

Density and Allocative Efficiency

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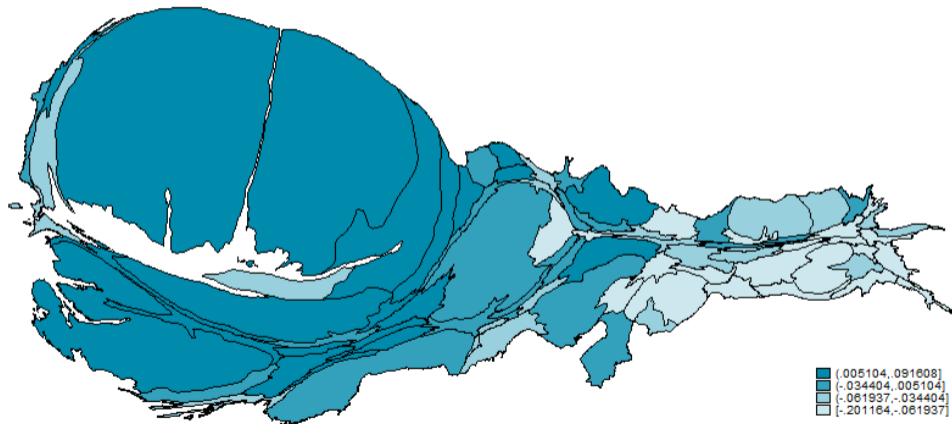
January 2019

CBRT-WB Joint Conference: Drivers of Firm Performance in Turkey

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Density and Allocative Efficiency: The Cartogram

Allocative Efficiency



The Research Question

- **General: How does density affect productivity?**
 - First paper (to my knowlegde) to estimate for Turkey
- **Specific: How does density affect the efficiency of resource allocation?**
 - First paper (to my knowlegde) to estimate
- Using a panel at the city-industry level based on the universe of Turkish manufacturing firms for the 2007-2016 period

Literature

- Economics of density
 - Theory: Marshall (1890), Lucas (1988), Glaeser (1999), Duranton and Puga (2004)
 - Emprics: Ciccone and Hall (1996), Ciccone (2002), Puga (2010), Abel and Gabe (2011), Ahlfeldt et al. (2015)
- Efficiency in the allocation of resources, and productivity
 - Olley and Pakes (1996), Restuccia and Rogerson (2008), Alfaro et al. (2008), Hsieh and Klenow (2009), Bartelsman et al. (2013), Andrews and Cingano (2014)

This Paper's Approach

- City level productivity aggregates problematic due to differences in industry mix
 - City and detailed industry level data
 - Control for time-industry fixed effects
- Productivity and density are potentially endogenous
 - IV 1: pre-industrialization density → largely reflecting agricultural productivity and captures historical persistence
 - IV 2: nearest land route distance from the sea → proxy for harsh geography, isolation, and climate in the Turkish context
- Physical infrastructure and human capital also affect productivity
 - Road quality and college graduate shares as additional controls

A Simple Decomposition of Productivity

- Define θ_{ijc} as labor share, P_{ijc} as log sales per worker for the firm i in industry j and city c
- Olley Pakes Decomposition:

$$\sum_{i \in j} \theta_{ijc} P_{ijc} = \bar{P}_{jc} + \sum_{i \in j} (\theta_{ijc} - \bar{\theta}_{jc})(P_{ijc} - \bar{P}_{jc})$$

- Two terms at the RHS:
 - 1 plain average of productivity
 - 2 productivity-size covariance term: Allocative Efficiency (AE)

Productivity at the City and Industry Level

- Entrepreneurship Information System (GBS): administrative data using the universe of manufacturing
- Firm productivity measured as sales per worker
- Deflated by industry deflators (producer prices)
 - Revenue-based measure
 - Only tradables (manufacturing)
- Weighted, unweighted and allocative efficiency measures
- 81 cities and 95 3-digit industries

Density Weighted by District Population

- Population density of 957 districts
- Weighted by the district population for each city
- A better measure for the typical crowdedness of a city
- Instruments
 - Persistence in density: 1927 population from historical Census data
 - Shortest land-route distance to the sea data from General Directorate of Highways

The Estimation Equation

$$AE_{jct} = \alpha \log D_{ct} + X' \beta + \gamma_{jt} + \gamma_{ct} + \epsilon_{jct}$$

- D_{ct} population density, X' a vector of controls, γ_{jt} industry \times year FE, γ_{ct} region \times year FE
- α is the coefficient of interest
- Estimation by OLS and 2SLS
- Also reported: dependent variable \rightarrow weighted and unweighted productivity

Results (All include industry-time, region-time, human capital, infrastructure controls)

	Allocative Efficiency		Unweight. Productivity		Weight. Productivity	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
log density	-0.0007 (0.0015)	0.0142*** (0.0031)	0.0741*** (0.0032)	0.0360*** (0.0071)	0.0733*** (0.0034)	0.0503*** (0.0076)
Observations	37,972	37,972	37,972	37,972	37,972	37,972
R^2	0.12	0.12	0.34	0.34	0.35	0.35
Endogenous	density		density		density	
Instruments	D1927, Sea Dist.		D1927, Sea Dist.		D1927, Sea Dist.	
Kleibergen-Paap rk LM statistic p-value	5281.725 0.00		5281.725 0.00		5281.725 0.00	
Cragg-Donald Wald F statistic 10% maximal IV size	5882.017 19.93		5882.017 19.93		5882.017 19.93	
Hansen J statistic p-value	0.559 0.4547		1.538 0.2149		0.816 0.3663	

Interpretation of Results

- Doubling density \rightarrow 1.4 percent increase through AE
- That is around 30 percent of the total density impact
- Inter-decile (p90-p10) difference in density can explain around
 - 33 percent of inter-decile difference in AE
 - 21 percent of inter-decile difference in total productivity
- Elasticity of density of around 5 percent is in line with the literature