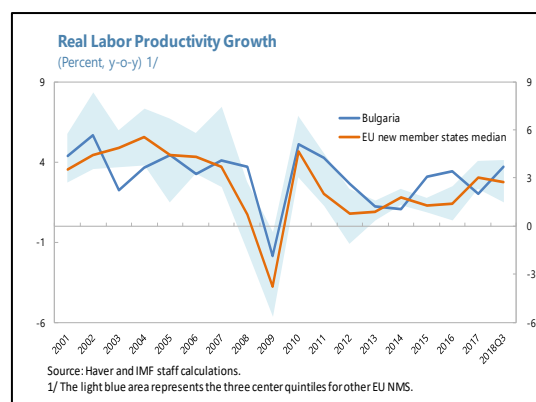


CORPORATE PRODUCTIVITY IN BULGARIA¹

This paper examines corporate productivity growth in Bulgaria using firm-level data. Firms with a higher share of innovative assets and lower financial distress are estimated to have higher productivity growth. The convergence of productivity to frontier firms may have slowed after the global financial crisis (GFC) for existing firms.

A. Introduction

1. Productivity growth in Bulgaria has slowed since the onset of the 2008-09 GFC. While the post-GFC slowdown of productivity growth is a global phenomenon (Adler et al., 2017) and Bulgaria's post-GFC productivity growth has been in line with other EU new member states (NMS),² boosting productivity growth is the ultimate way to address the long-term demographic challenges Bulgaria faces and achieve faster real convergence. Understanding the factors affecting productivity growth would help design policies to raise productivity.



2. There have been a large number of studies on productivity growth in recent years, inspired by the need to understand the post-GFC slowdown of productivity growth. Andrews et al. (2015) find that better education quality and well-functioning product and labor markets can help technology diffusion. IMF (2016) shows that the productivity gap between Central, Eastern, and Southeastern Europe countries and advanced Europe is largely due to structural and institutional obstacles that limit the efficient use of available technologies and allocative inefficiencies. Some recent studies on European firms point to a number of factors affecting productivity growth. Shabunina (2018) finds that regulatory barriers are associated with lower productivity growth. IMF (2018) shows that for Czech firms, smaller, younger, and more leveraged firms had lower productivity growth. Anderson and Raissi (2018) identify negative effects of corporate debt build-up on the growth of total factor productivity (TFP) for Italian firms, and provide weak evidence of a threshold level of corporate debt, beyond which productivity growth drops off significantly.

3. This paper investigates some of the factors that are associated with Bulgarian firms' productivity growth. Our analysis shows that Bulgarian firms with a higher share of innovative assets in total assets and stronger financial health had higher productivity growth. Foreign, larger, and younger firms and firms in the tradable sectors also generally had faster productivity growth.

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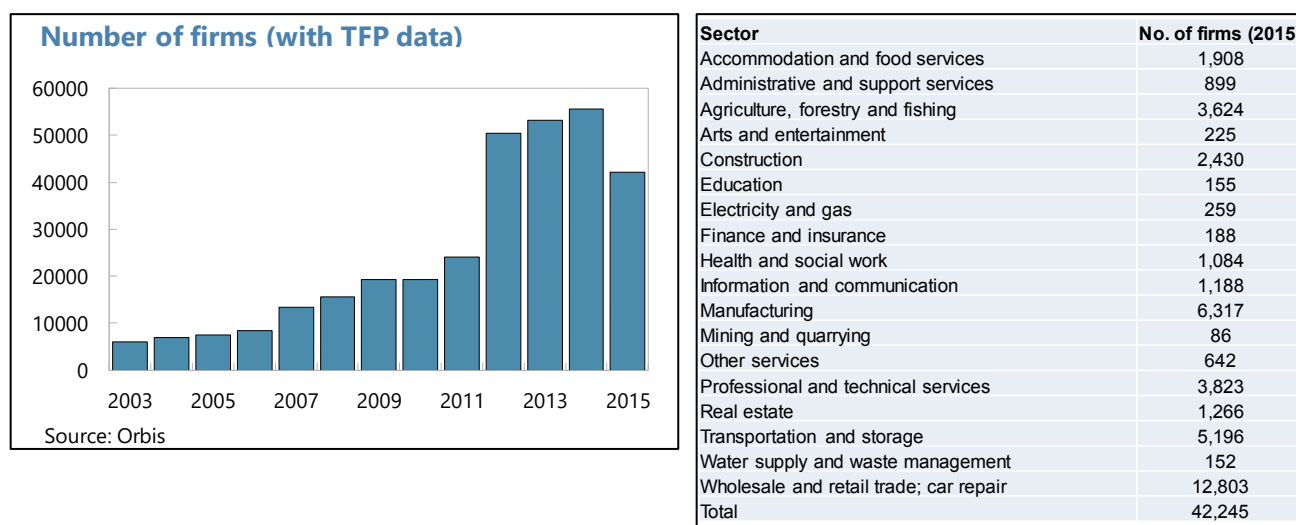
² Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.

Finally, the convergence of productivity to frontier firms seems to have slowed after the GFC for existing firms, though not for the whole sample of firms.

4. The paper is organized as follows: Section II describes the empirical framework and data. Section III presents the analysis. Section IV concludes.

B. The Analytical Framework and Basic Statistics

5. We use annual firm-level data from 2003 to 2015. The data come from the Orbis database, and only cover non-financial corporates. Variables are converted from dollar to lev, and then converted into real variables using deflators at the 2-digit NACE industry level if available.³ Data are cleaned by excluding clear misreporting and outliers. In particular, we dropped duplicate firm data, firms that have negative total assets, employment, sales or tangible fixed assets in any year, and firms with more than 2 million employees in any year. We also dropped firm-year observations with missing, zero, or negative values for costs of materials, operating revenue, and total assets, and firms without a NACE sector code. Furthermore, we calculated the ratio of assets, revenue, and revenue/assets per employee. Then we filtered out the top and bottom 0.1 percent of the sample based on the ratios. Further data quality checks are reported in Díez et al. (2018). The number of firms available in the sample increases substantially after the GFC.



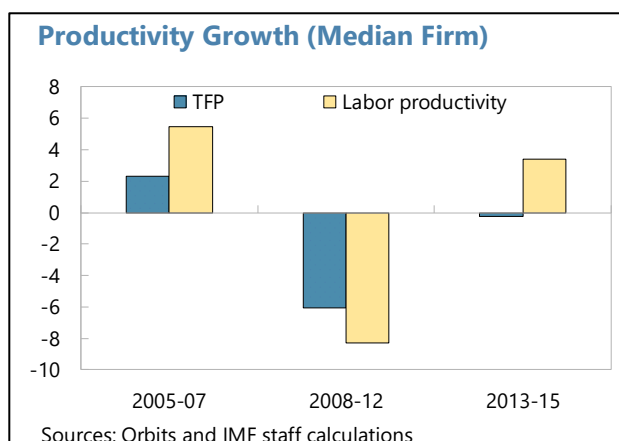
6. The empirical analysis uses both TFP and labor productivity. A Cobb-Douglas production function is estimated to derive TFP:

$$\ln Y_{it} = \alpha + \beta \ln K_{it} + (1 - \beta) \ln L_{it} + u_{it}, \quad (1)$$

³ If not, 1-digit NACE level deflator or GDP deflator is used.

where i represents firm and t represents year. Y_{it} is value added, K_{it} and L_{it} are capital and labor inputs, respectively. Then, the residual, u_{it} , is the log of TFP. The estimation is done by the 2-digit NACE industry level for which the production function is assumed to be the same. Labor productivity is measured as value added divided by the number of employees.⁴ Firm-level data (median or general distribution) also confirm a post-GFC slowdown in productivity growth.

7. We relate productivity growth to the share of intangible assets, measures of debt burden, productivity gap to industry leaders, and firm age, size, and ownership.



$$\Delta \text{Productivity}_{it} = \alpha + \beta \text{IA}_{it-1} + \delta \text{D}_{it} + \gamma \text{S}_{it} + u_{it}, \quad (2)$$

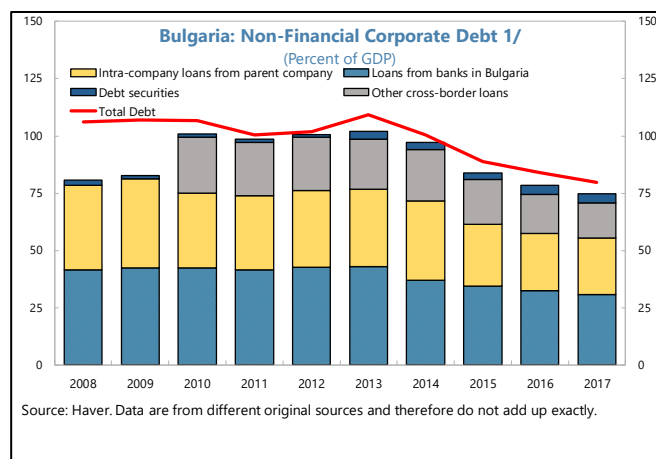
where $\Delta \text{Productivity}_{it}$ measures the growth of productivity for firm i from year $t-1$ to year t .

- IA_{it-1} is the ratio of intangible fixed assets to total fixed assets (with a lag). Intangible fixed assets include a company's proprietary technology (computer software, etc.), patents, copyrights, licensing agreements, and goodwill. A high share of intangible assets to total assets may indicate higher investment in research and innovation, which could lead to higher productivity growth. Seventy five percent of firms have zero intangible assets. A direct measure of R&D expenditure is not available.
- D_{it} represents two dummy variables used to measure corporate debt burden:
 - A dummy variable for firms with high debt-to-asset ratio: Bulgaria's non-financial corporate debt has continued to decline but remains high among the NMS. Debt is constructed as the sum of long-term and short-term financial debt. About half of the firms report zero debt, which raises concerns on misreporting. Measurement errors in independent variables would bias the estimated coefficients toward zero ("attenuation bias"). To capture possible threshold effects and to help alleviate the potential measurement error problem, we constructed a dummy variable set equal to 1 for firms whose debt-to-asset ratio is at the top 5 percentile. This is equivalent to a debt-to-asset ratio higher than 50 percent. But using other thresholds (e.g. the top 10 percentile) yields broadly similar results.

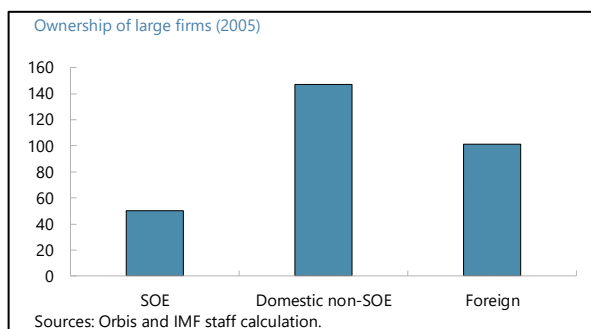
⁴ While the correlation between the level of TFP and labor productivity amounts to 0.29, the correlation of their growth rates is only 0.1.

- A dummy variable for firms with low interest coverage ratio (ICR): ICR is measured as the ratio of earnings before interest, tax, depreciation and amortization (EBITDA) to interest expenses. The dummy variable is set as 1 for firms with the ICR ratio less than 2, but using alternative cutoffs or directly using the level of ICR yields broadly similar results.

- S_{it} represents other firm characteristics including



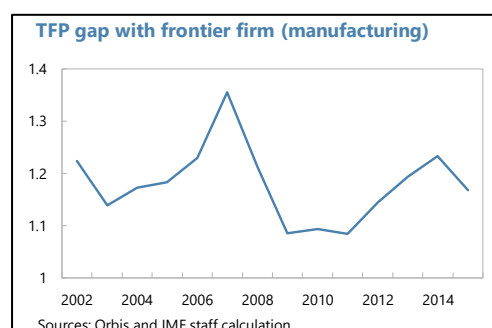
- Dummy variables representing firm size: medium-sized (50 to 250 employees), small (10 to 50 employees), and micro firms (less than 10 employees). Together they account for 99 percent of the firms and 56 percent of total assets.⁵



Share	No. of firms	Assets
Medium-sized firms	9%	24%
Small firms	37%	23%
Micro firms	53%	9%
Sum	99%	56%

Note: For firms included in Col. (1) of Table 1.

- Productivity gap to industry leaders at NACE2 two-digit levels (with a lag), where the leaders are the top 1 percent of firms in level of productivity: This is to explore how fast firms' productivity tends to converge towards the frontier firms (a measure of efficiency in technology diffusion). For the manufacturing sector, e.g., the TFP gap was 117 percent for the median firm in 2015.



- A dummy variable for state-owned enterprises (SOEs) which account for 1.4 percent of total firms; and a dummy variable for foreign firms, which account for 6.6 percent of total firms. State and foreign firms play an important role in the Bulgarian economy. This is to investigate whether there is any difference in productivity growth systemic for these firms. It should be noted, however,

⁵ Eighteen percent of Bulgarian firms in Orbis report only one employee, raising the possibility of misreporting. But most of these firms also have missing data for some of the other variables used in the regressions. As a result, only 3 percent of the firms included in the baseline regression (Column (1) of Table 1a) has only one employee, and dropping them did not change the regression results.

that the sample size will be significantly reduced when the two dummy variables are added to the regression, due to data limitations.

- A dummy variable for firms in the tradable sectors (mining, agriculture, manufacturing, information and communications technology). This is to examine whether firms in the tradable sectors had faster productivity growth than firms in the services sectors (where the products are less traded internationally). Faster productivity growth in the tradable sector would lead to a real exchange rate appreciation (the Balassa-Samuelson Effect).
- Sector and year dummy variables to capture omitted explanatory variables that are industry or year specific, e.g., industry-specific shocks or overall macroeconomic environment.
- Firm age. This is to see whether there is a difference in productivity growth as firms grow in years (not in size). We constructed the age of the firm based on the date of incorporation, and dropped those with non-positive values. Usually firms less than 5 years old are considered young firms. Young firms are less experienced but on the other hand are often more receptive to new technologies and innovations. Adding firm age significantly reduces the sample size due to data limitations.

C. Empirical Results

8. Stronger financial health is associated with higher productivity growth. Table 1a reports the results for TFP growth and Table 1b for labor productivity growth. High indebtedness is negatively associated with both TFP and labor productivity growth but not statistically significantly. On the other hand, firms with high interest payment burden (low ICR) had lower TFP and labor productivity growth, with the coefficient significant at the 1 percent level. One possible channel is that high debt payment burden prevented these firms from making more capital investment. While the current low interest rate environment does help reduce corporate interest payment costs, policy initiatives such as an efficient corporate debt restructuring framework could also potentially help reduce debt payment burden and possibly lead to higher investment and productivity growth. Reforms that improve business environment, e.g., strengthening governance and upgrading infrastructure, could also help improve corporate profitability and improve debt service capacity.

9. Firms with a higher share of intangible assets are estimated to have higher labor productivity growth. The share of intangible fixed assets in total fixed assets is positive in the labor productivity regressions and in most TFP regressions, but only statistically significant in the former. One possible explanation for these firms to have higher labor productivity growth (but not necessarily higher TFP growth) could be that some components of intangible assets are more effective in raising labor productivity. This suggests that policies that increase intangible assets, e.g., supporting R&D and innovation, could potentially help raise labor productivity growth. Bulgaria's R&D expenditure (in share of GDP) was low in the EU. In addition, accordingly to OECD (2017), Bulgaria has no expenditure-based R&D tax incentives. In this context, the recent proposal of tax relief for R&D activity by the Ministry of Economy is welcome.

10. The evidence also points to technological convergence for both TFP and labor productivity to industry leaders. The result is robust with the coefficient statistically significant at the 1 percent level in all specifications. The half-life of convergence to frontiers is about four years for TFP and three years for labor productivity.

11. Firm size, ownership, and age also are found to matter. Large firms generally had higher productivity growth except that the results are a bit mixed for micro firms. For labor productivity regressions using ICR (columns (4) to (6) of Table 1b), the evidence points to higher productivity growth for micro firms (not driven by outliers). Foreign firms and firms in tradable sectors generally had higher productivity growth. In this respect, a better business environment as discussed above could also be conducive to attracting more FDI. There is some evidence suggesting that younger firms had higher productivity growth and SOEs had lower productivity growth, although the coefficients are not always statistically significant.

12. There is some evidence of a post-GFC slowdown for existing firms in technological convergence, though not for the whole sample (Table 2). Table 2 reports the regression results for pre- and post-GFC periods separately. The coefficients for technological convergence are actually larger for the post-GFC period when all firms are included. However, the post-GFC period also includes a much larger number of firms. Limiting the sample to the same firms as in the pre-GFC period, the speed of convergence seems to have slowed in the post-GFC period, for both TFP and labor productivity.⁶ Klein (2016) also finds that the pace of productivity convergence to the frontier has slowed in the post-crisis period for Irish firms. Note earlier results suggest that older firms have lower productivity growth. But the magnitude of the impact is very small (0.01-0.03 percent per year), so this is not really what drives the decline in post-GFC convergence for existing firms. Most other results are generally similar to those from the whole sample. Firms with a higher share of intangible assets had faster labor productivity growth, although the coefficient is only statistically significant in the post-GFC period. Firms with stronger interest payment capacity and large firms had higher productivity growth. The results for the tradable sector dummy are however a bit mixed. When the post-GFC sample is limited to the same sample as in the pre-GFC period, firms in the tradable sector actually had lower TFP growth after the GFC and the coefficient is statistically significant (Column 4). One possible explanation is that the GFC had a severe impact on global trade and thus might have a particularly larger impact on the TFP growth of firms in the tradable sector during and post the crisis.

13. Additional robustness checks do not change the main results. Various robustness checks as mentioned earlier yield broadly similar results. Using debt-to-equity ratio instead of debt-to-asset ratio also yields similar results. We also tried including lagged productivity growth as an explanatory variable (the correlation between productivity growth and its lagged value is negative for both TFP

⁶ The median age for firms only included in the post-GFC sample is four years and the 90 percentile is ten years. This suggests while many or most of these firms are indeed new firms, there are also old firms which were simply not included in the pre-GFC sample.

and labor productivity), and used the Blundell-Bond system GMM for the estimation. The results are again broadly similar. These results are not reported, but available upon request.

D. Concluding Remarks

14. This paper uncovered several firm characteristics that are associated with higher productivity growth. The evidence suggests that firms with a higher share of innovative assets and lower financial distress had higher productivity growth, although the former correlation is only statistically significant for labor productivity. Foreign firms had faster productivity growth, so were larger and younger firms. The productivity catch-up seems to have slowed after the GFC for existing firms, but not for the whole sample of firms.

15. Policies that support R&D and innovation, improve business environment, and reduce debt service burden could potentially help raise productivity growth. Bulgaria's R&D spending lags behind other EU countries and there is ample room for improvement. A better business environment supported by stronger institutions could help improve company's profitability and financial health, raise investment, and attract more FDI, all conducive to raising productivity growth.

Table 1a. Bulgaria: TFP Growth

	(1)	(2)	(3)	(4)	(5)	(6)
Intangible assets/total assets	0.010 (0.011)	-0.007 (0.013)	0.010 (0.017)	0.018 (0.014)	0.004 (0.016)	0.022 (0.019)
Dummy for high debt	-0.002 (0.002)	-0.001 (0.002)	-0.001 (0.002)			
Dummy for low interest coverage ratio (ICR < 2)				-0.007*** (0.001)	-0.007*** (0.002)	-0.010*** (0.002)
Dummy for medium-sized firms	-0.020*** (0.003)	-0.019*** (0.003)	-0.020*** (0.003)	-0.019*** (0.003)	-0.017*** (0.004)	-0.017*** (0.004)
Dummy for small firms	-0.020*** (0.003)	-0.018*** (0.003)	-0.021*** (0.003)	-0.018*** (0.003)	-0.016*** (0.004)	-0.020*** (0.004)
Dummy for micro firms	-0.025*** (0.003)	-0.023*** (0.003)	-0.034*** (0.004)	-0.022*** (0.003)	-0.019*** (0.004)	-0.030*** (0.004)
Lagged distance to frontier	0.126*** (0.002)	0.128*** (0.002)	0.134*** (0.002)	0.116*** (0.002)	0.118*** (0.002)	0.120*** (0.003)
Dummy for tradable sectors	0.081*** (0.007)	0.070*** (0.018)	0.052** (0.022)	0.120*** (0.010)	0.127*** (0.013)	0.025 (0.030)
Dummy for SOEs		0.004 (0.003)			-0.002 (0.004)	
Dummy for foreign firms		0.020*** (0.002)			0.022*** (0.002)	
Firm age			-0.0001** (0.00004)			-0.0001 (0.00005)
R-squared	0.20	0.20	0.18	0.21	0.21	0.20
No. of firms	91678	27202	57003	64223	40465	27948
No. of obs	319,176	201,785	135,748	213,765	136,636	95,477

Note: ***, **, * indicate significance at 1, 5, and 10% level. All regressions include year and sector dummies.

Table 1b. Bulgaria: Labor Productivity Growth (2003-15)

	(1)	(2)	(3)	(4)	(5)	(6)
Intangible assets/total assets	0.126*** (0.029)	0.101*** (0.035)	0.200*** (0.042)	0.183*** (0.034)	0.165*** (0.040)	0.254*** (0.048)
Dummy for high debt	-0.007 (0.004)	-0.001 (0.005)	-0.008 (0.007)			
Dummy for low interest coverage ratio (ICR<2)				-0.152*** (0.005)	-0.145*** (0.006)	-0.126*** (0.007)
Dummy for medium-sized firms	-0.048*** (0.006)	-0.032*** (0.006)	-0.026*** (0.006)	-0.049*** (0.006)	-0.031*** (0.007)	-0.025*** (0.007)
Dummy for small firms	-0.043*** (0.006)	-0.024*** (0.006)	-0.019*** (0.006)	-0.032*** (0.006)	-0.011 (0.007)	-0.009 (0.007)
Dummy for micro firms	-0.016*** (0.006)	0.007 (0.007)	0.005 (0.007)	0.041*** (0.006)	0.064*** (0.007)	0.069*** (0.008)
Lagged distance to frontier	0.173*** (0.001)	0.178*** (0.001)	0.170*** (0.002)	0.177*** (0.001)	0.180*** (0.002)	0.171*** (0.002)
Dummy for tradable sectors	0.051*** (0.017)	0.041 (0.026)	0.010 (0.019)	0.011 (0.025)	0.059 (0.037)	0.124*** (0.040)
Dummy for SOEs		-0.024*** (0.007)			-0.008 (0.009)	
Dummy for foreign firms		0.124*** (0.006)			0.122*** (0.006)	
Firm age			-0.0003*** (0.0001)			-0.0002 (0.0001)
R-squared	0.12	0.12	0.11	0.13	0.14	0.13
No. of firms	104432	64768	46226	69396	43574	30428
No. of obs	351,323	221,653	150,491	225,723	143,864	100,930

Note: ***, **, * indicate significance at 1, 5, and 10% level. All regressions include year and sector dummies.

Table 2. Bulgaria: Productivity Growth by Sub-periods

	(1)	(2)	(3)	(4)	(5)	(6)
	2003-08			2009-15		
	<i>TFP</i>	<i>Labor prod.</i>		<i>TFP</i>	<i>Labor prod.</i>	
				<i>Same firms as in Col (1)</i>	<i>Same firms as in Col (2)</i>	
Intangible assets/total assets	0.004 (0.045)	0.064 (0.094)	0.020 (0.014)	0.029 (0.027)	0.200*** (0.037)	0.157** (0.064)
Dummy for low interest coverage ratio (ICR < 2)	-0.007 (0.005)	-0.127*** (0.014)	-0.006*** (0.002)	-0.004* (0.002)	-0.155*** (0.005)	-0.105*** (0.007)
Dummy for medium-sized firms	-0.026*** (0.006)	-0.027** (0.011)	-0.022*** (0.004)	-0.016*** (0.004)	-0.069*** (0.007)	-0.065*** (0.008)
Dummy for small firms	-0.030*** (0.006)	0.043*** (0.012)	-0.024*** (0.004)	-0.017*** (0.004)	-0.074*** (0.007)	-0.050*** (0.008)
Dummy for micro firms	-0.037*** (0.007)	0.173*** (0.013)	-0.026*** (0.004)	-0.016*** (0.005)	-0.007 (0.007)	0.009 (0.010)
Lagged distance to frontier	0.102*** (0.004)	0.169*** (0.003)	0.125*** (0.002)	0.072*** (0.003)	0.182*** (0.002)	0.135*** (0.002)
Dummy for tradable sectors	0.062* (0.034)	-0.053 (0.061)	-0.025 (0.019)	-0.056** (0.028)	0.038** (0.016)	0.030 (0.031)
R-squared	0.18	0.13	0.22	0.28	0.13	0.12
No. of obs	34,048	34,481	179,717	57,383	191,242	58,447

Note: ***, **, * indicate significance at 1, 5, and 10% level. All regressions include year and sector dummies.

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