the review of income and wealth

Review of Income and Wealth
Series 60, Number 3, September 2014
DOI: 10.1111/roiw.12017

PRODUCTIVITY IN A DISTORTED MARKET: THE CASE OF BRAZIL'S RETAIL SECTOR

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In a model of monopolistic competition with heterogeneous firms, distortions in prices drive a wedge between the marginal revenue products of factor inputs across firms. We use census data for Brazil's retail sector to study implications for aggregate productivity and relate distortions to regional variation in regulation using a differences-in-differences approach. Taxes, entry regulation, and access to credit may create distortions to output and capital that varies by firm size. Potential gains from reallocation have not diminished despite the process of services liberalization in the 1990s.

JEL Codes: D24, L50, O12

Keywords: Brazil, productivity, resource allocation, retail sector

1. Introduction

Latin America's disappointing productivity performance after market-oriented reforms in the 1990s is receiving widespread attention. According to a more and more dominant view, slow resource reallocation is the main culprit of low growth in Latin America.[1] In an increasingly competitive market, resources are assumed to flow from low- to high-productive users, improving allocative efficiency. Busso *et al*. (2012) find that the contribution of resource reallocation to growth was absent in the manufacturing industries of Latin America during the period after regulatory reforms. For Brazil's manufacturing sector, Menezes-Filho and Muendler (2007) find labor is flowing away from export industries because their labor productivity increases faster than their production. While output shifts to more productive firms, labor is shed, adding to unemployment. Hence, reforms might be related with efficiency gains at the firm level, but not at the aggregate when idle resources result.

Note: Thanks to the team at IBGE, the national statistical office of Brazil, for their hospitality and providing 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. This paper benefited from detailed comments by Marcel Timmer, two anonymous referees, the editor Robert Hill, and numerous comments and discussions at the 2008 IARIW conference in Portoroz, the 2010 IARIW conference in Sankt Gallen, the CAED conference at Imperial College, and seminars at the University of Groningen and the Inter-American Development Bank.

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[1]See, for example, Cole *et al*. (2005), Mukand and Rodrik (2005), Menezes-Filho Muendler (2007), Pages *et al*. (2009), and Inter-American Development Bank (2010).

In contrast to manufacturing, little is known about the role of the services sector in Latin America's economic performance. This is surprising, because the sector accounts for over two-thirds of GDP and employment (Timmer and de Vries, 2009). Insight into the functioning of the services sector is crucial for understanding aggregate economic performance. Evidence suggests that reallocation only marginally contributed to growth in the services sector as well (de Vries, 2008). What is preventing the reallocation of resources toward the most efficient firms? This paper studies allocative efficiency in the retail sector of Brazil, and explores the relation between regulation and resource misallocation, building upon the model of Hsieh and Klenow (2009) (HK hereafter).

Brazil opened up its retail sector in the World Trade Organization's 1995 General Agreement on Trade in Services, but also within MERCOSUL,[2] and between the MERCOSUL members and the European Union. Furthermore, the participation of foreign capital in Brazilian retail firms was freed from restrictions in the Sixth Constitutional Amendment of 1995 (World Bank, 2004). It was expected that these reforms would result in a retail revolution characterized by productive reallocation through the expansion of modern retail chains and the growth of small successful retail businesses (Reardon *et al.*, 2003).

This retail revolution happened in other countries. For example, in the U.S., average annual labor productivity growth of 11 percent in the retail sector during the 1987–97 period is for 90 percent due to new establishments from retail chains replacing independent mom-and-pop stores (Foster *et al.*,2006). A similar process, albeit at a lower scale, took place in the U.K. (Haskel and Sadun, 2009).[3]

The available evidence for Brazil's retail sector suggests a different development pattern. In Brazil, retail chains did not replace mom-and-pop stores during the period following reforms (de Vries, 2008). Instead, large chains, both domestic and foreign, typically acquired other existing (smaller-sized) chains. This development pattern may be partly explained by business regulations, such as zoning laws, and difficulties in setting up national distribution systems because of the quanitity and quality of rail and road networks. The share of small low-productive firms remained stable or even increased. The limited role of reallocation in Brazil's retail sector may explain its low labor productivity growth, averaging only 1 percent annually during 1996–2004 (de Vries, 2008). Limited reallocation of resources in Brazil's retail sector contradicts expectations from pro-competitive reforms.

Various policies and institutions may be related to resource misallocation. Despite the reforms, regulation in credit and product markets may have prohibited the start of a retail revolution in Brazil. For example, taxes are high and complying with all amounts to over 200 percent of gross profits in Rio de Janeiro (World Bank, 2006), reducing incentives for retail firms in other states to enter the market in Rio de Janeiro. Also, difficulties in access to credit and entry regulation may prevent the growth of successful retailers. Consistent with the idea that

[2]Mercado Comum do Sul, the regional trade block consisting of Argentina, Brazil, Paraguay, and Uruguay.

[3]Haskel and Sadun (2009) argue that lower growth in the U.K. retail sector relative to the U.S. is due to retail chains opening up smaller new establishments because of size restrictions. In other words, growth in the U.K.'s retail sector originates from resource reallocation, but occurs at a slower pace because scale economies cannot be fully exploited by retail chains.

regulation in labor and product markets may forestall growth in Brazil's retail sector, Restuccia (2008) calibrated the implications of taxes and entry costs for the misallocation of resources in Latin American countries. He found that taxes and entry costs can easily generate large misallocation of resources and hence explain a lower aggregate total factor productivity level in Latin America as compared to the U.S. Stringent regulations may prevent allocative efficiency improvements in Brazil's retail sector, and thereby impede growth.

This paper measures distortions in the retail sector by comparing marginal revenue products with the costs of factor inputs, following the tradition of models from Banerjee and Duflo (2005). We apply the HK model to study changes in resource allocation in Brazil's retail sector during the period from 1996 to 2006. Distortions to output and capital are inferred from residuals in first-order conditions in a model of monopolistic competition with heterogeneous firms. Wedges are measured if there is a difference between the cost and the marginal revenue product of factor inputs. In turn, these wedges are used to derive implications for aggregate productivity.

We apply the HK model to a dataset of retail firms in Brazil. The principal data source is the annual census of retail firms from 1996 to 2006. This dataset offers detailed information on output, inputs, and location of retail firms (and their establishments).

The findings suggest there are large potential output gains from the reallocation of resources to the most efficient retailers. Improvements in resource reallocation may improve TFP levels by a factor of two, which would bring productivity levels in Brazil's retail sector between 28 and 56 percent of the U.S. productivity level. However, the potential aggregate productivity gains from resource reallocation have gone largely unexploited during the post-liberalization period. We find no allocative efficiency improvements for the total retail sector and for most Federal States of Brazil separately. These results are consistent with the view that allocative efficiency is the main culprit of low productivity growth in Latin America.

The implications of distortions for aggregate productivity are examined, and distortions to output and capital are related to regional variation in regulation using a differences-in-differences approach. Selective policy implementation and enforcement may create implicit or *de facto* differences in the business environment faced by small and large firms. For example, governments often find it difficult to collect taxes from small firms. Instead, governments are likely to set higher tax rates and enforce compliance only among larger firms (Tybout, 2000). In contrast, capital market imperfections might be a bigger constraint for firms that lack sufficient collateral. Therefore, we allow the coefficients in our econometric model to vary by firm size. A novel aspect of the empirical approach is that we examine distortions to output and capital separately. HK examined the combination of distortions to output and capital. We show that separating both types of distortions is important due to differential effects of regulation across size class and type of distortion.

The remainder of this paper is organized as follows. Section 2 sketches the HK model and derives measures and implications of distortions for aggregate productivity. Section 3 describes the dataset. Potential gains and changes over time from

productive resource reallocation are estimated in Section 4. Section 5 examines the relation between regulation and distortions to output and capital. Section 6 provides concluding remarks.

2. Theoretical Framework

This section illustrates the relation between aggregate productivity and the allocation of resources. Implications of the misuse of resources for aggregate productivity can be studied in a model of monopolistic competition with heterogeneous firms. We follow the model introduced by HK. Based on the canonical model of Melitz (2003), HK introduced distortions to output and capital. Here, we only discuss the core elements and present the competitive equilibrium of the model in a format which suits our empirical analysis.

Assume aggregate output Y is the combination of the retail sale of goods Y_s in s retail industries under perfect competition in both the output and input market:

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

where the sum of industry shares $\sum_{s=1}^{S} \theta_s = 1$.[4] Output Y_s in industry s, is the combination of N_s differentiated products sold by all firms ($i = 1, \ldots, N_s$), which face a constant elasticity of substitution σ:

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

The Cobb–Douglas production function of each retailer 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 Y_{si} denotes the retailer's value added, A_{si} productivity, K capital, and L labor. The capital share α_s and labor share $(1 - \alpha_s)$ are only allowed to vary across industries. Costs C_{si} for a retailer 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 cost of capital relative to that of labor. The retailer's profits are given by:

$$\Pi_{si} = (1 - \tau_{Ysi}) p_{si} Y_{si} - wL_{si} - (1 + \tau_{Ksi}) rK_{si}, \tag{5}$$

[4]Under cost minimization $p_s Y_s = \theta_s p Y$, where p_s is the price of sales Y_s in industry s and $p \equiv \prod_{s=1}^{S} \left(\frac{p_s}{\theta_s} \right)^{\theta_s}$ is the price of the final good sold (which is set the numéraire, so $p = 1$). Throughout, quantities will be denoted by capital letters, and prices by lower-case letters.

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 labor in equal proportions. If a firm faces higher tax (enforcement) on profits, its size will be smaller than in the absence of distortions.

To the extent resource allocation in an industry is driven by distortions alongside firm productivity, this will result in differences in the marginal revenue products of capital and labor across firms. The marginal revenue product of labor is (see HK for details):

$$MRPL_{si} = \frac{p_{si}Y_{si}}{L_{si}} = \frac{w}{(1-\tau_{Ysi})}\left(\frac{\sigma}{\sigma-1}\right)\left(\frac{1}{1-\alpha_s}\right). \tag{6}$$

The marginal revenue product of capital is:

$$MRPK_{si} = \frac{p_{si}Y_{si}}{K_{si}} = \frac{r(1+\tau_{Ksi})}{(1-\tau_{Ysi})}\left(\frac{\sigma}{\sigma-1}\right)\left(\frac{1}{\alpha_s}\right). \tag{7}$$

The marginal revenue products of capital and labor, after taking into account distortions, are equalized across firms within industries because only distortions to output and capital are firm-specific. But before distortions are accounted for, marginal revenue products may differ depending on the distortions the firm faces. This has important implications for the firm's revenue productivity, which is an input share-weighted combination of the marginal product of capital and labor.

Solving for the equilibrium allocation of resources across industries, aggregate output can be expressed as:

$$Y = \prod_{s=1}^{S}\left(TFP_s K_s^{\alpha_s} L_s^{1-\alpha_s}\right)^{\theta_s}. \tag{8}$$

Next, to determine industry productivity TFP_s, it is useful to distinguish between the firm's revenue productivity, $TFPR_{si}$, and the firm's physical productivity, $TFPQ_{si}$. The use of a firm-specific deflator yields a "pure" measure of productivity, termed physical productivity $TFPQ_{si}$. In contrast, if an industry deflator is used, firm-specific differences in prices are not taken into account. Firm-specific prices are difficult to obtain, particularly for retail firms, and we follow HK by inferring price vs. quantity from revenue and the assumed elasticity of demand. Using an industry deflator gives a "contaminated" measure of productivity, which is termed revenue productivity, $TFPR_{si}$. Both firm-level productivity measures ($TFPR_{si}$ and $TFPQ_{si}$) are relative to the industry average. Following Foster *et al.* (2008), physical and revenue productivity are defined as:[5]

[5]The parameters $c_1 = \left(\frac{\sigma}{\sigma-1}\right)\left(\frac{1-\alpha_s}{1}\right)^{\alpha_s-1}\left(\frac{r}{\alpha_s}\right)^{\alpha_s}$ and $c_2 = \frac{w^{1-\alpha_s}(p_s Y_s)^{\frac{1}{\sigma-1}}}{p_s}$ are constant within industries.

$$TFPR_{si} \equiv p_{si}A_{si} \equiv \frac{\left(p_{si}Y_{si}/\overline{p_sY_s}\right)}{\left(rK_{si}/\overline{rK_s}\right)^{\alpha_s}\left(wL_{si}/\overline{wL_s}\right)^{1-\alpha_s}} = c_1 \cdot \frac{(1+\tau_{Ksi})^{\alpha_s}}{(1-\tau_{Ysi})}. \tag{9}$$

$$TFPQ_{si} \equiv A_{si} \equiv \frac{\left(Y_{si}/\overline{Y_s}\right)}{\left(rK_{si}/\overline{rK_s}\right)^{\alpha_s}\left(wL_{si}/\overline{wL_s}\right)^{1-\alpha_s}} = c_2 \cdot \frac{\left(p_{si}Y_{si}/\overline{p_sY_s}\right)}{\left(rK_{si}/\overline{rK_s}\right)^{\alpha_s}\left(wL_{si}/\overline{wL_s}\right)^{1-\alpha_s}}. \tag{10}$$

In comparison to HK, we adjust the productivity estimates for $TFPR_{si}$ and $TFPQ_{si}$ by making them unit invariant (that is, dividing output and inputs by the industry averages for output and inputs). This adjustment does not alter the distribution of $TFPR_{si}$ and $TFPQ_{si}$ and resulting productivity gains. However, values of $TFPR_{si}$ and $TFPQ_{si}$ are affected. In (cross-country) regression analysis this should be controlled for using fixed effects if the productivity estimates are not expressed as unit invariant or one can use the unit invariant measures proposed here without the need to control for level differences across different sources.

From equation (9), it follows that revenue productivity $TFPR_{si}$ only varies across firms within industries if firms face output and capital distortions. Firms with higher physical productivity $TFPQ_{si}$ demand more capital and labor up to the point where the higher output results in a lower price and thus the same $TFPR_{si}$ as the other firms.

Industry TFP_s can be shown to be:

$$TFP_s = \left(\sum_{i=1}^{N_s}\left\{A_{si} \cdot \frac{\overline{TFPR_s}}{TFPR_{si}}\right\}^{\sigma-1}\right)^{\frac{1}{\sigma-1}}. \tag{11}$$

An important aspect of the expression for industry productivity is that if all firms face the same distortions, industry TFP_s will be unaffected. That is, if $\tau_{Ysi} = \tau_{Ys}$ and $\tau_{Ksi} = \tau_{Ks}$ for all i, the distortions disappear from the expressions for equilibrium industry TFP_s, and TFP_s is given by $\overline{A_s} = \left(\sum_{i=1}^{N_s} A_{si}^{\sigma-1}\right)^{\frac{1}{\sigma-1}}$.[6]

Firm-level distortions cannot be observed from the empirical data and must be identified. Distortions to output and capital are estimated from:

$$(1-\tau_{Ysi}) = \frac{\sigma}{\sigma-1}\frac{\left(wL_{si}/\overline{wL_s}\right)}{(1-\alpha_s)\left(p_{si}Y_{si}/\overline{p_sY_s}\right)}. \tag{12}$$

[6]Note that $A_{si} = constant \cdot \frac{\left(Y_{si}/\overline{Y_s}\right)^{\sigma/(\sigma-1)}}{\left(rK_{si}/\overline{rK_s}\right)^{\alpha_s}\left(wL_{si}/\overline{wL_s}\right)^{1-\alpha_s}}$. This is derived from the assumption that product demand is given by $P_{si} = Y_{si}^{-1/\sigma}$.

$$(1+\tau_{Ksi}) = \frac{\alpha_s}{1-\alpha_s} \frac{\left(wL_{si}/\overline{wL_s}\right)}{\left(rK_{si}/\overline{rK_s}\right)}. \tag{13}$$

Firm-specific output distortions are inferred from equation (12) (itself derived from equation (6)), when the firm's labor share is low compared to the industry elasticity of output with respect to labor. Capital distortions are inferred from equation (13) when the firm's ratio of labor compensation to capital services is high relative to what one expects from the output elasticities of capital and labor of the industry.

An important parameter in inferring distortions to output and their implications for aggregate productivity is the elasticity of substitution σ between firm value added. Aggregate productivity gains from the removal of distortions are increasing in σ. HK assume a common σ across goods equal to $\sigma = 3$. Initially, we use $\sigma = 3$ as well, but the sensitivity of the results to the choice of σ will be considered.

To estimate the firm's productivity and its distortions to capital and output, a choice has to be made on the benchmark capital share α_s. Because the average capital distortion and the capital production elasticity in each industry cannot be separately identified, we use the industry shares for the Federal district Brasilia as the benchmark. HK use industry shares for the United States as the benchmark. We do not use the U.S. as the undistorted benchmark, because U.S. industry characteristics might not match those in the states of Brazil. That is, differences in institutions, market structure, and geography may induce input shares to differ across countries.

Instead, we assume Brasilia is comparatively undistorted. Our benchmark choice is motivated by the observations that GDP per capita is highest, overall business regulation is least restrictive (see Section 5.1), and state-specific estimates of the substitution elasticity σ (explained in the sensitivity analysis in the Appendix) suggest competition is strongest in Brasilia. Deviations of the firm's input cost shares from the median shares in that particular industry for Brasilia will show up as a distortion to output and/or capital for the firm.

3. Data

To derive measures of productivity and distortions, we use the annual census of retailers for the period 1996–2006. The measures of distortions will be used to examine implications for aggregate productivity in Section 4. In addition, the measures of distortions are related with indicators of regulation to examine whether taxes and difficulty in access to credit result in distortions to output and capital in Section 5. This section describes the regulatory indicators and retail census data.

The principal data source of retail trade firms is the annual survey of distribution (Pesquisa Anual de Comercio, PAC) from 1996 to 2006. Firms registered in the Cadastro Nacional da Pessoa Jurídica (CNPJ) from the Ministry of Economic Affairs and classified as wholesale, and retail 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, a group of firms which surpass the threshold and are included by census, and another group of firms below the threshold included by sample only. The empirical analysis focuses on firms included by census, because we do not have appropriate weights to assure the sample reflects the population.

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.[7] For 1996 this amounts to 14,445 firms included by census. In 2006, the number of firms included by census has risen to 19,346. While firms included by census constitute a fairly small share of the total population of retail firms, they represent the major part of the sector in terms of sales (about 60 percent). Furthermore, the dataset mainly includes single-establishment stores with low productivity levels. For example, in 2004 about 69 percent of the firms in our dataset are single-establishment firms.

Our analysis excludes many small informal firms. Employment information in the national accounts, largely based on the annual household survey (Pesquisa Nacional por Amostra de Domicílios, PNAD), suggests that between 50 and 60 percent of workers in the distribution sector do not have a signed labor card or are considered autonomous workers, comprising own-account workers and employers of unregistered firms. Related research that uses a similar approach to measure resource allocation as in this paper suggests that including the smallest firms may increase or reduce the estimated degree of misallocation (Busso *et al.*, 2012). In Mexico, misallocation decreases if only firms with 10 or more employees are considered. In contrast, in El Salvador potential productivity gains from improving allocation of resources increase. However, the overall effects appear small. In Mexico (El Salvador) the potential productivity gain is 227 (135) percent when all firms are included, compared to 208 (138) percent for firms of 10 or more employees.

Firms are linked across years using their identification numbers from the tax registry. Different national sector definitions are used in PAC over time, which are converted to the International Standard Industry Classification Revision 3.0. The empirical analysis is at the four-digit industry level to allow differences in the structure of trade between firms. In total, 22 retail subsectors are distinguished.

The census includes detailed information on output and inputs. To measure retail output, several concepts can be used. In this paper, we use value added. Sales are the number of goods sold multiplied by their respective price. This is the broadest output concept, and both the product mix and the quantity of goods sold affect output. If the cost of goods sold is subtracted from sales, the resulting output concept is gross margin, which is preferably extended by the provision of distribution services (Betancourt and Gautschi, 1993). Thus, higher gross margins generally reflect higher value-added services. The gross margin output concept has several inherent difficulties. First, subtracting cost of goods sold from sales suggests that the costs of goods are separable from other costs the firm faces. Second,

[7]Firms in several northern states located outside the Federal States' capital are not included in the survey because of the high costs involved in collecting information for these firms. These states are: Rondônia, Acre, Amazonas, Roraima, Pará, Amapá, and Tocantins.

gross margins can be affected by volume discounts. Firms with market power might negotiate lower prices, thereby increasing their gross margin. Third, volume measures of gross margin are difficult to measure since price data on cost of goods sold is needed. A third output concept is obtained by subtracting intermediate inputs from gross margin, resulting in value added. Only labor and capital costs are included in the value added output concept. The value added output concept is usually regarded as the preferable output measure for the retail sector (McGuckin *et al*., 2005).

Value added consists of compensation for labor and capital inputs. Labor input is measured by the firm's wage bill, which crudely controls for differences in human capital and hours worked (Hsieh and Klenow, 2009). Consistent with the flow measures of output and labor input, we measure capital services instead of capital stocks.

PAC reports information on investment, depreciation, and renting and leasing expenditures. This information is combined to estimate the firm's capital services. First, the services flows from the firm's own capital stock are estimated. The booked depreciation method is used to construct a "guesstimate" of the initial capital stock in 1995. Essentially, the booked depreciation method assumes that firms linearly depreciate their capital, and combines the reported depreciation and investment to construct an initial capital stock in constant prices.[8] Subsequent values of the firm's capital stock were estimated using the perpetual inventory method where a geometric depreciation rate ($\delta = 0.05$) is used. Multiplying the capital stock by the rental price (the sum of depreciation, the rate of return, and the price change of the capital asset) results in the annual services flows from the firm's own capital stock. Second, renting and leasing expenditures are added to the own-capital services flows. On average, own-capital services flows account for 66 percent of the firm's capital services, renting expenditures for 32 percent, and leasing expenditures for 1 percent.

Table 1 shows descriptive statistics for selected states and all states combined. Estimates of TFPR and TFPQ using equations (9) and (10) are close to one, because output and inputs are measured relative to the industry's average. Distortions to output are estimated from equation (12). Output distortions are negative on average, thus labor's share is high compared to what one would expect from the industry elasticity of output with respect to labor. The positive values for distortions to capital (estimated using equation (13)) indicate that the ratio of labor compensation to the capital stock is high relative to what one would expect from the output elasticities with respect to capital and labor. Hence, both distortions suggest a relatively intensive use of labor compared to the benchmark. Distortions

[8]See Broersma *et al*. (2003) for details on the method. We assume firms linearly depreciate their capital in 15 years. Alternatively, we estimate the initial capital stock from the equilibrium conditions in a neoclassical growth model (Easterly and Levine, 2002). The correlation between both estimates is high (0.80) and the results do not appear sensitive to the choice of method, but we prefer the booked depreciation method because it combines information on both investment and depreciation, whereas the neoclassical method uses investment data only. The median share of the firm's capital services in value added is 19 percent, whereas that of remuneration is 78 percent. Hence, capital as a share of value added is of relatively limited importance for productivity estimates. So results will be rather insensitive to the way in which capital is measured.

TABLE 1
DESCRIPTIVE STATISTICS FOR RETAIL FIRMS, 2006

	All States	Ceará (UF = 23)	Rio de Janeiro (UF = 33)	Brasilia (UF = 53)
Sales	14.44	14.70	13.91	14.75
	1.55	*1.63*	*1.38*	*1.60*
Value added	12.96	12.95	12.75	13.28
	1.25	*1.47*	*1.15*	*1.38*
Remuneration	12.67	12.49	12.47	12.85
	1.11	*1.29*	*1.05*	*1.19*
Capital services	11.24	11.25	11.23	11.69
	1.36	*1.60*	*1.29*	*1.49*
TFPR	1.16	1.22	1.11	1.23
	0.81	*1.11*	*0.59*	*1.10*
TFPQ	1.04	1.08	0.98	1.14
	1.00	*1.37*	*0.75*	*1.15*
τ_{Ysi}	−1.71	−2.29	−1.32	−1.65
	2.61	*3.57*	*1.63*	*2.56*
τ_{Ksi}	0.15	0.15	−0.09	0.11
	1.70	*1.40*	*1.08*	*1.58*
Observations	19346	396	2607	413

Notes: The mean values (in natural logarithmic form) for Sales, Value added, Remuneration, and Capital services are in current Reais. The standard deviations are below in italics. TFPR is estimated using equation (9), TFPQ is estimated using equation (10), output distortions are estimated from equation (12), and capital distortions are estimated from equation (13).
Source: Pesquisa Anual de Comercio (IBGE, 2006).

to capital are high in Ceará, where access to credit is also most restrictive (see Table 3, further discussed later), suggesting a positive relation between the two. Output and input data suggest that firm size in Rio de Janeiro is below average, which might be related with above average taxes distorting output more in this state than in others. We will formally examine the relation between regulation and distortions to output and capital in Section 5.

4. ALLOCATIVE EFFICIENCY IN BRAZIL'S RETAIL SECTOR

We consider the productivity distribution and the gains in aggregate productivity if distortions were to disappear. If there were no distortions (or all distortions were the same across firms within industries), the TFPR distribution would be equal to one, and there would be no potential gains in productivity from resource reallocation. Hence, the variance of the TFPR distribution reflects firm-specific distortions across states. One can estimate potential aggregate productivity gains by hypothetically removing these idiosyncratic distortions.

4.1. *The Revenue Productivity Distribution*

The first columns in Table 2 show statistics for the revenue productivity distribution. We estimated the distribution of TFPR for each Federal State separately and for all states combined. Output and factor inputs are relative to the industry mean, so the mean and median of the TFPR distribution approximate

TABLE 2
TFPR Distribution in 2006 and TFP Gains from Equalizing TFPR Within Industries

Federal State	n (1)	Mean (2)	Median (3)	Variance (4)	1996 (5)	2001 (6)	2006 (7)	β (8)
Rondônia	69	1.06	1.02	0.22	190	196	204	–1.52
Acre	51	1.06	0.97	0.29	231	187	214	1.91
Amazonas	198	1.04	0.72	1.03	188	216	235	2.93**
Roraima	31	1.00	0.88	0.26	212	236	229	0.72
Pará	182	1.08	0.90	0.56	204	212	218	1.19
Amapá	45	1.04	0.91	0.50	226	216	217	1.73
Tocantins	37	1.28	1.00	1.11	239	262	238	–0.48
Maranhão	193	1.11	0.90	1.02	179	196	238	2.83
Piauí	163	1.10	0.87	0.77	204	220	230	1.57*
Ceará	396	1.22	0.94	1.22	218	226	244	1.97*
Rio Grande do Norte	265	1.18	1.04	0.55	211	221	227	3.15**
Paraíba	185	1.22	0.97	0.83	224	227	237	1.56
Pernambuco	573	1.20	0.96	1.11	233	262	235	1.07
Alagoas	165	1.07	0.75	1.21	197	228	250	4.13***
Sergipe	157	1.12	1.00	0.47	203	223	206	0.57
Bahia	917	1.17	0.91	1.04	245	255	264	1.89
Minas Gerais	2148	1.16	0.99	0.53	237	243	257	1.75
Espírito Santo	499	1.20	0.96	1.35	242	239	274	2.33*
Rio de Janeiro	2607	1.11	0.99	0.35	239	246	223	–1.13
São Paulo	5451	1.24	1.10	0.53	244	246	242	–1.12
Paraná	1432	0.98	0.91	0.29	243	231	235	–1.40
Santa Catarina	821	1.25	1.01	0.94	235	247	254	1.84
Rio Grande do Sul	1104	1.11	0.97	0.61	237	250	274	2.93
Mato Grosso do Sul	299	1.04	0.90	0.66	232	251	260	2.52
Mato Grosso	394	1.23	1.01	0.80	241	248	267	2.65*
Goiás	551	1.15	0.93	1.06	229	243	269	3.81***
Distrito Federal	413	1.23	0.94	1.21	217	239	250	4.45***
Total economy	19346	1.16	1.00	0.65	257	266	257	–0.26

Notes: TFPR is estimated using equation (9). The number of observations, and the mean, median and variance of TFPR are shown in the first four columns. TFP gains from equalizing TFPR within industries are shown in column, 5, 6, and 7, assuming an elasticity of substitution eqaul to 3. The last column shows the β-coefficient from an OLS regression where % TFP gains are regressed against time. A significant negative value indicates improvements in allocative efficiency. * Significant at 10%; ** significant at 5%; *** significant at 1%.

one. The dispersion of TFPR varies considerably across states. The variance ranges from 0.22 in Rondônia to 1.35 in Espíritu Santo. If we correlate the variance in TFPR with the ranking of states on the strictness of business regulation we find a positive but insignificant relation, which suggests a weak positive relation between regulation and dispersion in marginal revenue products across firms within states. Obviously, these results are indicative at best and will be further explored in Section 5.

4.2. *Potential Gains from Resource Reallocation*

Potential gains in aggregate productivity across states are estimated by hypothetically removing distortions. If marginal products are equal across firms, industry TFP is $\overline{A_s} = \left(\sum_{i=1}^{N_s} A_{si}^{\sigma-1}\right)^{\frac{1}{\sigma-1}}$. Potential gains are estimated from:

$$\frac{Y}{Y_{efficient}} = \prod_{s=1}^{S}\left[\sum_{i=1}^{N_s}\left\{\frac{A_{si}}{\overline{A_s}}\cdot\frac{\overline{TFPR_s}}{TFPR_{si}}\right\}^{\sigma-1}\right]^{\frac{\theta_s}{(\sigma-1)}}. \tag{14}$$

For each industry, we calculate the ratio of actual TFP_s (equation (11)) to the efficient level of TFP_s, and then aggregate this ratio across industries using the Cobb–Douglas aggregator (equation (1)). The last columns in Table 2 provide percentage TFP gains by state from fully equalizing TFPR across firms in each industry for the years 1996, 2001, and 2006. The potential gains are large. For example, for 1996 potential TFP gains are 217 percent in Brasilia (Distrito Federal), 239 percent in Rio de Janeiro, and 244 percent in São Paulo.

Estimates of potential gains in retailing are higher than estimated productivity gains from equalizing TFP within manufacturing industries. For China and India, gains in manufacturing range from 86 to 128 percent (Hsieh and Klenow 2009). Estimates for manufacturing sectors in Latin American countries are in the same ballpark as those for Chinese and Indian manufacturing (Busso *et al*., 2012). Estimates of potential TFP gains for the retail sector in Mexico (267 percent) by Busso *et al*. (2012) are in line with our estimates for Brazil (257 percent).

Large potential gains are not out of line with TFP gaps in retail between the U.S. and Brazil. Estimates indicate that productivity levels in Brazilian retailing are between 14 and 28 percent of the U.S. productivity level (McKinsey, 1998; Mulder, 1999; Lagakos, 2009). Mulder (1999) finds that the relative productivity level dropped from 28 to 14 percent during the period 1975–1995. This finding is consistent with the 14 percent level for food retailing in 1995 obtained by McKinsey (1998). Also, preliminary evidence based on differences in the size composition between the U.S. and Brazil, suggests that resource allocation improvements may account for half of this retail TFP gap (Lagakos, 2009). Assuming larger firms have higher productivity levels, our estimates of the large potential TFP gains from resource reallocation are in line with these findings. That is, improvements in resource reallocation may improve TFP levels by a factor of two, which would bring productivity levels in Brazil's retail sector between 28 and 56 percent of the U.S. productivity level.

The approach to estimate potential gains is not without limitations. The model assumes a constant markup over marginal costs, which is a standard feature of monopolistic competition models. However, retailers usually have unique market powers because they supply different services: when consumers shop, they choose certain stores based on factors such as store location, hours of operation, range of products sold, and so on (Sunada, 2010). If the markup varies with marginal costs, the estimated TFP gains are imprecisely estimated. The present framework fails to completely remove the effects of differences in market power across firms on distortions and estimated productivity.[9]

[9]Other aspects, such as adjustment costs, returns to scale, and fixed costs will be reflected in the gaps as well adding to the imprecision of our estimates. Assuming constant returns to scale in retailing is consistent with the available empirical evidence of production function estimation, summarized in Betancourt (2004). However, large retail chains may benefit from scale, for example due to distribution systems.

The ideal way forward to measure distortions to prices and its effect on differences in marginal products of inputs across firms, is to use directly observed price information. Few surveys exist that allow this type of analysis, at least for the retail sector. Surveys for manufacturing industries sometimes do include price and quantity information. This might be used to examine the precision of the estimates, although it would not provide a definite answer to results for retailing given its unique features.

In the Appendix we examine the sensitivity of estimated potential aggregate TFP gains in various ways. The sensitivity analysis suggests that various adjustments, such as state-specific elasticities of substitution and trimming for outliers, affect the magnitude of potential TFP gains. However, all adjustments suggest that the potential gains from resource reallocation remain large.

We continue by examining whether potential TFP gains from resource reallocation have been realized during the period following services liberalization. Changes in the opportunity for increasing aggregate productivity by removing distortions are examined by comparing the potential gains between 1996 and 2006. Figure 1 presents results for the total economy and three large Federal States (Rio de Janeiro, São Paulo, and Minas Gerais). The figure suggests potential gains from resource reallocation have gone largely unexploited despite liberalization of the retail sector since the 1990s.

In Table 2, the last column shows the β-coefficient from an OLS regression where percentage TFP gains are regressed against time. A significant negative value indicates improvements in allocative efficiency. In most states, the coefficient is positive and insignificant. For some states we find a significant positive coefficient, but the change over time is small. This finding suggests slow resource

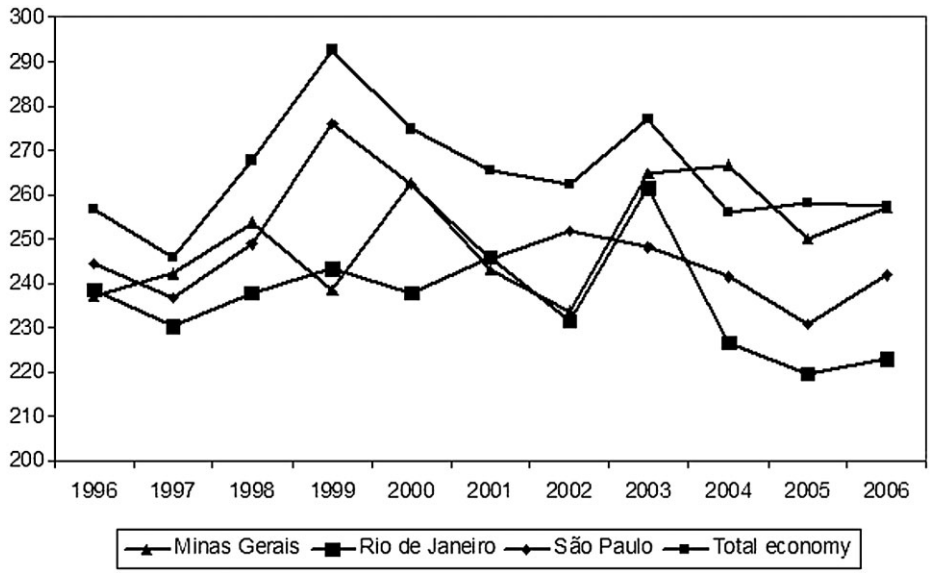

Figure 1. Potential Aggregate Productivity Gains from Resource Reallocation

TABLE 3
CORRELATION BETWEEN VARIABLES, 2006

	Value Added	Employment	Capital Services	TFPR	TFPQ	τ_{Ysi}	τ_{Ksi}
Value added	1						
Employment	0.94	1					
Capital services	0.84	0.82	1				
TFPR	0.02	–0.01[c]	–0.01[b]	1			
TFPQ	0.13	0.09	0.05	0.89	1		
τ_{Ysi}	0.04	0.02[a]	0.02[b]	0.42	0.37	1	
τ_{Ksi}	–0.02	–0.01[c]	–0.03	0.25	0.14	–0.22	1

Notes: Pearson correlation coefficients. All pairwise correlations are significant at the 1 percent level except for [a] significant at the 5 percent level, [b] significant at the 10 percent level, and [c] not significant.

reallocation following pro-competitive reforms as well. Although the magnitude of the TFP gains are sensitive to the assumption of the model, the sensitivity checks in the Appendix suggest that changes over time in the opportunity for increasing aggregate productivity by removing distortions are hardly affected.

Our finding of limited resource reallocation is consistent with earlier research attributing Latin America's disappointing performance after market-oriented reforms in the 1990s to the slow reallocation of inputs toward more efficient firms.[10] In particular, de Vries (2008) finds limited evidence of improvements in allocative efficiency after reforms in the retail sector of Brazil.

5. Regulation and Distortions to Output and Capital

In an exploratory data analysis, we correlated the variables used in this paper. Correlations are shown in Table 3. The relation between value added and productivity is positive, suggesting larger firms are more productive, which is consistent with core models of the size–productivity distribution of firms (Melitz, 2003). The correlation between employment and distortions to output is positive. This may reflect larger firms facing larger distortions to output. In contrast, the relation between employment and distortions to capital is negative, suggesting that smaller firms face larger distortions to capital, although the relation is not significant.

In this section we relate regulation to distortions using a particular form of a differences-in-differences (DD) approach, popularized by Rajan and Zingales (1998).[11] The advantage of this approach is that we are able to examine a causal relation between regulation and distortions as compared to a simple correlation between both. The substantial variation in regulation across states (see Table 4, discussed in the next section) allows us to examine the effects of regulations in a differences-in-differences approach. We examine how taxes, entry regulation, and access to credit impact distortions to output and capital. For taxes, we examine whether retail industries with higher commercialization margins will be more

[10]See, for example, Menezes-Filho and Muendler (2007), Pages *et al*. (2009), and de Vries (2008).
[11]For recent applications, see Aghion *et al*. (2007) and Bruno *et al*. (2008).

affected by higher sales taxes.[12] For example, commercialization margins in the retail sale of household appliances, articles, and equipment (CNAE 1.0 industry 5233) are higher than in specialized bakery and dairy stores (CNAE 1.0 industry 5221) (IBGE, 2006).[13] Therefore, retailers selling household appliances will be more affected by taxes as compared to retailers selling food, beverages, and tobacco. In turn, this will translate into higher distortions for high-margin firms in states with high taxes relative to low-margin firms in the same state.

For access to credit, we examine whether retail industries that depend more on external financing are more affected by difficulty in access to credit (Rajan and Zingales, 1998). Our measure for external financial dependence is expenditures related to outstanding debt (e.g., interest payments on loans). This measure should reflect the amount of desired investment that cannot be financed through internal cash flows generated by the same firm. The relative dependence on external finance will be higher in more capital-intensive retail industries. For example, dependence on external finance is highest in hypermarkets (CNAE 1.0 industry 5211) and lowest in stores selling candy and chocolates (CNAE 1.0 industry 5222). Finally, for measuring the effects of entry regulation, we interact difficulty in starting up a business with the relative entry rate by industry. Industries with higher churning will be relatively more affected by entry regulation.

The differences-in-differences approach requires a relatively frictionless market. We use the Federal State Brasilia as the comparatively undistorted benchmark. Obviously, distortions are present in Brasilia as well, as suggested by the potential gains from resource reallocation we found in Section 4. However, what matters is that the relative industry ordering of entry rates, commercialization margins, and external financial dependence in Brasilia corresponds to the ordering of natural entry rates, natural commercialization margins, and natural external financial dependence across industries, and that these orderings carry over to other states in Brazil (Klapper *et al.*, 2006).[14]

5.1. *Regulation: Taxes and Access to Credit*

Information on regulation is provided by the World Bank's Doing Business for Federal states in 2006 (World Bank 2006). The indicators we use are paying taxes, entry regulation, and getting credit. Taxes are considered, because the complex and burdensome tax system potentially distorts output. Recent research suggests that entry plays an important role in the evolution and aggregate efficiency gains in an industry, either directly or indirectly (Restuccia, 2008). Getting credit is considered, because it is identified as one of the most important constraints on growth in Brazil (Rodrik, 2007). In particular, small firms are

[12]Commercialization margins, gross profits, are defined as resale revenues minus the cost of goods sold, remuneration, and intermediate expenditures, over sales.

[13]CNAE is Classificação Nacional de Atividades Econômicas, the national industry classification, which closely maps the International Standard Industrial Classification 3.1.

[14]In addition, high correlations of industry orderings across regions suggest results are relatively insensitive to the benchmark considered.

constrained by access to credit (World Bank, 2006), which may result in relatively larger distortions to capital for these firms.[15]

The indicator of paying taxes records all taxes paid by a medium-sized firm, which is dedicated to general commercial activities and services within the second year of operation. Taxes are measured at all levels of government, resulting in more than 25 different public, state, and municipal taxes. These taxes include, among others, corporate income taxes, turnover taxes, and value-added taxes. Importantly, labor taxes (such as payroll taxes and social security contributions) are not included. Hence, the indicator of paying taxes can be used to examine distortions to output as they are expected to proportionally affect the marginal revenue product of labor and capital.

Entry regulation is measured by the number of procedures required for an entrepreneur to start up a commercial business, and the time and cost to obtain all licenses and permits. The indicator on getting credit measures the time and cost to create and register collateral. The collateral agreement must be registered with the Registry of Deeds and Documents in the city of the debtor. These registries are not linked across regions, and often not digitalized. The cost to register a security includes official duties and notary fees.

Information on the regulatory indicators is provided in Table 4. The cost of registering collateral (as a percentage of loan value) ranges from 0.2 in Rio de Janeiro to 3.8 in Ceará. In comparison, the cost of registering collateral is 0.01 percent of loans in Canada and the U.K. Also, the ease of starting up a business varies considerably and appears especially costly and cumbersome in Maranhão. Finally, taxes range from 89 percent of gross profits in the Amazone to 208 percent in Rio de Janeiro. Taxes in the U.S. are 45 percent of gross profits. Hence, although taxes, entry regulation, and collateral registration procedures are essential for an economy to function, they appear burdensome in Brazil.

The first row of Table 4 shows the final ranking of states in terms of business regulation (1 for the least regulated state, 13 for the most regulated state). This final ranking is a simple average of the ranking of a state on each indicator made by the World Bank.[16] The ranking suggests business regulation is least restrictive in Brasilia, and most restrictive in Ceará.

5.2. *Model Specification*

For 2006, we regress distortions to output and capital on regulation interacted with an industry-specific indicator. Initially, we do not allow effects to vary by firm size (z), and therefore exploit three dimensions: (i) firm; (s) industry; and (r) region. If we label the regulatory variable (taxes or access to credit) as "policy" and the related industry-specific factor as "industry factor," the estimated specification is as follows:

[15]Other forms of regulation might be relevant that are not addressed here. See, for example, Lagos (2006), Almeida and Carneiro (2007), and Petrin and Sivadasan (2012) for firm-level analysis of the effects of labor regulation in Latin America.

[16]A wider set of indicators is considered for the final ranking, also including registering property, and enforcing contracts.

TABLE 4

BUSINESS REGULATIONS ACROSS THE FEDERAL STATES OF BRAZIL, 2006

Federal State		Federal District	Amazonas	Minas Gerais	Rondônia	Maranhão	Rio Grande do Sul	Mato Grosso do Sul	Rio de Janeiro	Santa Catarina	Bahia	São Paulo	Mato Grosso	Ceará
Final rank		1	2	3	4	5	6	7	8	9	10	11	12	13
Getting credit	Time to create collateral	45	6	2	30	4	25	30	27	25	26	na	23	40
	Cost to create collateral	0	2	1	2	1	1	1	0	3	2	na	3	4
Paying taxes	Total tax payable	149	89	150	146	147	153	146	208	144	144	148	146	137
	Number of payments	12	23	23	12	12	12	12	12	23	12	23	23	23
Starting a bus.	Number of procedures	15	15	10	17	18	15	16	15	18	17	17	15	19
	Time (days)	49	68	19	30	47	35	41	68	44	25	152	41	44
	Costs (% of GDP per capita)	4.93	10.20	10.48	20.47	48.98	6.07	11.06	10.89	10.24	32.67	10.10	12.42	31.01

Notes: Time to create collateral in days, cost to create collateral in percentage of loan value, total tax payable as percentage of gross profits. Number of payments per year.

Source: Doing Business in Brazil (World Bank, 2006).

$$\gamma_{i,s,r} = \delta(policy_r \cdot industryfactor_s) + \sum_{r=1}^{R} \beta_r D_r + \sum_{s=1}^{S} \beta_s D_s + \varepsilon_{i,s,r}. \quad (15)$$

The dependent variable, $\gamma_{i,s,r}$, is either a measure of the distortion to output (τ_{Ysi}) or capital (τ_{Ksi}), or a combination of both ($TFPR_{si}$). Region dummies, D_r, and industry dummies, D_s, are included to control for other market, technological, or regulatory factors not included in the regressions. This specification allows us to relate regulation with idiosyncratic distortions. Since the specification controls for region- and industry-specific effects, the only effects that are identified are those relative to the interaction term (the regulatory variable and the industry-specific factor) that varies both across regions and across industries. For example, for taxes we may examine whether differences in distortions to output between firms in industries with high or low commercialization margins are smaller in regions with lower taxes.

In the introduction, it was argued that the effects of taxes and difficulty in access to credit are likely to vary by firm size. The exploratory data analysis in this section suggested that distortions may vary with firm size as a result of regulation. Furthermore, Bartelsman *et al.* (2008) use the World Bank Investment Climate Surveys to examine the differential impact of policy factors on performance and growth prospects of firms of different size in Latin America. They present descriptive evidence that medium-sized and, especially, large firms are more affected by high taxes and cumbersome tax administration than small firms. Medium and large businesses tend to be relatively less affected by lack of access to, and the cost of, financing. In contrast, Monteiro and Assunção (2012) find that taxes are an important policy variable for small firms, which affects their decision to register their business or stay informal. Monteiro and Assunção (2012) show that a simplification of the procedures and a reduction in the amount of taxes payable results in a 13 percentage points increase in retail firms that register. Ultimately, whether regulation creates misallocation of resources across firms of different size is an empirical issue.

To allow for differential effects of policies, in a second specification we allow the effect to vary by firm size z:

$$\gamma_{i,s,r,z} = \sum_{z=1}^{Z} \delta_z(policy_r \cdot industryfactor_s) + \sum_{r=1}^{R}\sum_{z=1}^{Z} \beta_{r,z} D_{r,z} + \sum_{s=1}^{S}\sum_{z=1}^{Z} \beta_{s,z} D_{s,z} + \varepsilon_{i,s,r,z}. \quad (16)$$

The employment-size categories distinguished are firms with $z1$ ($\leq$50 employees), $z2$ (51–100 employees), $z3$ (101–249 employees), and $z4$ ($\geq$250 employees).

A clear advantage of the DD approach compared to standard cross-state/cross-industry studies is that it allows to control for state and industry effects, thereby reducing problems with model misspecification and omitted variable bias. However, recent research has highlighted some disadvantages of the DD approach as well. Bertrand *et al.* (2004) argue that standard errors are biased due to autocorrelation if a long time series is considered. In our model setup, a single cross-section is considered, which is less susceptible to serial correlation problems. Donald and Lang (2007) show potential problems with grouped error terms, because the dependent variable differs across individuals while the policies being

studied are constant among all members of a group. Failure to account for the presence of common group errors can generate biased standard errors as well. Therefore, we correct the standard errors using a robust covariance estimator, where state-industries are clustered. The large number of groups (13 states × 20 industries) is expected to result in an asymptotically normally distributed t-statistic. Finally, spatial autocorrelation may exist if retail outlets in different neighboring regions are affected by common shocks. We aim to control for the latter by excluding firms with establishments in more than one region in the sensitivity analysis.

5.3. *Results*

Table 5 shows results from estimating equation (15). Results show the average impact of different types of regulation without differentiating by size. Columns (1)–(6) consider the effects on revenue ($TFPR_{si}$) and physical ($TFPQ_{si}$) productivity. Recall that in the model setup, revenue productivity is a composite measure reflecting distortions to output and capital, whereas physical productivity measures "true" productivity of the firm (see equations (9) and (10)). Hence, regulations are expected to be related with revenue productivity, and not with physical productivity.

Results in columns (1)–(3) of Table 5 suggest that access to credit is positively and significantly related with distortions (higher revenue productivity) in

TABLE 5

Regulation and Distortions to Output and Capital, No Allowance for Size Effects of Regulation

Panel A	TFPR (1)	TFPR (2)	TFPR (3)	TFPQ (4)	TFPQ (5)	TFPQ (6)
Taxes × Com. margins	0.094			0.037		
	(1.09)			(0.60)		
Credit × Fin. dependence		0.144			0.180	
		(1.98)**			(2.57)**	
Start × Entry rate			–0.054			0.174
			(0.47)			(1.72)*
Observations	15010	9559	15010	15010	9559	15010
R^2	0.05	0.04	0.05	0.08	0.08	0.08
Panel B	τ_{Ysi} (7)	τ_{Ysi} (8)	τ_{Ysi} (9)	τ_{Ksi} (10)	τ_{Ksi} (11)	τ_{Ksi} (12)
Taxes × Com. margins	–0.007			0.667		
	(0.05)			(2.74)***		
Credit × Fin. dependence		0.126			0.131	
		(1.14)			(1.29)	
Start × Entry rate			0.644			–0.975
			(2.06)**			(2.09)**
Observations	15010	9559	15010	15010	9559	15010
R^2	0.06	0.07	0.06	0.16	0.11	0.15

Notes: OLS regressions, robust t-statistics in brackets, region and industry dummies are included (not shown), clustering by region-industry. Number of observations for regressions where access to credit is interacted with financial dependence is smaller because no information on access to credit is available for São Paulo. * Significant at 10%, ** significant at 5%, *** significant at 1%.

industries with higher dependence on external finance. The relation is not significant for taxes on profits and entry regulation. A similar relation is observed between regulation and physical productivity (columns (4)–(6)), although the effect of entry regulation is also significant in this specification. This creates doubts on the accurateness of distinguishing TFPR and TFPQ, because the misallocation of resources across firms should solely be reflected in revenue productivity. Both productivity measures are highly correlated and therefore TFPR may reflect distortions to output and capital as well as true productivity to some extent. Furthermore, revenue productivity is a composite measure of distortions, which may obscure channels by which regulation affects resource misallocation. Therefore, examining distortions to output and capital separately might be more appropriate.

Regressions for distortions to output and capital are shown in the second panel of Table 5, columns (7)–(12). Results suggest taxes are insignificant and negatively related with distortions to output and significantly positively related with distortions to capital, and vice versa for entry regulation where both effects are significant at the 95 percent confidence level. The opposing effects may explain why taxes and entry regulation are not significantly related with revenue productivity in columns (1) and (3) of Table 5. Access to credit is positively related to both distortions to output and capital, which may explain why it is significantly related with revenue productivity.

A single coefficient for all firms may hide opposing effects across firm size. Therefore, we allow the impact of regulation to vary by firm size. Results from estimating equation (16) are shown in Table 6. Our interest centers on the relation between regulation and distortions to output and capital separately.

Results in Table 6 suggest different effects of regulation. Column (1) suggests that taxes on gross profits significantly distort output of large firms (the group $z4$), whereas the effect of taxes is insignificant for other firm size groups. Output distortions for large firms appear higher in regions with higher taxes and in industries with higher commercialization margins. This finding is consistent with earlier literature (e.g., Gollin, 2006; Guner *et al*., 2008) and recent findings from interviews with CEOs of retail chains in Argentina (Sánchez and Butler, 2008). It may be due to higher enforcement for large firms if tax collection involves fixed costs.

To explore the estimated impact of taxes on distortions to output we follow the approach outlined in Aghion *et al*. (2007). We estimate the difference in distortions to output between firms in industries with high commercialization margins (90th percentile of distribution in Brasilia) and firms in industries with low commercialization margins (10th percentile of the same distribution) in the region with the highest taxes compared to the region with the lowest taxes:

$$\delta_z[(Margin_{90th} - Margin_{10th})(Taxes_{max} - Taxes_{min})]. \tag{17}$$

Using the coefficients in column (1), the impact of taxes on distortions to output is 0.19 for large firms. This suggests that taxes have a modest but non-negligible impact on output distortions for large firms. However, the effect is sensitive to the model specification. In Section 5.4 we allow the elasticity of substitution to vary with firm size (a deviation from our model assumptions), to

TABLE 6

Regulation and Distortions to Output and Capital, Allowance for Size Effects of Regulation

	τ_{Ysi} (1)	τ_{Ysi} (2)	τ_{Ysi} (3)	τ_{Ksi} (4)	τ_{Ksi} (5)	τ_{Ksi} (6)
Taxes × Com. margins × $z1$	–0.041			0.606		
	(0.30)			(2.51)**		
Taxes × Com. margins × $z2$	0.147			1.019		
	(0.69)			(3.36)***		
Taxes × Com. margins × $z3$	–0.175			0.748		
	(0.87)			(2.89)***		
Taxes × Com. margins × $z4$	0.350			0.484		
	(2.29)**			(2.04)**		
Credit × Fin. dependence × $z1$		0.368			0.304	
		(1.54)			(1.37)	
Credit × Fin. dependence × $z2$		0.153			0.546	
		(0.56)			(1.77)*	
Credit × Fin. dependence × $z3$		–0.161			0.077	
		(0.95)			(0.49)	
Credit × Fin. dependence × $z4$		0.016			–0.068	
		(0.42)			(1.99)**	
Start × Entry rate × $z1$			0.625			–0.919
			(1.89)*			(2.17)**
Start × Entry rate × $z2$			0.754			–1.225
			(1.12)			(0.99)
Start × Entry rate × $z3$			0.318			–2.057
			(0.26)			(1.52)
Start × Entry rate × $z4$			1.378			–1.571
			(1.67)*			(1.86)*
Observations	15010	9559	15010	15010	9559	15010
R^2	0.06	0.07	0.06	0.16	0.11	0.15

Notes: OLS regressions, robust t-statistics in brackets, size-specific region and industry dummies are included (not shown), clusters by region-industry. The employment-size categories distinguished are firms with $z1$ ($\leq$50 employees), $z2$ (51–100 employees), $z3$ (101–249 employees), and $z4$ ($\geq$250 employees). Number of observations for regressions where access to credit is interacted with financial dependence is smaller because no information on access to credit is available for São Paulo. * Significant at 10%, ** significant at 5%, *** significant at 1%.

crudely control for differences in market power across firms. In that specification, the effect of taxes on the output distortion of large firms is still positive but no longer significant.

Entry regulation distorts output for small firms (column (3) in Table 6), which tends to make them smaller compared to an undistorted setting. The effect is also positive and significant for large firms, which might be related with larger firms that would like to open new establishments. In contrast to taxes on gross profits (and also access to credit, discussed next), the coefficients for the entry regulation have the same sign across size classes. Again, this specification is not robust to every alternative model specification that we consider in the next section, in particular to our attempt to control for spatial autocorrelation.

Difficulty in access to credit results in distortions to capital for medium-sized firms, as suggested by the significant and positive coefficient for the interaction effect of credit and financial dependence for group $z2$. For small firms the effect is not significant, which might be related to the employment threshold in the census

creating sample selection problems. For large firms, this effect is significantly negative, suggesting differential effects across firm size. Smaller firms are more likely to face borrowing constraints because of limited liability and imperfections in the enforcement of debt repayment (Albuquerque and Hopenhayn, 2004). Therefore, these firms in industries that depend relatively more on external finance are more likely to employ labor instead of capital. The differential impact between medium-sized and large firms is 0.94, suggesting that difficulty in access to credit has a substantial impact on distortions to capital at the sample mean. This result is robust to the alternative model specification discussed in the next section.

5.4. *Sensitivity of the Results*

The sensitivity of the effects of regulations that may differ by firm size and type of distortion, are examined along different dimensions. First, regressions might be affected by the hierarchical setup of the model specification. That is, distortions measured at the firm-level are related with region-industry indicators. Although region-industry clusters were used to adjust the standard errors, an alternative approach might be to include firm-specific variables as explanatory variables (also using clustered standard errors). In the first column of the three panels in Table 7, regressions are shown where the firm's employment is included. Note that we focus on the effects of taxes and entry regulation for output distortions, and the effects of access to credit on distortions to capital.[17] Employment was considered, because it proxies for firm size. Therefore, we examine whether the results are driven by differences in profit margins, entry rates, and dependence on external finance between industries across size classes and not by independent size effects. Including a firm-specific variable does not change the distortionary effects of taxes and access to credit across firm size.

Second, we considered the sensitivity of the results to the elasticity of substitution. It may be argued that the elasticity of substitution is higher for small firms, perhaps because of customer-binding marketing strategies and the broader assortment of large firms, and less fixed costs in small firms. As a crude proxy to control for differences in markup, we allow the elasticity to vary between 7 and 3 for the different size groups instead of letting it vary between states. Note that this is a clear deviation from the monopolistic competition model where the markup is assumed to be constant. Results from regressing the different measures of distortions to output and capital are shown in the second column of the three panels in Table 7. For taxes we no longer find a significant distortionary influence on output for large firms. This suggests competition reduces the effect of tax policies on distortions. Also, the effects of start-up costs are no longer significant. Only for difficulties in access to credit, does the relation with distortions to capital for medium-sized firms remain significant.

Third, spatial autocorrelation may exist if retail outlets in different neighboring regions are affected by common shocks. In an attempt to control for this effect, we drop regional and national retail chains from our sample. As with the previous specification where we deviated from the model, this is a demanding specification

[17]Results for the other specifications are available upon request.

TABLE 7

Regulation and Distortions to Output and Capital, Sensitivity Analysis

Panel A	τ_{Ysi} (1)	τ_{Ysi} (2)	τ_{Ysi} (3)
Taxes × Commercialization margins × $z1$	–0.041	–0.067	–0.058
	(0.30)	(0.51)	(0.42)
Taxes × Commercialization margins × $z2$	0.147	0.099	0.030
	(0.69)	(0.49)	(0.12)
Taxes × Commercialization margins × $z3$	–0.175	–0.305	–0.406
	(0.87)	(1.44)	(1.29)
Taxes × Commercialization margins × $z4$	0.350	0.090	0.179
	(2.29)**	(0.51)	(1.18)
Observations	15010	15041	14068
R^2	0.06	0.04	0.06
Panel B	τ_{Ksi} (4)	τ_{Ksi} (5)	τ_{Ksi} (6)
Credit × Financial dependence × $z1$	0.301	0.353	0.377
	(1.36)	(1.51)	(1.57)
Credit × Financial dependence × $z2$	0.545	0.590	0.602
	(1.77)*	(1.84)*	(1.87)*
Credit × Financial dependence × $z3$	0.078	0.113	0.512
	(0.49)	(0.70)	(0.92)
Credit × Financial dependence × $z4$	–0.070	–0.060	–0.093
	(2.52)**	(1.70)*	(1.10)
Observations	9559	9581	8806
R^2	0.11	0.11	0.12
Panel C	τ_{Ysi} (7)	τ_{Ysi} (8)	τ_{Ysi} (9)
Start × Entry rate × $z1$	0.625	0.419	0.570
	(1.89)*	(1.28)	(1.67)*
Start × Entry rate × $z2$	0.754	0.721	0.413
	(1.12)	(1.22)	(0.60)
Start × Entry rate × $z3$	0.319	–0.764	–0.614
	(0.26)	(0.55)	(0.34)
Start × Entry rate × $z4$	1.379	–0.275	0.882
	(1.67)*	(0.35)	(1.88)*
Observations	15010	15041	14068
R^2	0.06	0.04	0.06

Notes: OLS regressions, robust t-statistics in brackets, size-specific region and industry dummies are included (not shown), clusters by region-industry. The employment-size categories distinguished are firms with $z1$ ($\leq$50 employees), $z2$ (51–100 employees), $z3$ (101–249 employees), and $z4$ ($\geq$250 employees). Number of observations for regressions where access to credit is interacted with financial dependence is smaller because no information on access to credit is available for São Paulo. * Significant at 10%, ** significant at 5%, *** significant at 1%. First column includes firm's employment; second column shows results when the elasticity of substitution is allowed to vary across size groups; final column shows results from dropping regional and national retail chains from the analysis.

as most large firms are regional and national chains. The final columns of the panels in Table 7 again suggest that the effects of taxes on output for large firms are insignificant. However, entry regulation again appears to distort output for small and large firms. Also, access to credit creates distortions to capital for medium-sized firms.

6. Concluding Remarks

An increasingly dominant view holds the limited role of allocative efficiency as the main culprit of low productivity growth following reforms in Latin America since the 1990s. So far, this view has been largely based on evidence from the manufacturing sector. In this paper, we extended the analysis by examining allocative efficiency in the retail sector of Brazil. A novel methodological approach, following Banerjee and Duflo (2005), which uses the gaps between marginal revenue products and input prices to measure resource allocation, was followed.

We applied the HK model to a detailed census dataset of retail firms. Wedges between the opportunity cost and marginal product of factor inputs across firms were measured and implications for aggregate productivity were imputed.

The analysis suggests potential gains are large. For example, for 1996 potential TFP gains are 217 percent in Brasilia (Distrito Federal), 239 percent in Rio de Janeiro, and 244 percent in São Paulo. Large potential gains are not out of line with estimates of TFP gaps in retail between the U.S. and Brazil. Estimates indicate that productivity levels in Brazilian retailing are between 14 and 28 percent of the U.S. productivity level (McKinsey, 1998; Mulder, 1999; Lagakos, 2009). Improvements in resource reallocation may therefore improve TFP levels by a factor of two, which would bring productivity levels in Brazil's retail sector between 28 and 56 percent of the U.S. productivity level.

In addition, we find no evidence for improvements in allocative efficiency. Potential output gains from resource reallocation have not been realized during the 1996 to 2006 period as the gap remained more or less constant. This finding is in line with the view that the absence of productive reallocation is underlying low growth in Latin America following reforms.

After obtaining measures of distortions at the firm level and examining its implications for aggregate productivity, we related these distortions with regional variation in regulation using a differences-in-differences approach. Selective policy implementation and enforcement may create implicit or *de facto* differences in the business environment faced by small and large firms. Therefore, we allowed the coefficients in our econometric model to vary by firm size. The results suggest that regulation results in distortions to output and capital, but the effects may differ by firm size.

However, the approach to estimate distortion to output and capital across firms is not without limitations. The model assumes a constant markup over marginal costs, which is a standard feature of monopolistic competition models. However, retailers usually have unique market powers because they supply different services. The present framework fails to completely remove the effects of differences in market power across firms on distortions and estimated productivity. In a sensitivity analysis we approximate differences in markups across firm sizes by allowing the elasticity of substitution to increase with size. In these specification, taxes on gross output do not distort output for large firms any more. The approach followed here was to examine patterns for the retail sector, but they should be underpinned by very detailed retail industry studies. In particular, future research may try to examine productivity change for a narrow and relatively homogeneous retail industry and obtain firm-specific prices.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix: Sensitivity Analysis of the Potential TFP Gains
Table A1: Elasticities of Substitution by Federal State
Figure A1: Potential Aggregate Productivity Gains from Resource Reallocation