Energy Prices and Firm's Economic Performances in Emerging Countries

Massimiliano Calì – World Bank
Nicola Cantore – United Nations Industrial Development Organization
Giovanni Marin – University of Urbino Carlo Bo
Massimiliano Mazzanti – University of Ferrara; SEEDS
Francesco Nicolli – University of Ferrara; SEEDS

Motivation

- The impact of increasing energy prices – that are partially driven by environmental and energy taxes – on firm performances has received increasing attention in academic and policy debates.
- Evidence for emerging countries is limited.

Insights from the literature

1. An increase in energy prices may induce firms to adopt new and more efficient technologies which may reduce the use of energy (Popp, 2002; Aghion et al., 2016).
2. Higher energy prices can reduce competitiveness, if firms absorb the short run costs without generating innovation offsets (Marin and Vona, 2017).
3. Firms can partially transfer this increase in prices to consumers, reducing the aggregate market demand (Ganapati et al., 2017; Sadath and Acharya 2015).
4. Fourth, firms can switch to other sources of energy, if sources are not taxed equally or tax reforms change relative costs of energy (Rentschler and Kornejew, 2017).

Insights from the literature – 2

Rentschler and Kornejew, 2017

- Firms adopted a mix of the four response measures summarised above to mitigate the adverse effect of higher energy prices.
- The prevalence of one channel with respect to the others depend on firm and sector characteristics.

Marin and Vona, 2017

- The magnitude of the negative effect of energy prices on firms' employment and productivity is higher in more energy intensive sectors

Insights from the literature – 3

Several firm and regional level factors may influence the relationship between rising energy prices and firm performance.

De Groot et al., 2001: the existence of more attractive opportunity of investment and the incomplete depreciation of their previous investments, are the main barriers to energy efficiency investments.

Bernstein and Griffin, 2006: state and sub-state differences influence the shape of the relationship between energy price and demand in the US.

Abeberese, 2017; Dollar et al., 2005: in the developing world, the management of energy infrastructure and power outages are possible sources of intra-regional differences when the effect of energy prices on firm performances is examined.

Aim and scope

- This paper aims to expand the empirical evidence on the effect of energy prices on firm competitiveness by focusing on middle and upper-middle income countries.
- we focus on three of the channels mentioned above:
- the “energy efficiency” effect;
- the “absorption” effect;
- the “pass-on” effect
- We asses how the impact on energy price rise depend on energy intensity of production

Aim and scope

- we also control for the possible mediating role of several firm characteristics, that might be additionally relevant in defining the effect of energy prices on economic performances
- Our data set does not allow testing directly for possible “substitution” effect among different energy types.

Data and methodology

The empirical analysis relies upon different data sources:

1) micro-level data from the World Bank's Enterprise Survey (WB-ES). By tracking the same firm across different years enables us to carry out a robust multivariate analysis that exploit panel data structures.
2) We complement this data with country-sector energy price indices from Sato et al. (2019), which are available for 48 countries and 12 sectors over the period 1995-2015

Sample

Country	**WB survey years (panel data)**
Brazil	2003, 2009
Czech Republic	2002, 2005, 2009, 2013
Croatia	2002, 2005, 2009
Hungary	2002, 2005, 2009, 2013
Kazakhstan	2002, 2005, 2009
Mexico	2006, 2010
Poland	2002, 2005, 2009, 2013
Romania	2002, 2005, 2009
Russia	2005, 2009
Slovakia	2002, 2005, 2009, 2013
Turkey	2008, 2013

Measuring firms' performance: absorption, pass-on and energy efficiency

Variable name	**Description**	**Proxy used to test:**
tot emp	Total number of employees within firm	Absorption
sales/emp	Amount of sales over total employment	Pass-on
VA/emp	Value added over total number of employees	Energy efficiency
Return on sales	Percentage of revenues converted in profits	Absorption
Export share	Percentage of exports	Absorption

Sector-specific energy prices

To measure energy prices at the sectoral level an original index computed by Sato et al. (2019) is used.

The prices are constructed as weighted averages of fuel-specific prices by fuel consumption.

Energy Intensity

In order to assess firms' exposure to energy prices, the energy intensity index is measured as fuel and electricity costs over revenues

Econometric specification

$$Y_{it} = \pi_i + \alpha EP_{cst} + \beta EI_i + \gamma EI_i * EP_{cst} + \delta_s t + \phi_i^{foreign} t + \tau_t + \varepsilon_{it}$$

Where Y_{it} represents a set of different measures of firm performances for firm *i* and year *t*;

π_i is the firm fixed effect;

EP_{cst} are energy prices (in logarithm) in country *c*, sector *s* and year *t*;

EI_i is average firm-level energy intensity;

$\delta_i t$ are country-specific linear trends;

$\phi_i^{foreign} t$ are trends specific for foreign-owned firms;
τ_t are time dummies.

Econometric specification

We use average firm energy intensity (time invariant) to limit endogeneity concerns related to the endogenous response of firms in terms of reduction in energy intensity as a consequence of higher energy prices.

Effects identification

However, to the extent that unobserved time-varying firm-level shocks could be correlated both with energy intensity and firm performances (e.g. hiring a new manager), this would generate biased estimates of our parameters of interest.

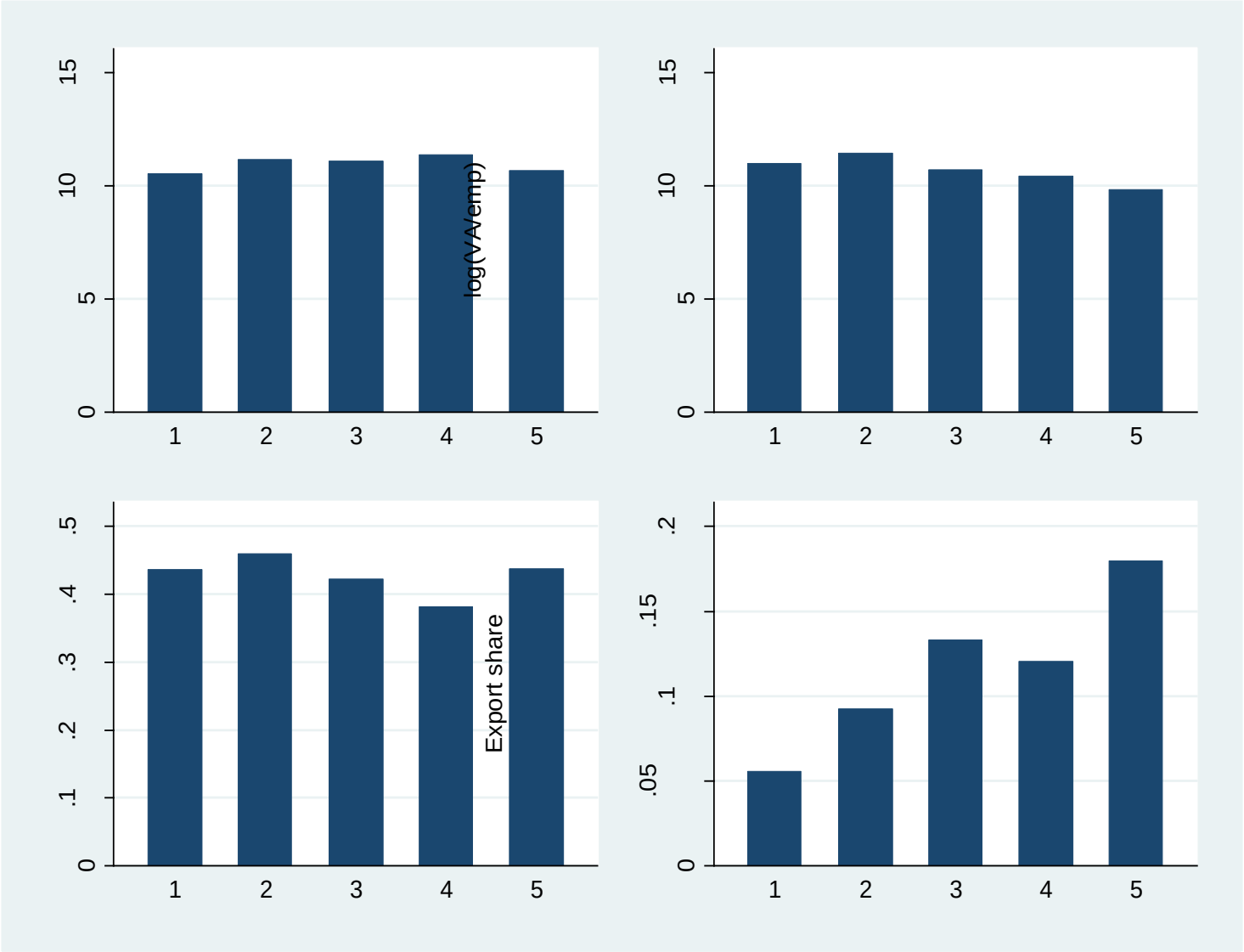
To address this concern, we also instrument the firm-level energy intensity variable with the average sector-country energy intensity.

Descriptive statistics

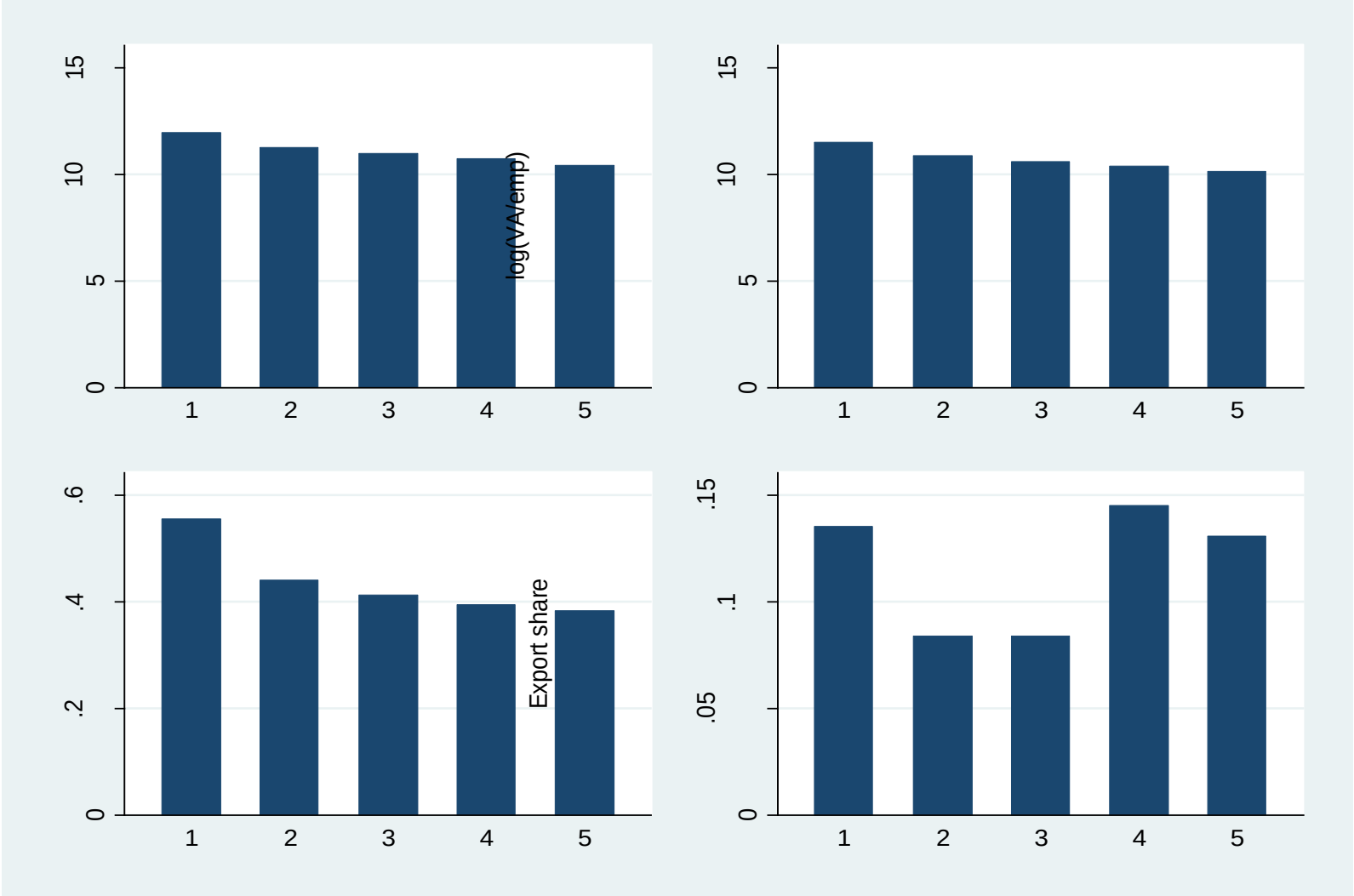
Variable	N	Mean	SD
Log (tot emp)	2,182	3.664	1.525
Log (sales/emp)	1,767	11.011	2.036
Log (VA/emp)	1108	10.621	1.919
ROS (return on sales)	1,612	0.426	0.318
Export share	2,188	0.115	0.255

Data coverage varies substantially across dependent variables.

Firms' performance indicators over quintiles of the Energy Price index



Firms' performance indicators over quintiles of firm's energy intensity



Baseline specification with fixed effect (Firm-FE; time FE and trends)

	log(tot emp)	log(sales/emp)	log(VA/emp)	Return on sales	Export share
log(ener price)	0.00508	0.673	1.106	0.185*	0.0649
	(0.207)	(0.434)	(0.709)	(0.106)	(0.0459)
log(ener price) x energy exp share	-1.753	-12.93*	-20.12**	-1.540**	-0.776
	(1.533)	(7.298)	(9.435)	(0.745)	(0.473)
R sq	0.0651	0.177	0.135	0.326	0.0384
N	2182	1767	1108	1612	2188
Net effect: 10th percentile of EI	-0.00357	0.595	0.963	0.174*	0.0612
	(0.205)	(0.400)	(0.668)	(0.102)	(0.045)
Net effect: median of EI	-0.0405	0.333	0.569	0.144	0.0449
	(0.198)	(0.307)	(0.579)	(0.094)	(0.041)
Net effect: 90th percentile of EI	-0.168	-0.540	-0.767	0.0415	-0.0119
	(0.216)	(0.437)	(0.684)	(0.081)	(0.047)

Instrumenting the interaction term (energy price x energy intensity)

	log(tot emp)	log(sales/emp)	log(VA/emp)	Return on sales	Export share
log(ener price)	-0.224	0.123	0.276	0.427**	0.138**
	(0.297)	(0.469)	(0.775)	(0.168)	(0.0567)
log(ener price) x energy exp share	2.290	-3.082	-6.914	-5.695**	-2.060**
	(3.073)	(7.920)	(10.41)	(2.277)	(1.021)
F test of excluded IV	26.46	24.17	18.88	23.72	26.33
N	2182	1767	1108	1612	2188
Net effect: 10th percentile of EI	-0.213	0.104	0.226	0.388**	0.128**
	(0.285)	(0.430)	(0.719)	(0.155)	(0.053)
Net effect: median of EI	-0.164	0.0417	0.0908	0.276**	0.0845**
	(0.242)	(0.315)	(0.583)	(0.121)	(0.039)
Net effect: 90th percentile of EI	0.00259	-0.166	-0.368	-0.104	-0.0662
	(0.211)	(0.429)	(0.603)	(0.115)	(0.066)

interpretation

Higher energy prices were associated with better firms' performance over the period, but especially in one case: Returns on sale.

The pass-on and efficiency/productivity hypotheses are rejected.

If effects do exist, those refer to (i) profitability, and (ii) export competitiveness.

Differential effect for medium-big firms (size effect)

	log(tot emp)	log(sales/emp)	log(VA/emp)	Return on sales	Export share
log(ener price)	0.290	0.105	-0.171	0.361***	-0.0482
	(0.308)	(0.477)	(1.280)	(0.102)	(0.0533)
log(ener price) x Medium-big firm	-0.435	0.836	1.531	-0.26***	0.173***
	(0.296)	(0.554)	(1.046)	(0.0929)	(0.0535)
log(ener price) x energy exp share	-3.574	-5.137	-7.220	-2.271**	0.243
	(3.148)	(6.975)	(23.42)	(1.108)	(0.584)
log(ener price) x energy exp share x	2.726	-11.66	-14.20	1.009	-1.579**
Medium-big firm	(3.502)	(9.097)	(21.81)	(1.541)	(0.784)
R sq	0.0673	0.180	0.138	0.329	0.0457
N	2182	1767	1108	1612	2188
Net effect of log(ener price)	-0.145	0.940*	1.359*	0.100	0.124***
for medium-big firms	(0.213)	(0.498)	(0.816)	(0.113)	(0.0461)
Net effect of interaction	-0.849	-16.80*	-21.42**	-1.262	-1.336**
for medium-big firms	(1.274)	(8.647)	(9.31)	(1.013)	(0.556)

interpretation

- The effect on ‘Returns on sales’ are very evident in medium-big firms.
- Returns on sale and export share are the only two economic dimensions that are affected by energy prices and intensity.