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A MULTILEVEL ANALYSIS OF FIRM PERFORMANCE IN EMERGING ECONOMIES: THE ROLE OF TRANSPORT INFRASTRUCTURES AND LOGISTICS

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INTRODUCTION

- Enterprises generate substantial employment and economic output and the role of the government became crucial for firm's success by creating conditions that bring them to growth.
- The success or failure of the economies can be traced in large part to the **performance of their enterprises**. (Frye and Shleifer, 1997; North and Thomas, 1973; Lewis 2003; McMillan and Woodruff, 2002)
- Studying firms' performance became important to explain the economies as a hole, especially in emerging economies, where the national context might be very diversified and firms operating are quite heterogeneous. (Goldszmidt et al., 2011)
- Focus on a particular aspect of the national context, recognizing the importance of "infrastructure as the platform for economic activity" (EBRD, 2017).
- This study aims to explore the determinants of firms' performance heterogeneity and its relationship with country transport infrastructures endowment and logistics in emerging economies by considering, in an integrated framework, both firm-level and country-level predictors.

BACKGROUND (1/4)

Enterprise is a **"black box"** (*Melitz, 1993*) because there are many effects caused by internal and contextual factors of enterprises

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Differences in firms' performance involving many dimensions

Firm level heterogeneity

- Firm-level heterogeneity due to different internal characteristics and behavior (Jensen and McGuckin, 1997)
- Internal characteristics determine performance heterogeneity within industry and aggregate levels (Davis et al., 1996).

Industry level heterogeneity

Factors that vary across industries are significant in business performance. Industry classification is an important concept that explains firm behavior. (Bernard and Jensen, 1995; McGuckin et al., 1996)

Country level heterogeneity

 The importance of a favourable business environment for firms' productivity and growth (Dethier et al. ,2010), as it varies widely across countries, especially in emerging economies, where the national context is very diversified and firms operating are quite heterogeneous (Goldszmidt et al., 2011)

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BACKGROUND (3/4) COUNTRY TRANSPORT INFRASTRUCTURES

QUANTITY and QUALITY of transport infrastructures

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- ensure convenient access to public infrastructure and good connectivity to the market
- important to attract foreign direct investment and enhance export activities
- reducing costs of trade
- creating new markets or improving the efficient production and consumption of goods and services

(Henckel and McKibbin, 2017)

At a macro-economic prospective

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Positive linkage between the stock of infrastructures and economic development and growth

Macrodata used to evaluate and compare differences on performance accross countries

The relationship must exists also at a microeconomic level





OVERVIEW OF PERCEIVED CONSTRAINS

- \cdot The responses of firm owners and managers in the BEEPS V when they are asked to assess the severity of different potential obstacles
- Transport is percieved most as a constrain by firms with foreign participations, exporters, medium and large enterprises, no EU countries

	Foreign owned	Others	Export	No export	Micro	Small	Medium	Large	EU (No EU
Electricity	3.4	-0.3	11.2	-3.3	-20.0	-5.2	7.0	8.3	-1.5	0.5
Telecommunications	6.4	-0.5	10.1	-3.0	-38.3	-2.2	6.8	-1.4	5.3	-1.9
Transport] (8.3)	-0.6	(12.9)	-3.8	-25.5	-6.0	(9.3)	6.6	-2.6	0.
Customs and trade regulation	33.9	-2.8	51.0	-16.8	-6.9	-11.5	14.0	14.1	-8.0	3.
Practice of competitors in the informal sector	-17.8	1.4	-1.9	0.6	34.9	3.0	-1.6	-14.9	10.2	-3.
Access to land	-5.9	0.5	-4.4	1.3	-25.6	-3.1	8.3	-4.0	-29.9	11.
Crime, theft and disorder	-11.6	0.9	5.1	-1.5	3.9	-1.7	4.1	-3.9	17.8	-6
Access to finance	-16.8	1.3	4.4	-1.3	8.6	0.4	1.8	-8.0	-5.4	1
Tax rates	-9.9	0.8	-1.5	0.4	-7.8	-1.3	4.4	-4.2	3.9	-1
Tax administration	-0.5	0.0	16.9	-5.0	-0.5	-1.7	4.5	-4.3	27.4	-9
Business licensing and permits	0.8	-0.1	10.2	-3.1	-19.6	-8.0	12.8	4.9	-3.6	1
Political instability	7.6	-0.6	12.0	-3.6	0.7	-1.5	1.9	1.5	5.4	-1
Corruption	1.0	-0.1	4.6	-1.4	-5.7	-1.7	3.7	-1.3	-3.7	1
Courts	13.3	-1.0	32.8	-10.0	2.8	-14.7	16.1	21.1	26.3	-9
Labor regulations	15.7	-1.2	37.4	-11.1	1.0	-10.9	12.5	15.3	62.4	-22
Inadequate educated workforce	9.1	-0.7	14.2	-4.2	-35.4	-11.9	13.9	22.0	4.5	-1

Note: Firms that answer "Don't know", "Refused" ore "Does not apply" are not part of the calculations.

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DATA (2/4)

A. Dependent variable	
Sales	Natural logarithm of total annual sales converted in USD at the national annual exchange rates at fiscal year 2011
B. Explanatory variables	
Microdata	
Age	Natural logarithm of the number of years since the firm began operations
Size	Categorical variable, 1 if firm has less than 5 employees, 2 if firm has >=5 and <=19 employees, 3 if firm has >=20 and <=99 employees, 4 if firm has >=100 employees
Exporter	Dummy variable equal to 1 if firm exports some of its outputs directly or indirectly, 0 otherwise
Qualification	% of permanent full-time employees at the end of the period which had a university degree
Foreign	Dummy variable equal to 1 if 1% of assets or more are owned by private foreign individuals, companies or organizations
Macrodata	
Gap	Distance of GDP per capita in PPP (constant 2010 USD) between the most developed economy in the sample and the respective country (Y^*/Y)
Roads	Total roads in km per square km, including expressways, urban roads, paved and unpaved roads
Rails	Total railways in km per square km, including public and non-public railways
Airports	Number of airports paved per 1,000 square km
Ports	Number of total ports, including the major seaports, riverports, container ports, oil and LNG terminals
LPI	The overall score of the Logistic Performance Index (mean of 2010 and 2012 LPI)

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DATA (3/4)

Variables	Obs.	Mean	Standard deviation	Min	Max
Dependent variable					
Sales USD (log)	11,990	13.43	1.93	1.79	21.72
Firm variables					
Age (log)	11,990	2.47	0.72	0	5.16
Size	11,990	63.04	268.55	1	11,000
Micro	11,990	0.02	0.14	0	1
Small	11,990	0.54	0.50	0	1
Medium	11,990	0.32	0.47	0	1
Large	11,990	0.12	0.33	0	1
Exporter	11,990	0.23	0.42	0	1
Qualification	11,990	32.60	30.64	0	100
Foreign	11,990	0.07	0.26	0	1
Country variables					
Gap (log)	32	0.90	0.70	0	2.71
Roads	32	0.63	0.59	0.03	2.18
Rails	31	0.03	0.03	0	0.12
Airports	32	0.47	0.40	0.03	1.62
Ports	32	3.19	2.87	0	11
LPI	31	2.82	0.31	2.25	3.43

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DATA (4/4)

Firm-level data

- The mean sales is about 6.6 million U.S. dollars
- Significant variation, from 659 thousand U.S. dollars for Tajikistan to up to 18.7 million U.S. dollars in the case of Slovenia
- Around 86% of the sample are small and medium enterprises
- The average age of the firms is around 15 years
- 7% of firms have foreign participations
- · 23% of firms export directly or indirectly
- The share of the permanent employees which has a university degree is around 33%

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Country-level data

- Density of roads and rails ascertain considerable differences between countries, respectively 0.63 and 0.03 km per square km in mean
- The less endowed country is Mongolia for both variables, also Kyrgyzstan and Tajikistan for railways. The most endowed counties are, respectively Hungary and Czech Republic
- Mongolia is the lasted country with an airport density value of 0.03 while Czech Republic and Cyprus present the higher airport density by 1.62
- The presence of ports is subject to geographical position. Turkey has the largest number of ports also the best LPI, 6 landlock countries

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THEORETICAL FRAMEWORK (1/2)

"Intercept as outcome" model

The level 1 linear regression model:

 $\begin{aligned} SALES_{ij} &= \beta_{0j} + \beta_{1j}AGE_{1j} + \beta_{2j}SMALL_{2j} + \beta_{3j}MEDIUM_{3j} + \beta_{4j}LARGE_{4j} + \beta_{5j}EXPORT_{5j} + \beta_{6j}QUALIFICATION_{6j} \\ &+ \beta_{7j}FOREIGN_{7j} + \sum_{k=1}\delta_{0k}SEC_{ik} + e_{ij} \end{aligned}$

The level 2 model:

 $\beta_{0j} = \gamma_{00} + \gamma_{01}GAP_j + \gamma_{02}ROADS_j + \gamma_{03}RAILS_j + \gamma_{04}AIRPORTS_j + \gamma_{05}PORTS_j + \gamma_{06}LPI_j + u_{0j}$

- $\beta_{1j} = \gamma_{10} + u_{1j}$
- $\beta_{2j} = \gamma_{20} + u_{2j}$
- $\beta_{3j}=\gamma_{30}+\ u_{3j}$
- $\beta_{4j}=\gamma_{40}+\ u_{4j}$
- $\beta_{5j}=\gamma_{50}+\,u_{5j}$
- $\beta_{6j} = \gamma_{60} + \, u_{6j}$
- $\beta_{7j} = \gamma_{70} + u_{7j}$
- intercept β_{0j} and slopes β_{1j} to β_{5j} are country-specific coefficients, *i* are firms and *j* are countries
- SEC are industry dummies classified according to the International Standard Industrial Classification
- *e_{ij}* is the standard error term of level 1 model
- γ_{00} is the estimated mean of sales
- γ_{01} to γ_{06} are country level fixed effects
- γ_{10} to γ_{70} are the estimated mean of the firm-level sloops
- u_{0j} to u_{7j} are the random country effects, the respective coefficients vary not only as a function of the predictors, but also as a function of unobserved country effects

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THEORETICAL FRAMEWORK (2/2)

From a statistical perspective

• We refer to the class of random effect models, specifically, to the "intercept as outcome" as a specification of the random-coefficients model, in which the intercept is a function of the country-level (level 2) predictors thus enabling us to explicitly model the hierarchical structure of the data and the unobserved heterogeneity (Raudenbush and Bryk, 2002; Skrondal and Rabe-Hesketh, 2008; Goldstein, 2011)

In the multilevel framework

• The specification of the random term can be interpreted as an adjusted measure of "performance" since it is a residual component that captures all the country level factors that were not accounted for by the level 1 covariates

ECONOMETRIC RESULTS (1/4)

		(1)	(2)	(3)		
		Varianco componente model	Random-intercept model with	Random-coefficient model with		
		variance-components moder	firm-level variables	firm-level variables		
Fixed effects						
For intercept	(β_{0j})					
Constant	(γ_{00})	13.4063*** (0.1419)	10.7692*** (0.2064)	10.7769*** (0.2089)		
For slopes (β_{1i})	$\dots \beta_{7i}$)		\frown			
Age	(y ₁₀)		0.1323*** (0.0196)	0.1355*** (0.0280)		
Small	(γ_{20})		1.1220*** (0.0923)	1.0975*** (0.0925)		
Medium	(γ_{30})		2.4847*** (0.0939)	2.4727*** (0.0973)		
Large	(γ_{40})		4.1492*** (0.0994)	4.1185*** (0.1169)		
Exporter	(γ_{50})		0.3305*** (0.0349)	0.3193*** (0.0537)		
Qualification	(γ_{60})		0.0041*** (0.0005)	0.0040*** (0.0010)		
Foreign	(γ_{70})		0.5237*** (0.0507)	0.5142*** (0.0787)		
Dummy Industry	(δ_{0k})	Yes	Yes	Yes		
Random effects				\frown		
Constant	(u_{0j})	0.7951* (0.1019)	(0.7717**) (0.0979)	0.7762* (0.1064)		
Age	(u_{1i})			0.0913*** (0.0352)		
Small	(u_{2i})			0.00002*** (0.0001)		
Medium	(u_{3i})			0.1328*** (0.0518)		
Large	(u_{4i})			0.3119*** (0.0723)		
Exporter	(u_{5i})			0.2068*** (0.0555)		
Qualification	(u_{6i})			0.0042*** (0.0009)		
Foreign	(u_{7j})			0.3092*** (0.0741)		
Log Likelihood		-23,539.96	-20,607.13	-20,562.33		
Level-1 firms		11,990	11,990	11,990		
Level-2 countries		32	32	32		

Model (1) IR test vs. linear regression: chibar2(01) = 1610.46 Prob >= chibar2 = 0.0000; Model (2) LR test vs. linear regression: chibar2(01) = 2129.35 Prob >= chibar2 = 0.0000; Model (3) LR test vs. linear regression: chi2(15) = 2218.95 Prob > chi2 = 0.0000; Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.10

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ECONOMETRIC RESULTS (2/4)

Detect for the existence of a hierarchical structure of the data: The Intra-class Correlation Coefficient (ICC) represents the percentage of total unexplained variance among firm's performance due to different country characteristics

Model	ICC	
	ρ	(s.e.)
Variance-components	0.164	0.035
Random-intercept model with		
firm-level variables	0.235	0.045
Random-coefficient model with		
firm-level variables	0.241	0.050

Some results on firms' characteristics

- Older firms are more likely to have good performance
- For obviously advantage of scale, by increasing of the firm's dimension a better performance characterizes the largest firms
- Firms which recur in export activities perform better
- Positive but small effect of the presence of high qualified human capital
- Foreign ownership positively correlated to firm performance
- AGE, EXPORT, QUALIFICATION and FOREIGN estimated random effects are spread wide largely around their mean across countries
- While, SIZE has a magnitude of the random effect smaller with respect to the estimated fixed effect mean

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ECONOMETRIC RESULTS (3/4)

"Intercept-as-outcome model" with country-level predictors											
		(1)		(2)		(3)		(4)		(5)	
Fixed effects											
For intercept	(β_{0j})										
Constant	(γ_{00})	10.8315***	(0.2879)	10.9049***	(0.2576)	11.0045***	(0.2514)	11.2844***	(0.2768)	8.3470***	(0.9656)
Gap	(γ ₁₀)	-0.1311***	(0.0288)	-0.1430***	(0.0312)	-0.1516***	(0.0315)	-0.1717***	(0.0361)	-0.1409***	(0.0311)
Road	(y ₂₀)	0.6177***	(0.1533)	\sim							
Rail	(y ₃₀)			10.6779***	(3.7152)		_				
Airport	(γ_{40})					0.6060**	(0.2430)				
Ports	(γ_{50})							0.0374	(0.0441)	\frown	
LPI	(γ_{60})									1.0170***	(0.3188)
For slopes (β_{1j}	β _{7j})										
Age	(γ_{10})	0.1304***	(0.0196)	0.1273***	(0.0198)	0.1307***	(0.0196)	0.1344***	(0.0220)	0.1350***	(0.0200)
Small	(γ_{20})	1.0891***	(0.0937)	1.0974***	(0.0935)	1.0888***	(0.0937)	1.0909***	(0.0930)	1.1053***	(0.0943)
Medium	(γ_{30})	2.4673***	(0.0965)	2.4619***	(0.0964)	2.4668***	(0.0966)	2.4679***	(0.0966)	2.4908***	(0.0981)
Large	(γ_{40})	4.1136***	(0.1156)	4.1178***	(0.1169)	4.1133***	(0.1158)	4.1136***	(0.1164)	4.1330***	(0.1194)
Exporter	(γ ₅₀)	0.3181***	(0.0520)	0.3322***	(0.0523)	0.3192***	(0.0520)	0.3201***	(0.0526)	0.3177***	(0.0532)
Qualification	(γ_{60})	0.0041***	(0.0010)	0.0042***	(0.0010)	0.0041***	(0.0010)	0.0041***	(0.0010)	0.0042***	(0.0010)
Foreign	(γ ₇₀)	0.5145***	(0.0790)	0.5092***	(0.0790)	0.5153***	(0.0785)	0.5155***	(0.0786)	0.5059***	(0.0798)
Dummy Industry	(δ_{0k})	Yes		Yes		Yes		Yes		Yes	
Random effects											
Constant	(u_{0j})	0.4292***	(0.0610)	0.4757***	(0.0809)	0.4876***	(0.0678)	0.5180***	(0.0762)	0.4637***	(0.0660)
Age	(u _{1j})	0.00004	(0.0059)	0.00003**	(0.0001)	0.0000**	(0.0000)	0.0363**	(0.0564)	0.0000**	(0.0000)
Small	(u_{2i})	0.0776**	(0.1005)	0.0628	(0.1225)	0.0759	(0.1059)	0.0517	(0.1603)	0.0545	(0.1573)
Medium	(u_{3i})	0.1093***	(0.0799)	0.0975***	(0.0871)	0.1112***	(0.0797)	0.1218***	(0.0785)	0.1197***	(0.0858)
Large	(u_{4i})	0.2961***	(0.0782)	0.3042***	(0.0812)	0.2978***	(0.0793)	0.3055***	(0.0819)	0.3171***	(0.0826)
Exporter	(u_{5i})	0.1939***	(0.0553)	0.1918***	(0.0556)	0.1943***	(0.0555)	0.1985***	(0.0554)	0.1978***	(0.0562)
Qualification	(u_{6i})	0.0041***	(0.0009)	0.0043***	(0.0009)	0.0043***	(0.0009)	0.0043***	(0.0009)	0.0043***	(0.0009)
Foreign	(u_{7j})	0.3112***	(0.0610)	0.3087***	(0.0744)	0.3077***	(0.0739)	0.3084***	(0.0740)	0.3073***	(0.0753)
Log Likelihood		-20549.1		-20225.8		-20553.8		-20554.1		-20257.9	
Level-1 firms		11,990		11,990		11,990		11,990		11,990	
chi2 = 0.0000; Model (4) L Prob > chi2 = 0.0000; Model (4) L	regression: chib R test vs. linea lard errors in pa	par2(01) = 962.08 Pr32 r regression: chi2(15) = rrentheses *** p<0.01, **	= chibar2 = 0.00 1242.35 Prob > * p<0.05, * p<0.1	00: Model (2) LR te31s chi2 = 0.0000; Model (5 0	linear regression LR test vs. line	on: chibar2(01) = 329 ar regression: chi2(15	07 Prob >= chil) = 887.77 Prob	bar2 = 0.0000: Mo321 > chi2 = 0.0000; Mode	3) LR test vs. I el (6) LR test ve	inear regression 31,2 s. linear regression: cf	(15) = 1186.01 Prob i2(15) = 1067.93
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ECONOMETRIC RESULTS (4/4)

- GAP of GDP has a negative correlation with all the transport infrastructure variables, less developed countries have worse transport infrastructure endowment
- · Negative relationship of the GAP of GDP as an indicator of the level of development of a country with firm performance and heterogeneity at country level
- The extension of the ROADS, RAILS and AIRPORTS network is important for business performance. Part of performance heterogeneity at country level is related to the development of its transport network
- · PORTS variable shows positive but not statistically significant coefficient
- The LPI shows positive and significative coefficient which means that infrastructure performance of a country also is important to firm performance
- The ICC and the random coefficient of the intercept decrease considerably, evidence that part of country variability has been explained by transport infrastructure characteristics included at country level



