Credit, productivity and reallocation of resources*

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Abstract

Many enterprises in emerging market economies suffer from difficulties in accessing credit. But what happens when access to credit improves? This paper exploits Brazil's 2005 bankruptcy reform, which strengthened creditor protection and resulted in a substantial acceleration of credit and investment growth. Our analysis goes beyond average effects and examines to what extent improving access to credit affected the allocation of resources across firms of different productivity levels. We find evidence that the reform was particularly effective in alleviating credit constraints for high-productivity firms. After the reform, better access to credit allowed these firms to thrive on the expense of others. Our results suggest that better access to credit can improve the allocation of resources across firms, thus raising aggregate productivity.

Keywords: TFP, access to credit, credit reform, heterogeneous firms.

JEL Classification: G33, O16, F12.

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1. Introduction

Firms that face difficulties in access to credit are likely to be constraint in their ability to invest in productivity-enhancing projects. While this would in principle hold for most firms, high-performing firms may forego particularly high-return projects due to financial frictions. In this case, progress in financial development may not only improve the productivity of the average firm, but also the allocation of resources across firms with different productivity levels. The importance of resource reallocations for aggregate productivity has been the subject of extensive research, particularly for emerging market economies (Hsieh and Klenow, 2009). For Brazil, for example, estimates suggest potential productivity gains from a reallocation of resources on the order of 40% (Busso et al, 2013). Against this background, the potential contribution of deeper credit markets to growth could be substantially higher than often assumed, to the extent that financial development also plays a role for fostering the migration of resources to high-performing firms.

This paper investigates the reallocation effects of better access to credit using the example of Brazil, where a legal reform in 2005 strengthened the rights of creditors and lowered credit risk. Low levels of creditor protection through the legal system have often been touted as one important factor behind difficulties in access to credit in emerging economies (Safavian 2007, Djankov et al. 2008).[1]

The Brazilian bankruptcy law reform from 2005 ensured creditors a more rapid liquidation of distressed firms and allocated higher priority for secured creditors vis-à-vis workers and tax authorities. Following the reform, recovery rates rose substantially. Concomitantly, both credit expansion and business investment growth accelerated markedly (see Araujo, Ferreira and Funchal, 2012; Ponticelli and Alencar, 2016).

In this paper, we are particularly interested in how the credit reform affected the reallocation of resources across firms. We use the 2005 reform in Brazil as a source of exogenous variation to investigate the effect on firm productivity and on the allocation of resources. The discrete timing of the reform and the fact that it was largely unanticipated allow estimating a difference-in-differences model, comparing initial high-preforming firms to other firms across the pre- and post-reform periods.

Our results reveal that initially more productive firms reaped stronger benefits from the reform than others. This suggests that credit reforms can play a role in improving the allocation of

[1] Across countries, creditor protection is positively correlated with the development of credit markets (La Porta et al., 1997; Djankov et al., 2007).

resources across firms. This finding is robust to using alternative measures of productivity and cannot be explained by possible pre-existing trends.

This paper is structured as follows. Section 2 reviews the related literature while section 3 describes the Brazilian insolvency reform. Section 4 describes our data and section 5 presents the empirical strategy and results. Section 6 explores the robustness of our findings followed by a conclusion in the last section.

2. Related literature

Our paper contributes to the literature on credit constraints and the allocation of resources across firms. Several studies have documented substantial differences across firms with respect to productivity, even within narrowly defined sectors (for a general survey see Syverson, 2011; for evidence for Brazil see De Negri and Ferreira, 2015; Gomes and Ribeiro, 2015). Especially in emerging market economies, aggregate productivity could often be significantly higher if less resources were trapped in low-productivity enterprises (Hsieh and Klenow, 2009). To the extent that credit constraints may be one possible explanation behind this, improving access to credit may help to foster a reallocation of resources towards more productive firms. Empirical work confirms this role for credit constraints in preventing firms from investing in better technologies, suggesting that they can stand in the way of a better allocation of resources (Banerjee and Moll 2010, Buera et al. 2011 and Caselli and Gennaioli 2011).

Our finding can be interpreted as one possible channel through which the widely documented aggregate positive links between financial development and different aspects of private sector performance, including investment, innovation activities, productivity and growth, materialize (Rajan and Zingales 1998, Braun 2003, Beck 2002, Beck 2003).

The positive reallocation effects of better access to credit that we find can be rationalized by recent theoretical work on heterogeneous firms in the spirit of Melitz (2003). Based on the Melitz (2003) framework of heterogeneous firms, Bustos (2011) and Ponticelli and Alencar (2016) present models where firms of heterogeneous productivity levels face fixed costs to invest in a better technology that reduces marginal costs. To adopt that high technology, they must borrow from financial intermediaries. Whether a given firm can borrow enough to pay this fixed cost depends on the initial productivity of the firm, so that more productive firms are more likely to undertake productivity-enhancing investments. Ponticelli and Alencar (2016) explicitly model creditor protection rights. In their model, stronger creditor protection allows more firms to borrow for productivity-enhancing investment. Those that gain access to credit due to stronger creditor protection are the most productive ones among the previously credit-constrained firms. In other words, the principal beneficiaries in terms of growth are firms with above-average

productivity, thus shifting the aggregate allocation of resources towards more productive firms.

Moreover, our analysis also bears similarities to recent work that links credit constraints to participation in international trade. Chaney (2016) models how overcoming credit constraints allows firms to pay the fixed costs necessary for engaging in export activities. Similarly, the interaction between credit constraints and firm productivity affects the selection of firms into exports in Manova (2013). Empirical work has confirmed the notion that more credit-constrained firms are less likely to export and/or export less at the intensive margin (Minetti and Zhu 2011 and Berman and Héricout 2010).

With respect to the specific case of Brazil that we analyze, our paper is related to Araújo et al. (2012) and Ponticelli and Alencar (2016), who look at the same Brazilian creditor reform. The former document higher average loan maturities and lower borrowing costs after the reform, while the latter show that differences in court enforcement across municipalities led to differential effects of the reform on firm investment and size across these municipalities. What distinguishes our work from previous analyses of this specific reform episode is that we detect differential effects across firms, with implications for the reallocation of resources across firms.

3. Brazil's 2005 insolvency reform

Prior to 2005, Brazil's bankruptcy law made it very difficult for secured creditors to claim assets pledged as collateral for corporate loans. Secured creditors' claims were treated as subordinate to both workers and tax authorities, and the liquidation process was slow and ineffective (Araújo et al., 2012). As remaining assets from insolvencies often depreciate rapidly, their speedy liquidation is often a crucial factor for loan recovery rates.

The new bankruptcy legislation introduced in June 2005 was directly aimed at improving creditor rights and access to finance. The new law significantly reduced judicial uncertainty and raised the priority of secured creditors, by giving them preference over tax authorities and limiting the amount paid for each worker. Moreover, a distressed firm could be now sold before the creditors' list was constituted, which further helped to speed up the liquidation process. The effects of the new law, which is discussed in detail by Araújo and Funchal (2005), were highly visible: Recovery rates jumped from almost zero to 12% within one year and private credit to corporate borrowers rose substantially in its aftermath (Figure 1).

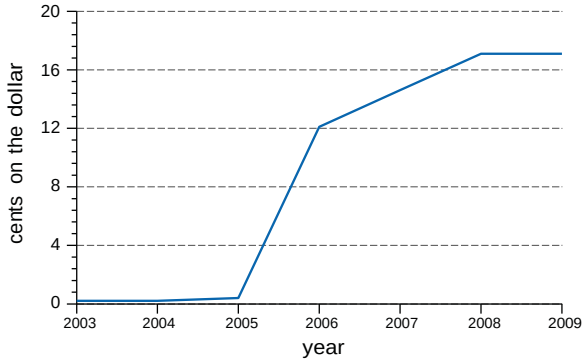
The exact nature of the new bankruptcy laws took most observers by surprise, which lends significant exogeneity to the reform. Political divisions between tax authorities who feared revenue losses and private lenders made it highly doubtful that creditors would obtain seniority over tax authorities, for example. As a result of this power struggle, the content of the reform

was almost impossible to anticipate before the final draft was released by the end of 2004 (Ponticelli and Alencar, 2015).

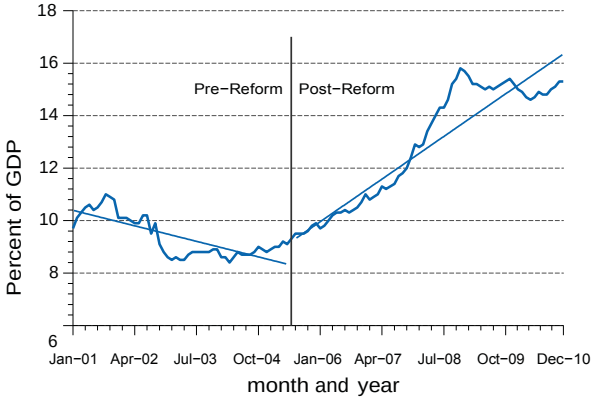
Ponticelli and Alencar (2015) argue that the periods before and after the reform were not characterized by noticeable differences in institutional settings other than the bankruptcy law, which helps for identification. The government of President Luiz Inácio Lula da Silva (Lula) of the Workers' Party took power in 2003, and remained in office until the last year of the sample. Lula's economic policies were largely a continuation of those of his social-democrat predecessor, Fernando Henrique Cardoso. Aggregate GDP growth rates were fairly similar around 3.5% in the periods before and after the reform.

Figure 1.

Loan recovery rates



Credit to corporate borrowers from non-earmarked sources*



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Note: Part of the sources of funding of Brazil's banks are earmarked for specific directed lending activities, beyond the influence of banks. Loans that belong to this category are not included here.

Source: Araújo et al. (2012) and Central Bank of Brazil.

4. Data

We use firm-level data from the commercially available ORBIS database, published by the private company Bureau van Dyke, for the period 2000-2010. The data contain annual balance sheet data as well as profits and loss accounts and allow us to obtain measures of total factor productivity (TFP) for a sample of 1,736 firms over the period 2000-2010. More details on the firm-level data are provided in the appendix.

In order to estimate productivity, we use value-added to measure output from two input factors, labor and capital. Nominal values are deflated using industry-specific deflators at the 2-digit level and a capital deflator. We measure TFP using a multilateral index suggested by Aw, Chen and Roberts (2001), which builds on Caves and Diewert (1982a, 1982b). This index expresses each individual plant's output and inputs as deviations from a reference firm, which employs geometric means of logarithmic inputs and logarithmic output and of input costs shares. This guarantees that comparisons between any two plant-year observations are transitive and hence allows for consistent comparisons of TFP in firm-level data with a panel structure. The TFP index approach allows for flexible and heterogeneous production technology, and has also been used, for instance, in Arnold and Javorcik (2009) and Griffith et al. (2004).[2]

The TFP index for firm *j* in industry *i* at time *t* is defined as follows:

$$TFP_{jt} = lnY_{jt} - \overline{lnY_t} - \frac{1}{2}\sum_n (\sigma_j^n - \overline{\sigma_i^n})(lnx_{jt}^n - \overline{lnx_t^n}) \quad (1)$$

where *Y* is value added, x^n is the use of factor n, upper bars indicate geometric means across all firms in the same 2-digit industry *i*. In the same vein, σ_j^n is the cost share of factor *n* in the revenues of firm *j*, while $\overline{\sigma_i^n}$ is the geometric mean cost share in industry *i* in year *t*. In our case with two factors labor and capital, we use the identifying assumption $\sigma_j^1 + \sigma_j^2 = 1$, which is equivalent to assuming constant returns to scale. The index is calculated separately for each of 2-digit industry.

5. Empirical strategy and results

We are interested in the differential effects of better access to credit on firms with different productivity levels. Since access to credit improved substantially after the reform, we create a

[2] We also present a robustness check using parametric productivity estimates. A comparison of the robustness of five widely used productivity measures (index numbers, data envelopment analysis, stochastic frontiers, GMM and semiparametric estimation) suggests that the approach we chose tends to produce very robust results across the different experiments (Van Biesebroeck, 2007).

binary variable $Reform_t$ that takes the value 1 in the years after the 2005 reform. We interact this with different indicators of strong pre-reform performance $\phi_{j,t0}$, to get a sense of the extent to which high-performing firms reap particular benefit from the reform. Lacking guidance about possible thresholds, we experiment with a number of specifications. A straightforward one is to include an indicator that takes the value one for firms whose performance was above the industry-median in the pre-reform years and zero otherwise, called $\phi_{j,t0}^{med}$. As an alternative, we also create an indicator for firms that were in the top third of productivity in their respective industry, $\phi_{j,t0}^{p33}$. Our basic equation of interest is the following:

$$TFP_{jt} = \beta_0 + \beta_1(\phi_{j,t0} * Reform_t) + \kappa_j + \rho_t + \varepsilon_{jt} \quad (2)$$

where κ_j are firm fixed effects, ρ_t are year fixed effects and ε_{jt} is an error term. Note that the presence of year and firm fixed effects also control for the constituent terms of the interaction term. Rather than estimating equation (2) as is, we prefer to estimate the equation using a two period model, one before and one after the reform. This facilitates the interpretation of the results and allows us to deal with issues related to serial correlation and the adjustment of standard errors (see Bertrand et al., 2004).

$$\Delta TFP_j = \beta_1 \phi_{j,t0} + u_j$$

where ΔTFP_j is the change in TFP between the pre-reform and the post-reform periods, where we take simple averages over available observations for 2002-2004 and 2006-2008, respectively. The year of the reform, 2005, is excluded from the analysis.

The specification in first differences also allows us to use fixed effects to control for different trends across industries and states, ϑ_i and ν_s. We also control for the possibility of different productivity growth trajectories across firms of different size by adding the initial number of employees as a proxy for the initial firm size, $\ln empl_{j,t0}$, into the differenced equation. Our baseline estimation equation is as follows:

$$\Delta TFP_j = \beta_1 \phi_{j,t0} + \nu_s + \vartheta_i + u_j \quad (3)$$

The coefficient β_1 provides an answer to the question whether firms with higher initial productivity ($\phi_{j,t0}$ = 1) obtain larger gains following the reform. If that hypothesis were confirmed, the estimated coefficient β_1 should be positive and significant.

Table 1 shows our main results for estimating equation (3). In columns 1 and 2, we define high productivity firms as those with TFP levels above the median and the 66th percentile, respectively. For both definitions we find that initially more productive firms reap stronger

productivity benefits from the reform than the remaining firms. Note that, in all specifications, we control for $\ln empl_{j,t0}$. Not controlling for initial firm size leads in general to a larger effect of $\phi_{j,t0}$ on ΔTFP_j.

Table 1.

Effect of the reform on firm productivity

Dependent variable: ΔTFP_j	**(1)**	**(2)**	**(3)**
$\phi_{j,t0}^{med}$	0.208***		
	(0.0567)		
$\phi_{j,t0}^{p33}$		0.269***	
		(0.0589)	
$\phi_{j,t0}^{assets}$			0.395***
			(0.0511)
$\ln empl_{j,t0}$	0.0854***	0.0659**	0.0340**
	(0.0256)	(0.0273)	(0.0172)
Observations	1,736	1,736	1,736
R-squared	0.053	0.065	0.066

Notes: All estimations include a constant, state and industry fixed effects.
Errors are clustered by firm.
***, **, and * indicate significance at 1%, 5%, and 10% level.

In column 3, we use yet another definition of ϕ to shed light on the principal channel through which the hypothesis of stronger firms reaping greater benefits is founded in the model. In other words, we tie the definition of ϕ closer to the incidence of credit constraints.

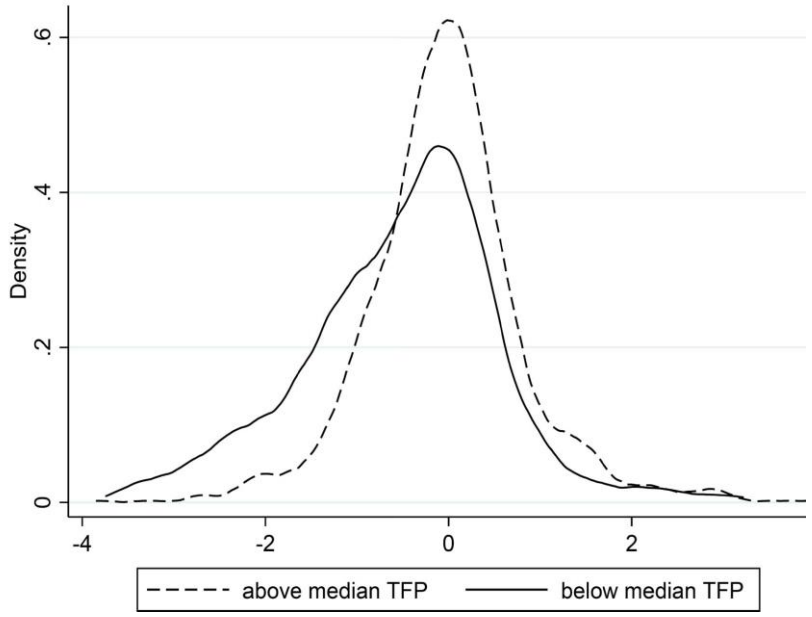
We do so by defining $\phi_{j,t0}^{assets}$ as one for firms that satisfy two conditions: a pre-reform productivity level above the industry-median and a lower ratio of fixed assets to revenues than the industry median. The idea behind this definition is that firms with relatively few fixed assets were at a relative disadvantage prior to the reform, but could have overcome this disadvantage as the assets they could pledge became more valuable to lenders. We find that the estimated coefficient for β_1 is larger under this definition. In other words, our earlier findings are confirmed for firms that were initially highly productive but financially constrained. High-productivity firms observed between 20% and 39% higher productivity growth in comparison to other firms.

Our basic finding can be illustrated in a simple picture. Figure 2 depicts the distribution functions of TFP growth between the pre-reform and post-reform periods, for firms that were initially strong performers and those that were not. This simple graphic analysis uses the same definition for high-performing firms as in column 1 of Table 1. It cannot account for the fixed effects and

covariates we control for in the regression analysis, but even the raw data clearly confirm the stronger productivity growth of initially more productive firms. The cumulative density function of the strong performers dominates the one for low performers at all points.

Figure 2.

Distributions of productivity growth between pre-reform and post-reform period



Source: Authors‘ calculations

6. Robustness checks

We explore the robustness of our findings along several dimensions. First, we are interested whether our approach to measuring productivity, which is unobservable by nature, matters for our results. We therefore repeat our baseline estimations using an alternative measure of TFP, estimated as the residual from simple industry-level OLS regressions of a Cobb-Douglas production function. The production functions use value added as the dependent variable with capital (K_{jt}) and labor (L_{jt}) as production factors: $Y_{jt} = \gamma_j + \alpha L_{jt} + \beta K_{jt} + u_{jt}$. These results, shown in columns 1 to 3 of Table 2, are qualitatively equivalent to those obtained in Table 1.

An even simpler and more objective method of measuring firm performance is to look at firms' sales ($\Delta \ln Sales_j$). The empirical literature on heterogeneous firms has documented a strong positive correlation between productivity and output (Oi and Idson 1999, Syverson 2011, Melitz and Trefler 2012, and Yang 2012), so that sales could even be interpreted as a proxy for productivity. If better firms grow more in terms of sales, we could also take this as an indication that the allocation of resources improves in the aftermath of the credit reform. Columns 4, 5 and 6

of Table 2 report the results for equation (3) using $\Delta \ln Sales_j$ as the dependent variable. In all columns, the results reveal a positive and significant effect for the initially high-performing firms.[3]

Table 2.

Robustness checks using Cobb-Douglas residual productivity and sales

Dependent variable:	ΔTFP_j *Cobb Douglas*			$\Delta \ln Sales_j$		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$\phi_{j,t0}^{med}$	0.0949***			0.0449*		
	(0.0291)			(0.0237)		
$\phi_{j,t0}^{p33}$		0.108***			0.0493**	
		(0.0302)			(0.0243)	
$\phi_{j,t0}^{assets}$			0.182***			0.0502**
			(0.0593)			(0.0243)
Observations	1,723	1,723	1,723	1,733	1,733	1,733
R-squared	0.061	0.064	0.065	0.093	0.092	0.095

Notes: All estimations include a constant, state and industry fixed effects. Errors are clustered by firm.
***, **, and * indicate significance at 1%, 5%, and 10% level.

As a final robustness check, we want to rule out the presence of intrinsic correlations between levels and growth of productivity in our data, which we could be wrongly attributing to policy changes. While our baseline estimations control for systematic differences in productivity growth across industries, across states and initial firm size, it is nonetheless conceivable that pre-existing trends related to initially strong performance would be creating a bias in our estimations of equation (3). In other words, firms that did well at the beginning and that are not well-captured by industry or state dummies may have been on a trajectory of strong TFP growth, independently of the credit reform. To shed light on this, we replicate our regressions using only data from the pre-reform period, i.e. between 2002 and 2004. This is akin to a falsification exercise, where we replicate our baseline estimation in a part of the data where we know that no credit reform took place. Our results in Table 3 show that in the absence of the reform, we detect no change in TFP for the initially more productive firms.[4]

[3] In all columns from Table 2, $\phi_{j,t0}$ is defined based on the initial productivity of firm *j* in time t_0

[4] Note that we do not observe firms in all years before and after the reform. This explains the restricted number of observations when we consider only the years 2002 and 2004.

Table 3.

Robustness check: Falsification exercise

Dependent variable: ΔTFP_j	**(1)**	**(2)**	**(3)**
$\phi_{j,t0}^{med}$	-0.0295		
	(0.109)		
$\phi_{j,t0}^{p33}$		-0.0690	
		(0.0540)	
$\phi_{j,t0}^{assets}$			-0.0136
			(0.117)
$\ln empl_{j,t0}$	0.0225*	0.0245*	0.0180
	(0.0130)	(0.0131)	(0.0117)
Observations	341	341	341
R-squared	0.192	0.191	0.189

Notes: All estimations include a constant, state and industry fixed effects. Errors are clustered by firm.
***, **, and * indicate significance at 1%, 5%, and 10% level.

7. Conclusion

This paper investigates the heterogeneous responses of firms to a bankruptcy law reform that strengthened creditor rights, improved access to credit and lead to an increase in aggregate credit. We use the 2005 reform in Brazil as a source of exogenous variation to investigate the heterogeneous effects on firm productivity and on the allocation of resources across firms. The discrete timing of the reform and the fact that it was largely unanticipated allow estimating a difference-in-differences model.

Our results suggest that initially more productive firms were able to reap stronger benefits from the reform. They are consistent with the view that prior to the reform, credit constraints have curtailed growth opportunities for more productive firms with strong growth potential, while better access to credit post-reform has allowed these firms to grow on the expense of others. These results hold regardless of the specific measure of productivity employed, and they also hold for sales growth. This leads to a positive reallocation effect, with important benefits for aggregate productivity, as better access to credit has improved the allocation of resources and aggregate productivity by allowing strong firms to outgrow weaker ones, both in terms of productivity and sales.

Our empirical analysis is of particular interest to developing and emerging economies, where shallow credit markets often coincide with comparatively low levels of creditor protection through the legal system, for example due to the lack of an efficient judicial system. The fact that these countries also tend to suffer from an inefficient allocation of resources across firms of different productivity levels strengthens the case, made by Caselli and Gennaioli (2008), for example, for financial market reforms that strengthen creditor rights.

References

Araujo, A., R. Ferreira, and B. Funchal (2012). The Brazilian bankruptcy law experience. *Journal of Corporate Finance* 18 (4), 994–1004.

Arnold, J. M. and B. S. Javorcik (2009). Gifted kids of pushy parents? foreign direct investment and plant productivity in Indonesia. *Journal of International Economics* 79, 42–53.

Aw, B., X. Chen, and M. Roberts (2001). Firm-level productivity differentials and turnover in Taiwanese manufacturing. *Journal of Development Economics* 66, 51–86.

Beck, T. (2002). Financial development and international trade. is there a link? *Journal of International Economics* 57, 107–131.

Beck, T. (2003). Financial dependence and international trade. *Review of International Economics* 11(2), 296–316.

Berman, N. and J. Héricourt (2010). Financial factors and the margins of trade: Evidence from cross-country firm level data. *Journal of Development Economics* 93 (2), 206–217.

Bertrand, M., E. Duflo, and S. Mullainathan (2004). How much should we trust diff in-difference estimates? *Quarterly Journal of Economics* 119(1), 249–275.

Braun, M. (2003). Financial contractibility and asset hardness. University of California Los Angeles, mimeo.

Bustos, P. (2011). Trade liberalization, exports, and technology upgrading: Evidence on the impact of Mercosur on Argentinian firms. *American Economic Review* 11, 304340.

Caselli, F. and N. Gennaioli (2008). Economics and politics of alternative institutional reforms. *Quarterly Journal of Economics* 123 (3), 1197–1250.

Caves, D. L. and E. Diewert (1982a). The economic theory of index numbers and the measurement of input, output and productivity. *Econometrica* 50 (6), 1393–1414.

Caves, D. L. and E. Diewert (1982b). Multilateral comparisons of output, input and productivity using superlative index numbers. *Economic Journal* 92, 73–86.

Chaney, T. (2016). Liquidity constrained exporters. *Journal of Economic Dynamics and Control* 72, 141-54.

Djankov, S., O. Hart, C. McLiesh, and A. Shleifer (2008). Debt enforcement around the world. *Journal of Political Economy* 116 (6), 1105–1149.

Gomes, V. and E. Ribeiro (2015), "Produtividade e competição no mercado de produtos: uma visão geral da manufatura no Brasil", in De Negri, F. and L. R. Cavalcante (eds.), *Produtividade no Brasil: Desempenho e determinantes*, Volume 2 - Determinantes, IPEA, Brasília.

Hsieh, C. and P. Klenow (2009). Misallocation and manufacturing TFP in China and India. *Quarterly Journal of Economics* 124 (4), 1403–1448.

Manova, K. (2013). Credit constraints, heterogeneous firms and international trade. *Review of Economic Studies* 80, 711–744.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica* 71(6), 1695–1725.

Melitz, M. and D. Trefler (2012). Gains from trade when firms matter. *Journal of Economic Perspectives* 26(2), 91-118.

Minetti, R. and S. Zu (2011). Credit constraints and firms export: Microeconomic evidence from italy. *Journal of International Economics* 83 (2), 109–125.

Oi, W. and T. Idson (1999), Firm Size and Wages, in Aschenfelter, O. and D. Card (eds.), *Handbook of Labor Economics*, Volume 3, Part B, 2165-2214.

Ponticelli, J. and L. Alencar (2016). Court enforcement, bank loans and fi investment: Evidence from a bankruptcy reform in brazil. *Quarterly Journal of Economics* 131 (3), 1365–1413.

Rajan, R. and L. Zingales (1998). Financial dependence and growth. *American Economic Review* 88(3), 559–586.

Safavian, M. and S. Sharma (2007). When do creditor rights work? *Journal of Comparative Economics* 35 (3), 484–508.

Syverson, Chad (2011). What Determines Productivity? *Journal of Economic Literature* 49(2), 326-65.

Yang, Judy (2012). Large firms are more productive, offer higher wages and more training: Assessing private sector contributions to job creation. *International Finance Corporation Report: Survey note 7.* Washington DC: World Bank.

Appendix

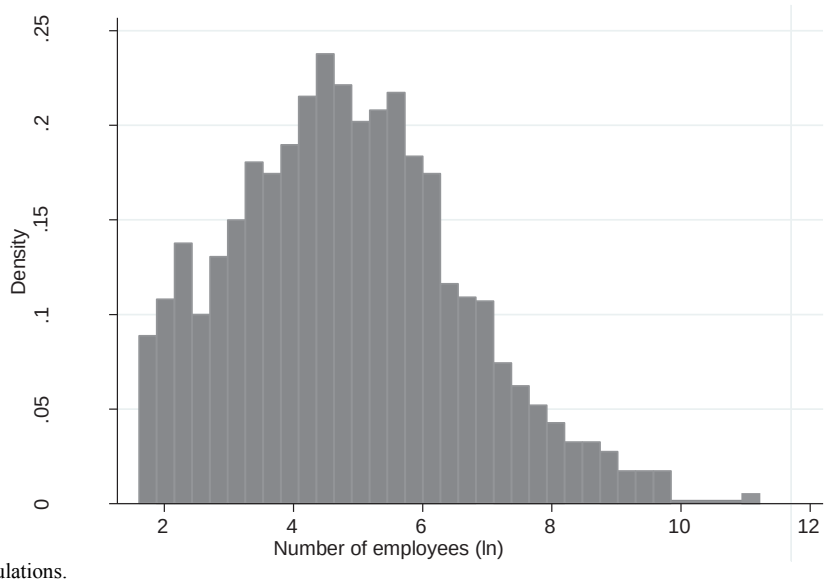
Table A1 provides summary statistics for the main variables. Figure A1 shows the distribution of firm size for firms with up to 10,000 employees and reveals a large share of firms with 25 to 500 employees. This share is relatively high in comparison to the structure of the Brazilian economy, which has many small firms. Thus, if there is a bias in our sample, it is towards larger firms. Since larger firms face less financial constraints, our results most likely strengthen the importance of financial constraints for firm productivity.

Table A1: Summary statistics of the main variables

Variable	Mean	Std. Dev.	Min.	Max
$\phi_{j,t0}^{assets}$	0.191	0.393	0	1
$\phi_{j,t0}^{med}$	0.534	0.488	0	1
$\phi_{j,t0}^{p33}$	0.306	0.420	0	1
$\ln empl_{j,t0}$	5.05	1.762	1.61	11.222

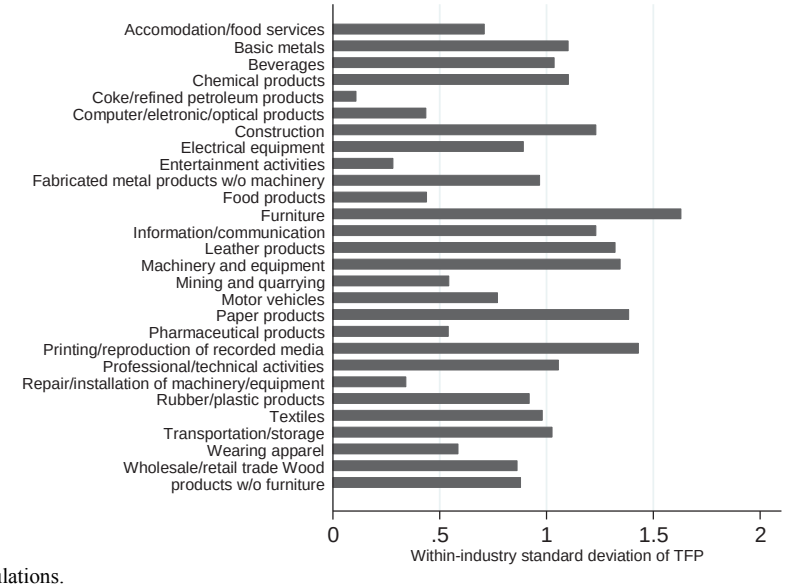
We compute the degree of firm heterogeneity within industries in terms of the productivity dispersion and the covariance between firm size and productivity. Given that measurement issues generally affect cross-industry comparisons, we avoid these issues by focusing on within-industry measures of dispersion and covariance. Figure A2 reports the coefficient of variation of TFP within-industries and reveals large dispersion in TFP within industries. Moreover, the dispersion varies significantly across industries. As argued by Hsieh and Klenow (2009), higher dispersion of firm productivity within an industry may hint at a greater misallocation of resources.

Figure A1: Distribution of firm size



Source: Authors' calculations.

Figure A2: Coefficient of variation of TFP, by industry



Source: Authors' calculations.