Session Number: Parallel Session 2C: Growth and Productivity
Time: MONDAY, AUGUST 25, MORNING

Paper Prepared for the30th General Conference of
The International Association for Research in Income and Wealth

Portoroz, Slovenia, August 24-30, 2008

Productivity In A Distorted Market: Evidence From Distributive Trade Firms In Brazil

Gaaitzen J. de Vries

For additional information please contact:

Name: Gaaitzen J. de Vries
Affiliation: University of Groningen and GGDC
Full mailing address: PO Box 800, 9700 AV Groningen, the Netherlands
Email address: g.j.de.vries@rug.nl

Productivity In A Distorted Market: Evidence From Distributive Trade Firms In Brazil ⋆

First and incomplete draft

July 2008

Gaaitzen J. de Vries [a]

[a] *University of Groningen and GGDC, Faculty of Economics and Business, PO Box 800, 9700 AV Groningen, the Netherlands. E-mail: g.j.de.vries@rug.nl*

Abstract

This paper explores the relation between distortions to the business environment and differences in productivity across firms. In the Hsieh and Klenow (2007) model of monopolistic competition with heterogeneous firms, distortions affect the marginal product of capital and labour across firms. We study the model implication empirically using information on the business environment across the Federal states of Brazil in combination with location and productivity data of firms from the annual census of distributive trade firms during 1996 to 2004. We find sizeable differences in the marginal product of capital and labour across trade firms in Brazil, larger than that found across trade firms in less-regulated Chile. Distortions to the business environment across the Federal states are positively related with the spread in productivity across firms.

Key words: Distributive trade sector, Market distortions, Productivity, Brazil
JEL: D24, L50, O12

⋆ I thank the team at IBGE, the national statistical office of Brazil, for their hospitality and providing me access to the firm level data. IBGE ensures confidentiality of responses by requiring researchers to work on site at CDDI with output checked before leaving the premises. I would also like to thank the National Statistical Office of Chile (INE), in particular Hernan Frigolett and Cristina Silva, for providing access to the firm level data for Chile. I would like to thank seminar participants at the University of Groningen for helpful comments.

1 Introduction

Consider two retailers with identical technologies. Both retailers are active in the market and face business regulation which increases their marginal costs. But one retailer has political connections and benefits from tax exemptions, while the other retailer without political connections has no such benefits.[1] Firms equate marginal product with marginal cost. Thus, the marginal product in the firm with political connections is lower than the marginal product in the firm without political connections.

Business regulation often serves social and economic objectives. Regulation is, for example, related to urban planning (protecting small retailers in city centres) or aims at maintaining health and safety standards. However, public opinion hints at distorting effects of excessive business regulation in the Brazilian economy. For example, Brazilians have the saying "to my friends: everything, to my enemies: the law". In fact, Brazil is one of the most regulated countries in the world (World Bank, 2006). Besides business regulation, other factors such as theft, corruption, infrastructure, and the inadequate provision of energy create distortions to the business environment as well.

In this paper, we study implications of distortions to the business environment for dispersion in productivity in the distributive trade sector of Brazil. Hsieh and Klenow (2007) developed a model of monopolistic competition with heterogeneous firms, where distortions to output and production factors increase the dispersion in marginal products across firms.[2] They use this model to examine the extent to which misallocation of resources reflects aggregate productivity differences across the manufacturing sector of the US, China, and India. They find that if marginal products are equalized to the extent observed in the US, aggregate productivity is between 25-40 and 50-60 percent higher in China and India respectively. In a cross-country analysis, Bartelsman et al. (2006) study the relationship between resource allocation and regulation. They find that market oriented reforms in Eastern European countries led to an improvement in the allocation of resources equal to about a 30-50 percent increase in labour productivity. Alfaro et al. (2007) examine differences in the allocation of inputs across firms in a cross-country setting. Calibrating a model similar to Restuccia and Rogerson (2007) and Hsieh and Klenow (2007), they find that the misallocation of resources across firms accounts for much of the cross-country income differences.

[1] In Brazil, for example, representatives of foreign distributive trade firms allege that non-transparent barriers exist (USICT, 1996). Non-transparent barriers include variable administrative fees, and inconsistently applied customs clearance procedures.

[2] Restuccia and Rogerson (2007) develop a similar model, but with homogeneous products and decreasing returns to scale at the firm level.

Although we draw upon the model developed by Hsieh and Klenow (2007), the direction in this paper is different. We are interested in understanding the role of distortions in creating misallocation of resources. Although the previous literature discusses this issue, it mainly aims to explain cross-country income differences as a result of resource misallocation (Alfaro et al., 2007; Bartelsman et al., 2006; Hsieh and Klenow, 2007; Restuccia and Rogerson, 2007).[3] We exploit information on the business environment across the Federal states of Brazil in combination with location and productivity data of firms from the annual census of distributive trade firms during 1996 to 2004. The variation in distortions across Federal states and less spurious measurement error within a particular country motivate us to examine Brazil.[4]

We find a sizeable spread in the marginal product of labour and capital, and hence a large productivity dispersion across Brazilian distributive trade firms. The productivity dispersion is larger across trade firms in Brazil than across trade firms in less-distorted Chile. Within Brazil, we generally find a positive relation between distortions to the business environment and the spread of the productivity distribution across Federal states. In particular, theft, corruption, electricity provision, and licensing and operating permits significantly increase the spread of the productivity distribution across the Federal states. Despite the Real plan and services liberalization, we find little reduction in the spread of the productivity distribution over time, suggesting that other factors are more important in removing disparities in productivity. Unfortunately, given the limited information on business regulation across the Federal states of Brazil, we only provide tentative evidence on the relation between the productivity distribution and distortions to the business environment.

Next, section 2 presents the model. Section 3 describes the dataset. Results are discussed in section 4. Section 5 concludes.

2 A model of productivity and firm dynamics in a distorted market

Implications of distortions to the business environment for productivity can be studied in a model of monopolistic competition with heterogeneous firms.

[3] An exception is Restuccia (2008) who quantifies the implications of taxes and entry costs for the misallocation of resources in Latin American countries using a calibration exercise. He finds that taxes and entry costs can easily generate the misallocation of resources and hence the lower observed aggregate total factor productivity in Latin America as compared to the US.

[4] In addition, since most trade firms are single establishment firms, we believe firm fixed effects such as those from regional retailing chains and business regulation are probably small.

This model originates from Melitz (2003), who incorporates heterogeneity with respect to the firms' marginal costs in a (symmetric) model of monopolistic competition. Hsieh and Klenow (2007) introduce distortions in this model. Since the model we present here draws upon Hsieh and Klenow (2007), we only discuss the core elements and present the model in a format which suits our empirical analysis.

We assume a standard Cobb Douglas production function for distributive trade firms. And we study the steady state competitive equilibrium of the model, so retailers take the wage rate and the rental rate of capital as given. We abstract from productivity dynamics by assuming time invariant firm productivity. [5]

Two distortions are incorporated in the model. The first is a capital distortion, τ_{Ksi}, which changes the marginal product of capital relative to the marginal product of labour. The second is an output distortion, τ_{Ysi}, which distorts the marginal product of capital and labour in equal proportions.

Assume the final sales of good Y from a "representative" firm under perfect competition in both its output and input market. This final good Y is the combination of sales Y_s in s distributive trade industries:

$$Y = \prod_{s=1}^{S} Y_s^{\theta_s}. \tag{1}$$

where the sum of industry shares $\sum_{s=1}^{S} \theta_s = 1$ is Cobb-Douglas. [6] Aggregate sales Y_s in industry s, is the sum of n_s differentiated products sold by firms i, which face a constant elasticity of substitution σ: [7]

$$Y = \left(\sum_{i=1}^{N_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}. \tag{2}$$

[5] The model of firm dynamics developed by Ericson and Pakes (1995) assumes firms actively adopt to the environment. That is, productivity is related with the distortions a firm faces. Distortions might lead a firm to invest more or less in research and development, which in turn determines its productivity. These dynamics are not considered in our model.

[6] Under cost minimization $P_s Y_s = \theta_s PY$, where P_s is the price of sales Y_s in industry s and $P \equiv \prod_{s=1}^{S} (\frac{P_s}{\theta_s})^{\theta_s}$ is the price of the final good sold (which is set the numéraire, so $P = 1$).

[7] Firms sell a single type of good or variety. These varieties are symmetrically differentiated, with a common elasticity of substitution σ between any two variables. In addition, we assume the elasticity of substitution is time-invariant and does not differ across goods.

The Cobb-Douglas production function of each firm selling a differentiated good in industry s is given by:

$$Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}, \tag{3}$$

where A denotes the firms' productivity, K capital, and L labour. To minimize measurement error, the capital share α_s and labour share $(1 - \alpha_s)$ are only allowed to vary across industries. Production costs are given by:

$$C_{si} = wL_{si} + (1 + \tau_{Ksi})RK_{si}, \tag{4}$$

where w is the wage rate, R is the rental cost of capital, and the capital distortion τ_{Ksi}, raises the marginal product of capital relative to that of labour. Recall the introductory example. In this example, the firm with political connections has tax exemptions and therefore a lower value of τ_{Ksi} in comparison to the firm without political connections. Cost minimization results in the optimal capital-labour ratio:

$$\frac{K_{si}}{L_{si}} = \left(\frac{\alpha_s}{1 - \alpha_s}\right)\left(\frac{w}{R}\right)\left(\frac{1}{1 + \tau_{Ksi}}\right). \tag{5}$$

A positive value of τ_{Ksi} indicates negative distortions, a negative value reveals positive distortions (subsidies), and a zero value suggests no distortions. Hence, capital distortions (τ_{Ksi}) affect the mix of inputs. A larger distortion to capital is associated with a lower capital-labour ratio. Similarly, but exactly the reverse of a capital distortion, are distortions to labour input. For example, Lafontaine and Sivadasan (2006) study the effects of labour market regulation upon labour productivity. Using productivity data of foreign establishments from an international food retailer, they find that stricter labour market regulation induce local establishments to substitute labour for capital. Hence, Lafontaine and Sivadasan (2006) find labour market regulation affects the factor mix.

Profits are given by:

$$\pi_{si} = (1 - \tau_{Ysi})P_{si}Y_{si} - wL_{si} - (1 + \tau_{Ksi})RK_{si}, \tag{6}$$

where P_{si} is the price of the good sold by firm i in industry s, and τ_{Ysi} is the output distortion which affects the marginal products of capital and labour in equal proportions. A positive value of τ_{Ysi} indicates negative distortions, a negative value reveals positive distortions, and a zero value suggests no

distortions. The mark up price over marginal cost is fixed because we assumed constant returns to scale in production and the mark up is given by:

$$P_{si} = \left(\frac{\sigma}{\sigma-1}\right)\left(\frac{w}{1-\alpha_s}\right)^{1-\alpha_s}\left(\frac{R}{\alpha_s}\right)^{\alpha_s}\left(\frac{(1+\tau_{Ksi})^{\alpha_s}}{A_{si}(1-\tau_{Ysi})}\right). \tag{7}$$

Maximizing output Y_s, we obtain the allocation of capital and labour, and firm output. The allocation of labour is:

$$\begin{aligned} L_{si} = & \frac{(1-\tau_{Ysi})^{\sigma} A_{si}^{\sigma-1}}{(1+\tau_{Ksi})^{\alpha_s(\sigma-1)}}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\left(\frac{(1-\alpha_s)}{w}\right)^{\sigma(1-\alpha_s+\frac{\alpha_s}{\sigma})} \\ & \times\left(\frac{\alpha_s}{R}\right)^{\alpha_s(\sigma-1)} I^{\sigma-1}\theta_s Y. \end{aligned} \tag{8}$$

Where $I = \left(\sum_{i=1}^{N} P_{si}^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$. The allocation of capital is:

$$\begin{aligned} K_{si} = & \frac{(1-\tau_{Ysi})^{\sigma} A_{si}^{\sigma-1}}{(1+\tau_{Ksi})^{\alpha_s(\sigma-1+\frac{1}{\alpha_s})}}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\left(\frac{(1-\alpha_s)}{w}\right)^{\sigma(1-\alpha_s+\frac{\alpha_s}{\sigma}-\frac{1}{\sigma})} \\ & \times\left(\frac{\alpha_s}{R}\right)^{\alpha_s(\sigma-1+\frac{1}{\alpha_s})} I^{\sigma-1}\theta_s Y. \end{aligned} \tag{9}$$

And firm output is:

$$Y_{si} = \frac{(1-\tau_{Ysi})^{\sigma} A_{si}^{\sigma}}{(1+\tau_{Ksi})^{\alpha_s\sigma}}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\left(\frac{(1-\alpha_s)}{w}\right)^{\sigma(1-\alpha_s)}\left(\frac{\alpha_s}{R}\right)^{\alpha_s\sigma} I^{\sigma-1}\theta_s Y. \tag{10}$$

Equation 10 shows that firm output within industries differs because of firm-specific productivity (as in Melitz (2003)), and because of firm-specific output and capital distortions. In the empirical analysis, we are unable to use firm's physical output Y_{si} but use firms' revenue $P_{si}Y_{si}$ in stead. Foster et al. (2008) term output Y_{si} divided by inputs a measure of "physical productivity", or TFPQ hereafter.[8] Revenue $P_{si}Y_{si}$ divided by inputs is a measure of "revenue productivity", or TFPR hereafter. Since we will use revenue productivity in the empirical analysis, the marginal revenue product of labour is given by:

[8] The measure of "physical productivity", denoted by TFPQ, is: $A_{si} \equiv \frac{Y_{si}}{K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}}$

$$MRPL_{si} = \frac{P_{si}Y_{si}}{L_{si}} = \frac{w}{(1-\tau_{Ysi})}\left(\frac{\sigma}{\sigma-1}\right)\left(\frac{1}{1-\alpha_s}\right). \tag{11}$$

Thus, a higher output distortion increases the marginal revenue product of labour. Likewise, an output subsidy lowers the marginal product. The marginal revenue product of capital is:

$$MRPK_{si} = \frac{P_{si}Y_{si}}{K_{si}} = \frac{R(1+\tau_{Ksi})}{(1-\tau_{Ysi})}\left(\frac{\sigma}{\sigma-1}\right)\left(\frac{1}{\alpha_s}\right). \tag{12}$$

Here, an output distortion increases the marginal revenue product of capital, and a capital distortion increases the marginal revenue product of capital as well. The "revenue productivity" of a firm is given by:

$$\begin{aligned} TFPR_{si} \equiv P_{si}A_{si} &\equiv \frac{P_{si}Y_{si}}{L_{si}K_{si}} \\ &= \frac{(1+\tau_{Ksi})^{\alpha_s}}{(1-\tau_{Ysi})}\left(\frac{\sigma}{\sigma-1}\right)\left(\frac{1-\alpha_s}{w}\right)^{\alpha_s-1}\left(\frac{R}{\alpha_s}\right)^{\alpha_s}. \end{aligned} \tag{13}$$

$TFPR_{si}$ can also be expressed as a weighted average of the firm's marginal revenue product of capital and labour:

$$\begin{aligned} TFPR_{si} &= \frac{(1+\tau_{Ksi})^{\alpha_s}}{(1-\tau_{Ysi})}\left(\frac{\sigma}{\sigma-1}\right)\left(\frac{1-\alpha_s}{w}\right)^{\alpha_s-1}\left(\frac{R}{\alpha_s}\right)^{\alpha_s} \\ &= (MRPL_{si})^{1-\alpha_s}(MRPK_{si})^{\alpha_s}. \end{aligned} \tag{14}$$

From this, it follows that revenue productivity $TFPR$ only varies across firms within industries if firms face output and capital distortions.[9] In this model of monopolistic competition, firms with higher physical productivity $TFPQ$ demand more capital and labour up to the point where the higher output results in a lower price and thus the same $TFPR$ as the other firms. Hence, the distribution of $TFPR$ signals distortions. Distortions to the business environment increase the dispersion in $TFPR$. In contrast, the $TFPQ$ distribution reflects true productivity differences across firms.

In the remainder of this paper, we empirically examine the model implication from equation 13: distortions increase the dispersion in revenue productivity ($TFPR$). We expect a positive relation between distortions to the business

[9] This result arises from the assumption of unit elastic demand and a downward-sloping demand curve.

environment and the spread of the *TFPR* distribution. The spread of the productivity distribution, however, might be related with firm size as well. That is, we might observe differences in dispersion among small and larger firms, because of opportunities to evade regulations for small firms or higher bargaining power with officials for larger firms. Given the diffuse (and opposing) effects, the theoretic relation between firm size and the productivity dispersion is ambiguous. The next section describes the data set. Thereafter, we empirically examine the link between distortions and productivity.

3 Data

In this section we describe the two main data sets which we use. The first data set consists of indicators of distortions to the business environment across Federal states. The second data set includes information on location and productivity of firms from the annual census of distributive trade firms during 1996 to 2004.

3.1 Distortions to the business environment across Federal states

We use two sets of indicators for the business environment across Brazil's federal states. The first data set includes information on the business environment from the Investment Climate Survey for Brazil in 2003 (World Bank, 2003). The second data set includes information on business regulation from the Doing Business in Brazil report in 2005 (World Bank, 2006). Both data sets provide information for 13 out of the 27 Federal states of Brazil. [10]

The Investment Climate Survey for Brazil is a business establishment survey aimed at generating statistical information for the formal assessment of the investment climates across states. The survey aims to indicate possible deficiencies in the provision of physical infrastructure, the structure and functioning of factor and product markets, inter-business relations and networking, the state of industrial regulation, law and order, tax and custom administration, and other aspects of governance.

[10] Information on the business environment from the Investment Climate Survey is available for the states: Amazonas, Bahia, Ceará, Goiás, Maranhão, Mato Grosso do Sul, Minas Gerais, Paraíba, Paraná, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, and São Paulo. Business regulation information from the Doing Business in Brazil report is available for the states: Amazonas, Bahia, Ceará, Federal District, Maranhão, Mato Grosso, Mato Gross do Sul, Minas Gerais, Rio de Janeiro, Rio Grande do Sul, Rondônia, Santa Catarina, São Paulo.

In 2003, 1641 business establishments across 13 states reported to the Investment Climate Survey (ICS). The establishments reported on a large set of business constraints on a 0 (no obstacle) to 4 (very severe obstacle) scale. From this data, we calculate the (unweighted) average across establishments by state, where we assume that constraints to the business environment reported by manufacturing establishments apply to firms in the distributive trade sector as well.

Table 1 shows business constraints across Brazil's Federal states. Tax rates, cost of finance, and the economic and regulatory environment constrain businesses the most. Telecommunications and shortfalls in electricity constrain businesses the least. Substantial variation exists across states. For example, infrastructure (proxied by transportation) appears a relatively more important business constraint in the Amazone. But corruption constrain businesses in São Paulo relatively the most.

The World Bank's Doing Business in Brazil (2006) reports on indicators of business regulation for 13 out of 27 Federal states. The reported indicators are: starting a business, registering property, getting credit, paying taxes, and enforcing contracts. Each indicator refers to business conditions in the capital of the Federal state.

For each indicator several assumptions on the type of business are made to examine the ease of doing business. For example, to examine the ease of starting a business, a small to medium sized limited liability company with general commercial activities is assumed. For such a firm, the number of procedures to obtain all necessary permits and licenses and completing all inscriptions verifications and notifications with the authorities (local, state, and federal) to enable operations are counted. The number of days it takes to comply with all procedures and the start up costs are examined for this indicator as well.

Indicators on doing business are reported in table 2. The first row shows the final ranking of states in term of business regulations (1 is the least regulated state, 13 is the most regulated state). The final ranking is a simple average of the ranking of a state on each of the indicators of business regulation. The other rows in table 2 show indicators for starting a business, registering property, getting credit, paying taxes, and enforcing contracts. We find substantial variation in business regulation across states. For example, time to start a business ranges from 19 days in Minas Gerais to 152 days in São Paulo. Taxes are high and vary across states. Taxes range from 89 percent of gross profits (sales minus cost of goods sold and labour costs) in the Amazone, to 208 percent in Rio de Janeiro. To enforce contracts in Maranhão, 48 percent of the debt is used. This is three times as high as in São Paulo (15.5 percent).

For comparison, we add indicators on the ease of doing business in the US and

Chile in table 2. This shows that Brazil is heavily regulated. The US scores better on every indicator and Chile on most indicators. For example, taxes are 44.9 percent of gross profits in the US and 26.4 percent in Chile. The Brazilian state with the lowest taxes is the Amazone with 89 percent of gross profits.

Indicators of business regulation in the Doing Business in Brazil report (World Bank, 2006) capture conditions faced by firms in Brazil regardless their economic activity. Indicators are established for 2005. Ideally, we use time series indicators of regulation directly related to distributive services. However, data unavailability restricts us to cross-state differences in business regulation in general and for a single cross-section, for which we assume a relation between average distortions and the dispersion in productivity.

3.2 Distributive trade firms in Brazil

This subsection describes the main characteristics of the distributive trade sector in Brazil. A detailed discussion of the issues we face in constructing the longitudinal data set of trade firms can be found in de Vries (2008).

Our principal data source of trade firms is the Annual Survey of Distribution (PAC) from 1996 to 2004. Firms registered in the Cadastro Nacional da Pessoa Jurídica (CNPJ) from the ministry of Economic Affairs and classified as distributive trade firms in the Cadastro Central de Empresas (CEMPRE) of the national statistical office (IBGE) are surveyed in PAC. The PAC dataset consists of two groups, namely a group of firms which surpass the threshold and are therefore included by census, and another group of firms which are below the threshold and are therefore included by sample only.

Firms with more than 20 employees or firms with less than 20 employees but with establishments in more than one Federal State are included in PAC by census. For 1996, the initial year in the data set, this amounts to 26,838 distributive trade firms included by census. In 2004, the final year in our data set, the number of firms included by census has risen to 32,171. While firms included by census in PAC constitute a small share in the total population of trade firms (2.3 percent), their sales share is about 71.8 percent (IBGE, 2004).[11] Firms included by census fill in an extended questionnaire and are required to report regional establishment data as well.

Registered firms with less than 20 employees are selected by means of a stratified random sampling procedure (the dataset has 12,402 sampled firms in 1996 and 10,596 sampled firms in 2004). Sampled firms are surveyed for a maximum of 3 consecutive years and fill in a simplified questionnaire. Because

[11] These shares are relatively stable over time.

of the sample character, our empirical analysis focuses on firms included by census. [12]

Table 3 shows descriptive statistics for firms included by census. The statistics reported in this table should be interpreted while taking into account that we only include firms above the threshold. Output and input variables are reported for the full census data set.

4 Productivity and distortions to the business environment

In this section, we first (tentatively) examine the relation between labour productivity and business regulation. Next, we present estimates of the TFPR distribution in Brazil and compare this with the TFPR distribution in Chile. Thereafter, we use the estimates of the TFPR dispersion across Federal states of Brazil to explore the relation between distortions and gaps in the marginal products across firms. Finally, we explore the dispersion in productivity across size classes.

4.1 Firm's Labour productivity and Business regulation

A first pass at examining the relationship between productivity and business regulation, is by specifying a regression model:

$$lnLP_i = \alpha + \beta' Xi + \epsilon_i, \tag{15}$$

where LP is the natural log of labour productivity of firm i, and X includes: the ranking of Federal states on business regulation, GDP per capita, employment, employment squared, the number of establishments, and regional and industry dummies. In one model specification for entering firms, we also considered the ranking of Federal states on starting a business. To account for correlation across firms in the same Federal state, we estimate equation 15 using clustered robust standard errors.

The regression results are reported in table 4. The first column shows regression results for the full sample, while the other columns show results for continuing, entering, and exiting firms separately. In all model specifications, business regulation is negatively related with productivity. This indicates that firm productivity is lower in states with more stringent business regulation.

[12] We do not have appropriate weights to assure that the (weighted) sample reflects the population.

In addition, the relationship between the ranking of states on starting a business indicates a negative relation between regulation and productivity as well. GDP per capita is positively related with productivity, except for the model specification for exiting firms only. The positive correlation between productivity and GDP per capita for continuing and entering firms, and the negative relation for exiting firms could indicate that competition is related with productivity improvements for survivors and more stringent selection for entrants and exiters. Further, we find a positive relation between productivity and employment for continuing firms, but a negative relation for entrants and exiters. The negative relation for exiters indicates that larger exiting firms are less productive than smaller exiting firms. Finally, the relation between the number of establishments is positive, indicating that chains are more productive than single establishment firms. The last column (column (6)) shows regression results for a random sample drawn from the full sample. The coefficients and the significance of the explanatory variables are in accordance with those from the full sample.

The results from estimating equation 15 should be interpreted as tentative evidence on the relationship between distortions to the business environment and productivity. Several explanatory variables (such as capital) are not (yet) included in the model specification, and the exogeneity assumption for explanatory variables can be questioned. In addition, the regression indicate statistical significance but not economic significance. We will continue by examining the distribution of productivity across firms for the Federal states of Brazil.

4.2 TFPR distribution and Business Regulation

We estimate the distribution of TFPR using equation 13. First we set the rental price of capital, the elasticity of substitution, and we make a choice on the output elasticities of production factors for cross-country and cross-state comparisons. The rental price of capital R is the annual average real interest rate from the World Bank Global Development Finance [13] plus the depreciation rate. [14] Recall from equation 4, that capital costs of a firm are $(1+\tau_{Ksi})R$ so the actual rental price differs across firms by capital distortions.

We assume the elasticity of substitution $\sigma = 3$. This entails three simplifying assumptions. First, although Broda and Weinstein (1996) show that substitution elasticities differ across goods, we assume elasticities of substitution do not differ across goods. Second, we assume the elasticity of substitution is constant. This assumption is, however, violated if the amount of retailed

[13] The real interest rate is 8.1 percent in 1996

[14] We assume that fixed assets are depreciated annually by 7.0 percent

varieties changes during the period from 1996 to 2004. Third, we follow Hsieh and Klenow (2007) and assume that the elasticity of substitution is 3. We have no data of substitution elasticities for retailed products in Brazil to examine this assumption. [15]

For benchmark comparisons with the productivity distribution in Chile, we set the output elasticity of capital in each industry to 1 minus the labour share from the corresponding industry in the US. We use US labour shares as a benchmark of a relatively undistorted market. [16] Industry labour shares for the US refer to those from the 2002 census of distributive trade firms. Since we only know the labour share in sales, we scale up each industry's labour share by the difference in labour share in sales and value added from each industry in the data set. Distortions are estimated from:

$$(1+\tau_{Ksi}) = \frac{\alpha_s}{1-\alpha_s}\frac{L_{si}}{RK_{si}}. \tag{16}$$

$$(1-\tau_{Ysi}) = \frac{\sigma}{\sigma-1}\frac{L_{si}}{(1-\alpha_s)P_{si}Y_{si}}. \tag{17}$$

Capital distortions are inferred from equation 16 when the ratio of labour compensation to the capital stock is high relative to what one expects from the output elasticities of capital and labour. Output distortions are inferred from equation 17, when the labour share is low compared to the industry elasticity of output with respect to labour. [17]

Before estimating the revenue productivity distribution, we apply an outlier correction procedure similar to Hsieh and Klenow (2007). The 1 percent tails from the distributions of $\ln\left(\frac{1+\tau_{Ksi}}{1+\bar{\tau_{Ks}}}\right)$, and $\ln\left(\frac{1-\tau_{Ysi}}{1-\bar{\tau_{Ys}}}\right)$ across industries are trimmed.

Table 5 shows statistics for the revenue productivity distribution. We estimate the distribution of $\ln TFPR$ (or $\frac{(1+\tau_{Ksi})^{\alpha_s}}{(1-\tau_{Ysi})}$) relative to the industry mean. [18] We present the standard deviation, the interquartile range (25th - 75th percentile),

[15] We assume rents show up as payments to labour (managers) and capital (owners) pro rata in each industry. Therefore, the elasticity of substitution does not affect production elasticities. Choosing a larger elasticity of substitution increases the spread of the *TFPR* distribution.

[16] We use a concordance between CNAE and NAICS2002 at six-digit levels.

[17] Value added should not include output subsidies or taxes, since from the model it follows that pre-tax TFPR is equal across firms in the absence of distortions. Therefore, we subtract reported subsidies and taxes in PAC from value added.

[18] The remaining term of TFPR in equation 13 is a constant across firms within an industry, which drops out when the industry mean is subtracted.

and the 10th - 90th percentile. For comparison, we present similar statistics for distributive trade firms in Chile.[19] We find a higher TFPR dispersion in Brazil than Chile. Higher productivity dispersion in Brazil, larger than in Chile, suggests higher distortions in the Brazilian economy. Because Chile is less regulated (see table 2), this suggests a link between business regulation and dispersion in marginal products across firms.[20]

The distribution in productivity over time is shown in table 5 as well. Numerous policy changes affected the behaviour and performance of distributive trade firms, but two policy changes stand out in the 1990s. First, the introduction of the Real plan in 1994. The Real plan brought an end to running inflation (the average annual inflation rate between January 1986 and December 1994 was 820 percent). The second major policy change is services liberalization since the early 1990s. The Collor administration, which came to power in March 1990, began a process of privatization, deregulation, and greater openness to foreign trade. This process was continued by subsequent governments throughout the 1990s. For trade in services, policy reforms were visible in liberalization commitments in the WTO's General Agreement on Trade in Services (GATS), but also within MERCOSUR[21], and between the MERCOSUR members and the European Union (World Bank, 2004). While we expect that both the Real plan and services liberalization removed some distortions to the business environment, table 5 shows that the spread of the TFPR distribution in Brazil did not decline during the period from 1996 to 2004.

4.3 Distortions and the TFPR distribution

The model we present in section 2 delineates that the spread of the revenue productivity distribution, *TFPR*, increases with distortions (see equation 13). To empirically examine the link between distortions and productivity, we regress statistics of the *TFPR* distribution on a constant and an indicator of distortions.

We use indicators of distortions from the Investment Climate Assessment Survey (World Bank, 2003) and the Doing Business in Brazil report (World Bank, 2006). Each indicator is separately regressed on statistics of the TFPR distribution (the standard deviation, the interquartile range (25th - 75th percentile),

[19] Real interest rates for Chile are obtained from the World Bank Global Development Finance as well.
[20] For Chile, data is from the Encuesta Anual de Comercio. For comparison purposes we only use data from trade firms with more than 20 employees.
[21] The regional trade block consisting of Argentina, Brazil, Paraguay, and Uruguay.

and the 10th - 90th percentile). Each regression has 13 observations.[22]

Table 6 shows regression results. In general, distortions increase the dispersion in TFPR.[23] Thus it appears the estimated TFPR distribution signals distortions. However, only a few indicators are significantly related with the dispersion in TFPR. In particular, theft, corruption, and the adequate provision of electricity and telecommunications affect the productivity distribution across states. While tax rates, cost of finance, and the economic and regulatory environment are the most important constraints of the business environment, they do not significantly affect the TFPR distribution. This finding results from the high overall distortion of taxes, access to credit, and the regulatory environment. So reducing the distorting effects of theft, corruption, and the inadequate provision of electricity and telecommunications will make the TFPR distribution across states more comparable, but reducing taxes, enabling access to credit, and ease regulations will further reduce the spread of the TFPR distribution across all states.

4.4 Productivity dispersion across size classes

Figure 1 shows dispersion in productivity across size classes for Chile and Brazil. For Chile we used a single data set, namely the Encuesta Anual de Comercio. We find that the dispersion in productivity decreases with the size of firms. This indicates that smaller firms face larger distortions. Apparently, larger firms are better able to accommodate to the business environment. Perhaps because of greater bargaining power with officials on regulations and businesses which supply them intermediate inputs (such as electricity).

For Brazil, we used the Pesquisa Anual de Comércio for firms above the census threshold (roughly those firms with >20 employees). For firms with less than 5 employees, we used the survey of small firms (Economia Informal urbana, ECINF) for 2003. Again we find that larger firms show a smaller dispersion in productivity. Interestingly, the data also suggests that the dispersion in productivity for small firms in Brazil is lower as compared to small firms in Chile, although this result might be driven by the limited number of observations for small firms in Chile (N=60).

[22] Firm fixed effects, such as political connections from regional or national chains are not accounted for in the analysis. Since most firms are single establishments, firm fixed effects are probably small.

[23] Since the value of the 10th-90th percentile range is larger as compared to the standard deviation, we expect the coefficients for distortions to be larger as well. In most cases the coefficient is larger, although measurement error blurs this finding in several cases.

These results, however, are tentative since we face several data limitations. First, the data set for Chile and the survey of small firms in Brazil is a sample from the total population. We do not have appropriate sampling weight to adjust for this. Second, the data set for Chile and small firms in Brazil does not provide the sectoral detail as in the Pesquisa Anual de Comércio, although the pattern of dispersion in size class and productivity dispersion is unaltered if we estimate the dispersion in TFPR using less disaggregated sectors.

5 Conclusion

In this paper we examined the relation between distortions and productivity in a large developing country. We use information on distortions to the business environment across the Federal states of Brazil combined with location, and productivity data of firms from the annual census of distributive trade firms during 1996 to 2004. We studied productivity in trade firms through the prism of a monopolistic competition model with heterogeneous firms, where distortions create gaps in the marginal product of capital and labour. The main implication of the model is that distortions increase the dispersion in productivity.

We found sizeable differences in the marginal product of labour and capital across trade firms in Brazil, larger than that found in Chile. And we found a positive correlation between distortions and the spread of the productivity distribution across states, suggesting that distortions affect marginal products across firms and thereby result in resource misallocation. Despite the Real plan (1994) and services liberalization during the 1990s, we did not find an improvement in resource allocation over time. In addition, we found that distortions decrease with firm size.

Our findings imply that Brazil should re-evaluate business regulations and carefully examine other distortions to the business environment across states. Less excessive business regulation, a reduction in theft and corruption, and the adequate provision of electricity and telecommunications will improve the allocative efficiency of resources and hence improve aggregate productivity.

6 Research plan

In the near future, I would like to make several improvements to the paper. First, I want to estimate TFPR and TFPQ for a representative data set of the entire distribution of Brazilian distributive trade firms. That is, I want to obtain estimates of TFPR and TFPQ for each firm, and the distribution

of these two variables should adequately reflect the population of distributive trade firms. This is extremely relevant for the Brazilian trade sector, because many informal retailers evade labour regulations whereas formal retailers do face these additional labour costs (McKinsey, 1998). In particular, I expect a fat left tail for the TFPQ distribution because of many low-productivity informal retailers. I expect a highly dispersed TFPR distribution, because of excessive business regulation in Brazil (some evidence is already provided in the paper, where I compare the distribution of Brazil with that of Chile). [24]

Second, I want to regress firm-specific estimates of TFPR and TFPQ on business regulation. In addition, I want to regress TFPR and TFPQ on firm size dummies (<5 employees implies for some definitions that the retailer is informal). I expect that business regulation is positively related with TFPR, because the HK model clearly delineates that distortions increase TFPR. I expect that business regulation is negatively related with TFPQ, because a more competitive business environment sorts out the most productive firms. Some of the regressions I have in mind are:

- Cross section regressions with TFPR and TFPQ as the dependent variables. Include: indicators of business regulation, region-specific indicators (GDP per capita), and firm-specific variables (dummies for chains, employment (?), size dummies). Use clustered robust standard errors.
- 2SLS regression with TFPR and TFPQ as the dependent variables. Business regulation is instrumented along the lines of La Porta et al. (1998) using absolute latitude, initial (regional) GDP per capita, and other cultural variables (?).

Third, I want to examine the role of resource misallocation in explaining differences in TFP across the Federal states of Brazil. First, I estimate TFP

[24] Some of the difficulties I face are: *i)* setting appropriate sampling weights. The dataset of informal firms (defined as firms $<$ 5 employees), and small firms (firms $<$ 20 employees) is a sample. Firms with $>$ 20 employees or with establishments in more than one Federal State are all included in the dataset. *ii)* matching the industry classification of the dataset of informal firms (ECINF) with the dataset of formal firms (PAC). The ECINF industry classification is unconventional and does not allow an immediate and clear correspondence with standard industry classifications. *iii)* the dataset of informal firms is for 1997 and 2003, whereas the dataset of formal firms is for 1996 to 2004. Therefore, some of the dynamics (see below) cannot be examined. *iv)* comparability of several variables between ECINF and PAC. For example, ECINF reports sales and value added for the month October, whereas sales and value added in PAC refers to the calendar year. Also, ECINF reports the capital stock of informal firms, whereas the capital stock in PAC has to be estimated from depreciation and investment data. *v)* firms or establishments? There are several opportunities to actually use establishment data, that way, we could also control for firm fixed effects in the regressions.

levels across the Federal states. I expect (and hope) that TFP will be highest in the least constraint business environment, the Federal district Brasilia. Next, I examine the percentage TFP gain across the states from moving to the "Federal district efficiency". This will indicate to what extent resource misallocation is responsible for TFP gaps across the Brazilian regions (see HK for details). This approach allows to examine the contribution of resource allocation improvement to TFP growth across the regions. This will also bear further policy implications on the role of business regulation in raising aggregate productivity.

References

Alfaro, L., A. Charlton, and F. Kanczuk (2007). Firm-Size Distribution And Cross-Country Income Differences. *Harvard Business School working paper 07-086.*

Bartelsman, E., J. Haltiwanger, and S. Scarpetta (2006). Cross Country Differences in Productivity: The Role of Allocative Efficiency. *mimeo Free University Amsterdam.*

Broda, C. and D. E. Weinstein (1996). Globalization and the Gains from Variety. *Quarterly Journal of Economics 121*, 541–585.

de Vries, G. J. (2008). Productivity Dynamics In The Distributive Trade Sector Of Brazil, 1996-2004. *mimeo University of Groningen.*

Ericson, R. and A. Pakes (1995). Markov-Perfect Industry Dynamics: A Framework For Empirical Work. *Review of Economic Studies 62*, 53–82.

Foster, L., J. Haltiwanger, and C. Syverson (2008). Reallocation, Firm Turnover, And Efficiency: Selection On Productivity Or Profitability? *American Economic Review 98*, 394–425.

Hsieh, C. T. and P. J. Klenow (2007). Misallocation and Manufacturing TFP in China and India. *NBER working paper 13290.*

IBGE (2004). *Pesquisa Anual De Comércio.* Rio de Janeiro: IBGE.

La Porta, R., F. Lopez-de Silanes, A. Shleifer, and R. Vishny (1998). Law and Finance. *Journal of Political Economy 106*, 1113–1155.

Lafontaine, F. and J. Sivadasan (2006). Within-firm Labour Productivity Across Countries: A Case Study. *mimeo University of Michigan.*

McKinsey (1998). *Productivity: The Key To An Accelerated Development Path For Brazil.* São Paulo, Washington: McKinsey and Company.

Melitz, M. J. (2003). The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica 71*, 1695–1725.

Restuccia, D. (2008). The Latin American Development Problem. *mimeo University of Toronto.*

Restuccia, D. and R. Rogerson (2007). Policy Distortions And Aggregate Productivity With Heterogeneous Plants. *University of Toronto working paper 283.*

USICT (1996). General Agreement On Trade In Services: Examination Of South American Trading Partners' Schedules Of Commitments. *report U.S. International Trade Commission.*

World Bank (2003). Investment Climate Assessment Survey Brazil. *World Bank publication.*

World Bank (2004). Brazil - Trade Policies To Improve Efficiency, Increase Growth, And Reduce Poverty. *World Bank report 24285-BR.*

World Bank (2006). Doing Business in Brazil. *Publication of the International Finance Corporation.*

Figure 1. Dispersion in ln TFPR across size classes

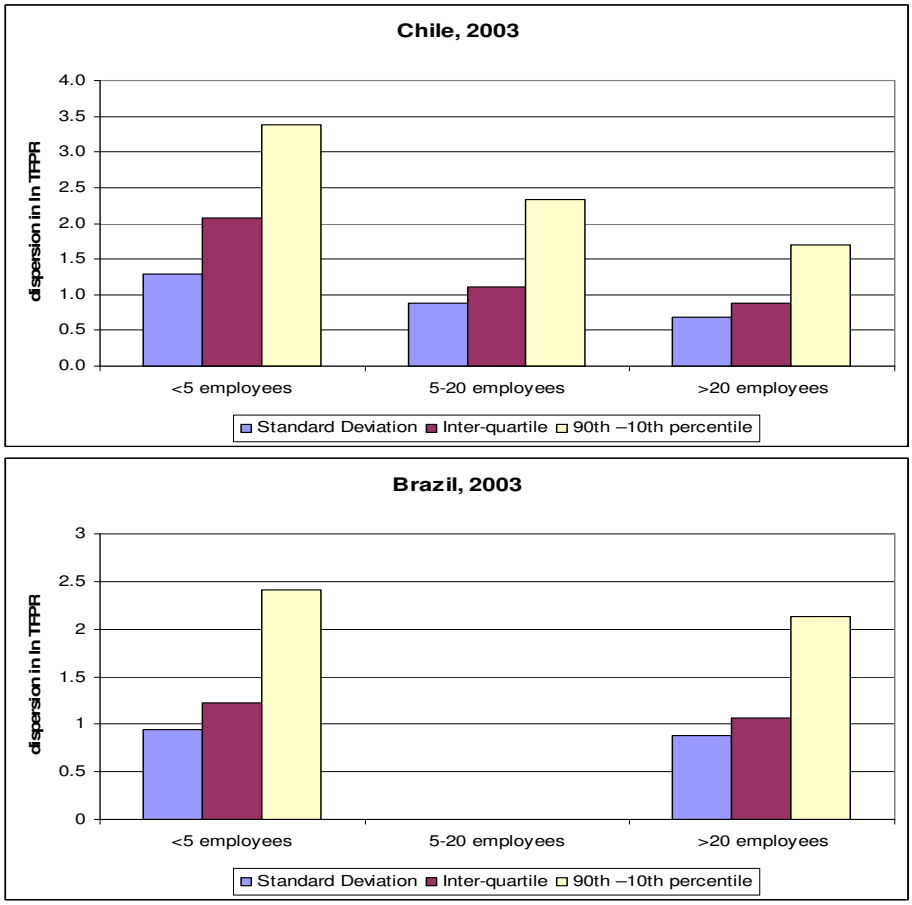

Table 1: Indicators of business constraints

	Amazonas	Bahia	Ceará	Goiás	Maranhão	Mato Groso do Sul	Minas Gerais	Paraíba	Paraná	Rio de Janeiro	Rio Grande do Sul	Santa Catarina	São Paulo	Average
Telecommunications	1.14	0.49	0.62	1.11	0.74	0.55	0.63	0.48	0.43	0.61	0.58	0.49	0.80	0.67
Electricity	1.53	1.04	1.37	1.98	0.45	1.13	1.30	0.74	0.91	1.25	1.08	0.99	1.41	1.17
Transportation	2.11	1.08	1.16	1.82	1.14	1.84	1.55	0.70	1.20	1.25	1.13	1.10	1.31	1.34
Access to land	1.31	0.91	0.89	1.15	0.48	1.11	1.04	0.83	1.20	1.13	1.20	1.17	1.11	1.04
Tax rates	3.22	2.94	3.30	3.32	2.64	2.93	3.42	3.26	3.28	3.30	3.15	3.25	3.42	3.19
Tax administration	2.40	2.53	2.69	2.80	2.20	2.70	2.81	2.70	2.83	2.85	2.65	2.63	3.07	2.68
Skills of available workers	2.27	2.08	1.99	2.27	2.18	2.38	2.09	1.77	2.22	2.06	2.02	2.12	2.03	2.11
Licensing and operating permits	1.90	1.48	1.66	1.99	1.64	1.79	1.70	0.95	1.58	2.09	1.29	1.46	1.92	1.65
Access to finance	2.37	2.28	2.67	2.89	2.52	2.35	2.53	3.13	2.76	2.39	2.44	2.66	2.83	2.60
Cost of finance	2.89	2.91	3.13	3.27	3.25	2.79	3.25	3.34	3.42	3.21	3.16	3.34	3.50	3.19
Economic and regulatory policy uncertainty	2.81	2.73	2.97	3.12	3.00	2.62	3.19	2.77	2.98	3.26	2.85	3.21	3.31	2.99
Macroeconomic instability	2.81	2.65	2.87	3.00	2.36	2.68	3.21	2.88	3.10	3.22	2.88	3.10	3.24	2.92
Corruption	2.89	2.27	2.71	3.27	2.27	2.78	2.92	2.95	3.04	2.87	2.45	3.01	3.09	2.81
Crime, theft, disorder	1.93	1.92	2.21	2.86	2.18	2.11	2.50	2.00	2.50	2.49	2.18	2.05	2.73	2.28
Anti-competitive, informal practices	2.44	2.06	2.44	2.66	2.64	2.42	2.60	1.91	2.57	2.58	2.55	2.70	2.44	2.46
Legal system ,conflict resolution	1.91	1.39	1.76	2.30	1.83	1.81	1.97	0.83	1.92	2.01	1.88	1.76	1.74	1.78

Table 2: Business regulation across Brazil's Federal states

		Amazonas	Bahia	Ceará	Federal district	Maranhão	Mato Grosso	Mato Grosso do Sul	Minas Gerais
Final Rank		2	10	13	1	5	12	7	3
Starting a business	Time (days)	68	25	44	49	47	41	41	19
	Cost (% of income per capita)	10	33	31	5	49	12	11	10
Registering property	Time (days)	40	88	63	57	27	43	83	58
	Cost (% of property value)	4	2	4	2	5	3	5	3
Getting credit	Time to create collateral (days)	6	26	40	45	4	23	30	2
	Cost to create collateral (% of loan value)	2	2	4	0	1	3	1	1
Paying taxes	Total tax payable (% of gross profit)	89	144	137	149	147	146	146	150
	Number of payments	23	12	23	12	12	23	12	23
Enforcing contracts	Time (days)	835	873	942	730	690	1157	755	1068
	Cost (% of debt)	22	16	32	19	48	19	17	20

		Rio de Janeiro	Rio Grande do Sul	Rondônia	Santa Catarina	São Paulo	US	Chile
Final Rank		8	6	4	9	11		
Starting a business	Time (days)	68	35	30	44	152	6	27
	Cost (% of income per capita)	11	6	20	10	10	1	10
Registering property	Time (days)	75	81	69	51	47	12	31
	Cost (% of property value)	3	4	5	2	4	1	1
Getting credit	Time to create collateral (days)	27	25	30	25	na	na	na
	Cost to create collateral (% of loan value)	0	1	2	3	na	na	na
Paying taxes	Total tax payable (% of gross profit)	208	153	146	144	148	45	26
	Number of payments	12	12	12	23	23	10	10
Enforcing contracts	Time (days)	813	1473	794	1017	546	300	480
	Cost (% of debt)	21	21	16	22	16	9	29

Table 3
Descriptive statistics

	mean	standard deviation
Real Sales	14.55	(1.53)
Capital	11.55	(2.34)
Employment	3.62	(0.85)
Labour productivity	10.94	(1.17)
Payroll	12.33	(1.11)
Average establishment size	34.75	(46.07)
Observations	171,035	

Note: real sales, employment, labour productivity, and payroll are in logs. The period is 1996 to 2004.

Table 4
Estimates of labour productivity model, Dependent variable: labour productivity

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS, random sample
	All firms	Continuing firms	Entering firms	Entering firms	Exiting firms	All firms
Constant	11.922***	11.983***	12.048***	12.121***	12.018***	11.650***
Business regulation	-0.018***	-0.018***	-0.009***	-	-0.034***	-0.018**
Days needed to start up a business	-	-	-	-0.008***	-	-
GDP per capita	0.013***	0.001***	0.035***	0.032***	-0.004	0.035***
Employment	0.0002***	0.0002***	-0.0086***	-0.0086***	-0.0022**	0.0012**
Employment^2	-0.00000001***	-0.00000001***	0.00000981***	0.00000981***	0.00000119***	-0.000000669**
Establishment	0.012**	0.009**	0.063***	0.063***	0.093***	0.038**
Dummies for:						
Region	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.36	0.38	0.36	0.36	0.36	0.47
Observations	23056	17189	3858	3858	2009	643
Clustering by region	Yes	Yes	Yes	Yes	Yes	Yes

Note: Regression results are from a cross-section (year = 2003) model estimated using OLS.

Table 5
Dispersion in ln TFPR

Brazil	1996	2000	2004
Standard Deviation	0.85	0.86	0.87
Inter-quartile range	1.03	1.04	1.04
10th - 90th percentile	2.04	2.12	2.12
N	8,708	13,587	17,634
Chile		2003	2004
Standard Deviation		0.69	0.73
Inter-quartile range		0.88	0.92
10th - 90th percentile		1.69	1.84
N		588	643

Note: data are from Pesquisa Anual de Comercio for Brazil, and Encuesta Anual de Comercio for Chile (for comparison purposes we only use data from trade firms with more than 20 employees).

Table 6: Distortions to the business environment and the TFPR distribution

	TFPR standard deviation	TFPR inter-quartile range	TFPR 10th-90th percentile range
Business constraint due to:			
Legal system/conflict resolution	0.089	0.176	0.114
t-value	*(1.90)**	*(2.22)***	*(0.76)*
R^2	*0.250*	*0.310*	*0.050*
Anti-competitive/informal practices	0.084	0.138	-0.025
t-value	*(1.07)*	*(0.99)*	*(-0.11)*
R^2	*0.090*	*0.080*	*0.000*
Crime, theft, disorder	0.144	0.180	0.260
t-value	*(3.27)****	*(1.90)**	*(1.66)*
R^2	*0.490*	*0.250*	*0.200*
Corruption	0.116	0.145	0.372
t-value	*(2.29)***	*(1.46)*	*(2.80)***
R^2	*0.320*	*0.160*	*0.420*
Macroeconomic instability	0.097	0.181	0.338
t-value	*(1.44)*	*(1.54)*	*(1.88)**
R^2	*0.160*	*0.180*	*0.240*
Economic and regulatory uncertainty	0.149	0.227	0.259
t-value	*(2.05)**	*(1.69)*	*(1.13)*
R^2	*0.280*	*0.210*	*0.100*
Cost of Finance	0.086	0.015	0.110
t-value	*(1.00)*	*(0.09)*	*(0.44)*
R^2	*0.080*	*0.000*	*0.020*
Access to finance	0.074	-0.036	0.220
t-value	*(1.02)*	*(-0.27)*	*(1.08)*
R^2	*0.090*	*0.010*	*0.100*

	TFPR standard deviation	TFPR inter-quartile range	TFPR 10th-90th percentile range
standards and quality	0.166	0.145	0.011
t-value	*(1.96)**	*(0.87)*	*(0.04)*
R^2	*0.260*	*0.060*	*0.000*
patents and registered trademarks	0.174	0.143	0.258
t-value	*(2.00)**	*(0.82)*	*(0.93)*
R^2	*0.270*	*0.060*	*0.070*
Licensing and operating permits	0.116	0.238	0.249
t-value	*(2.30)***	*(2.96)***	*(1.60)*
R^2	*0.320*	*0.440*	*0.190*
Skills of available workers	0.100	0.211	0.043
t-value	*(0.85)*	*(1.03)*	*(0.12)*
R^2	*0.060*	*0.090*	*0.000*
Tax administration	0.103	0.132	0.324
t-value	*(1.28)*	*(0.90)*	*(1.44)*
R^2	*0.130*	*0.070*	*0.160*
Tax rates	0.118	0.226	0.500
t-value	*(1.54)*	*(1.71)*	*(2.71)***
R^2	*0.180*	*0.210*	*0.400*
Access to land	0.061	0.228	0.332
t-value	*(0.71)*	*(1.67)*	*(1.48)*
R^2	*0.040*	*0.200*	*0.170*
Transportation	0.053	0.142	0.156
t-value	*(1.14)*	*(1.90)**	*(1.20)*
R^2	*0.110*	*0.250*	*0.120*
Electricity	0.114	0.230	0.356
t-value	*(3.15)****	*(4.22)****	*(3.88)****
R^2	*0.470*	*0.620*	*0.580*

	TFPR standard deviation	TFPR inter-quartile range	TFPR 10th-90th percentile range
Telecommunications	0.144	0.297	0.403
t-value	*(2.03)**	*(2.56)***	*(2.00)**
R^2	*0.270*	*0.370*	*0.270*
Business regulation			
days needed to start up a business	0.045	0.110	0.154
t-value	(0.99)	(0.92)	(0.95)
R^2	0.08	0.07	0.08
days needed to enforce a contract	-0.008	-0.004	-0.013
t-value	(1.22)	(0.22)	(0.57)
R^2	0.12	0.00	0.03
taxes as % of gross profit	0.026	-0.026	-0.057
t-value	(0.41)	(0.15)	(0.25)
R^2	0.02	0.00	0.01
days to register property	-0.071	-0.140	-0.150
t-value	(0.85)	(0.64)	(0.50)
R^2	0.06	0.04	0.02
days to obtain credit	0.107	0.098	0.345
t-value	(0.87)	(0.29)	(0.77)
R^2	0.07	0.01	0.06

Note: coefficients, t-value, and R-squared from individual OLS regressions of the dependent variable on a constant and a distortion to the business environment. The number of observations is 13 for each regression, and the dependent variable refers to 2003.