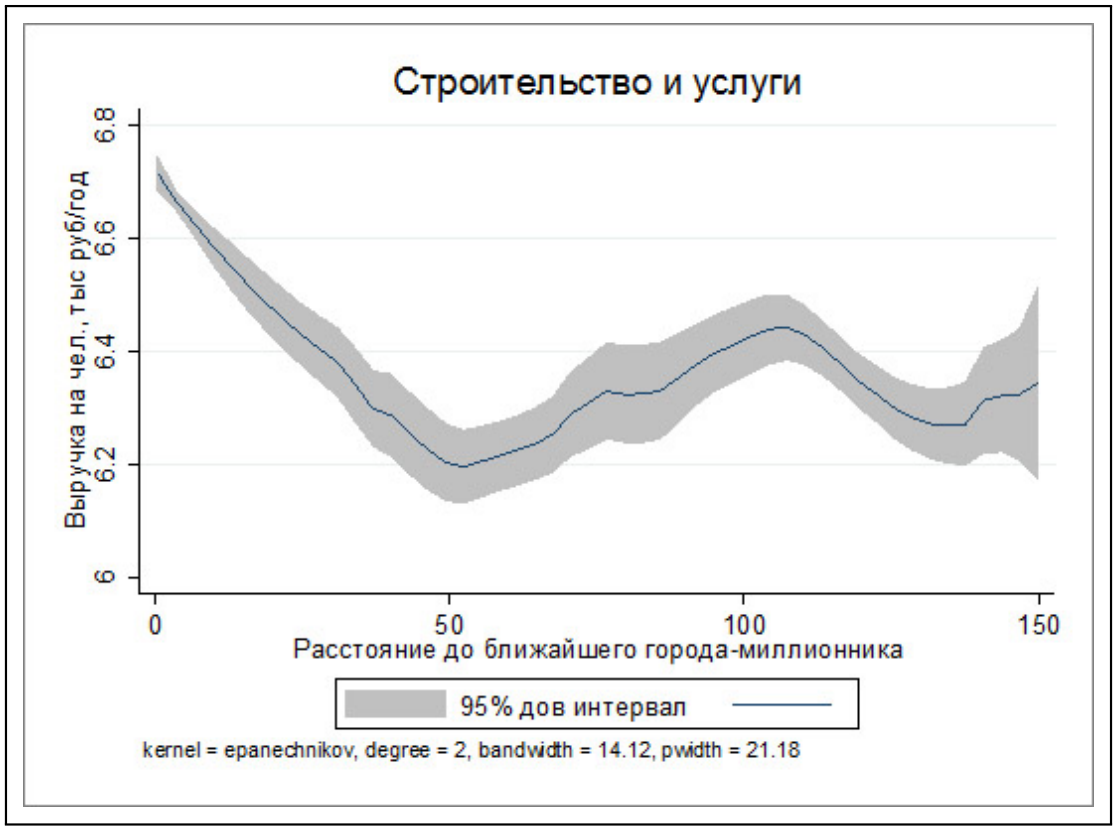
Agglomeration shadow, manufacturing, Moscow and St. Petersburg



Agglomeration shadow, manufacturing, 1 mil cities



Agglomeration shadow, construction and services, 1 mil cities



Conclusions

- Agglomeration effects in Russia are heterogeneous by industry, but are very strong overall
- All of the effect is due to productivity gains, none - due to selection
- Some suggestive evidence that Soviet legacy still works against agglomeration benefits

To do (properly):

- Geographical extent of agglomeration benefits
- Internal or external agglomeration benefits?
  - Preliminary results: employment in the same industry in 60 km radius raises productivity, city size does not matter, connected industries (vertical chains) do not matter
- Other geographical features and transport