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Taxes, Misallocations and Productivity

Bruno Caprettini*

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Abstract

Misallocations of factors of production have the potential to explain a large portion of cross-country differences in productivity (Hsieh and Klenow (2009)). Yet, empirical evidence relating actual differences in firms' productivity to observable policy distortions has been scarce. In this paper I exploit a fiscal reform in Brazil to provide direct empirical evidence of the distortions created by turnover taxes. Turnover taxes are business taxes that, unlike Value Added Taxes, do not allow to deduct the cost of intermediate inputs from the tax base, and that for this reason hit disproportionately industries whose inputs account for a large share of the final value of production. Using a difference-in-difference approach, I show that after the reform sectors that rely more on intermediate inputs grow faster in employment, revenue and industrial sales. Firms in the same sectors that were not affected by the reform do not show similar patterns of growth during the period. These results have relevant policy implications, as turnover taxes are very common around the world.

*Caprettini: Universitat Pompeu Fabra, Ramon Trias Fargas, 25-27, Barcelona, Spain 08005 (e-mail: bruno.caprettini@upf.edu). I would like to thank my advisors Paula Bustos and Antonio Ciccone for constant encouragement and support. I also received valuable comments from Ciccio Amodio, Alessandra Bonfiglioli, Fernando Broner, Vasco Carvalho, Gino Gancia, Gene Grossman, Eduardo Morales, Jacopo Ponticelli, Stephen Redding, Esteban Rossi-Hansberg, Alessandro Tarozzi, Joachim Voth, Chris Woodruff and seminar participants at CREI International Lunch, UPF and UAB PhD student seminars and CEPR PEDL Workshop. I carried out part of the project while I was a Visiting Student at the Department of Economics at Princeton University: I wish to thank Gene Grossman, Stephen Redding and everybody in the International Trade Section for their very kind hospitality. Also, I would like to thank Carlos Lessa and Luis-Carlos Pinto at the IBGE for their help to access the firm-level data. Financial support from the Private Enterprise Development in Low-Income Countries is also gratefully acknowledged. All errors are mine.

1 Introduction

Productivity differences between rich and poor countries are thought to depend in large part on misallocations of resources across firms. Policies that alter relative prices faced by different producers affect how resources are allocated in the economy, and can prevent productive sectors to expand (Jones (2011b)). Although misallocations have the potential to explain a large portion of cross-country differences in productivity (Hsieh and Klenow (2009)) empirical evidence relating actual differences in firms' productivity to observable policy distortions has been scarce. The main challenge faced by researchers is that the number of potential distortions in poor countries is large, and reforms directly aimed at eliminating some of them are rare. As a result, the size of distortions created by specific policies is often difficult to assess.

In this paper I exploit a fiscal reform in Brazil to provide direct empirical evidence of the distortions created by turnover taxes. Turnover taxes are business taxes that are levied at every stage of production, with no deduction for the cost of intermediate inputs. They hit disproportionately industries whose inputs account for a large share of the final value of production, and they create incentives to integrate vertically. Turnover taxes are very common around the world, especially in low income countries. As of 2013, 60 countries had some form of tax on turnover in place according to the World Bank, and 22 of them were classified as low income countries (World Bank (2012)). Although turnover taxes are generally thought to be very distortive (Diamond and Mirrlees (1971a); Diamond and Mirrlees (1971b); Jones (2011a); Keen (2013)), there is very little empirical research on them, and there is virtually no estimate of the magnitude of the distortions that this type of tax creates.[1]

I examine how Brazilian manufactures responded to a fiscal reform that eliminated two different turnover taxes. Between December 2002 and December 2003 the Brazilian government passed two separate reforms that converted two turnover taxes, *PIS* and *COFINS*, into two value added taxes (VATs), a type of tax that allows to deduct the cost of intermediate inputs and that for this reason does not hit sectors differentially. Using a difference-in-difference approach, I compare the different impact of the reform on sectors that use intermediate inputs intensively and on sectors in which intermediate inputs account for a lower share of the final value of production. I obtain a sectoral measure of intermediate input use that is not affected by the reform by taking the United States as a benchmark, and by assuming that the share going to intermediate inputs in U.S. sectors is a good proxy for the technical importance of intermediate inputs across any economy.

[1] Best et al. (2013) look at turnover taxes in Pakistan, but they document their advantages over a tax on profits in terms of tax enforcement.

Using data from the yearly Brazilian industrial survey over the period 1997-2009, I show that Brazilian sectors that rely more heavily on intermediate inputs grew faster after the reform in terms of employment, revenues and industrial sales. These results survive to the inclusion of other sectoral characteristics and they are concentrated only in the set of firms that are actually affected by the reform. I do not find significant growth in the sectors with higher intermediate input intensity before the reform, and the fact that I find faster growth also for employment suggests that changes in the incentives to misreport revenues or sales can not explain entirely the results. The implied elasticity to the tax is large, and the results have relevant policy implications, because these gains came at no expense for tax revenues.

The remainder of the paper is organized as follows. Section 2 provides some background and explains the 2002-2003 reform. Section 3 introduces the data used and section 4 presents the results. Section 5 concludes.

2 Background

Brazilian manufacturing firms are subject to a complex fiscal regime and have to pay several different taxes and contributions. This paper focuses on two of the social contributions paid by every manufacturing firm: the *Programa de Integração Social* (PIS: contribution for the social integration programme) and the *Contribuição para Financiamento da Seguridade Social* (COFINS: contribution for the funding of social security). Until 2002 these contributions were levied on the total value of turnover, with no deductions for the cost of intermediate inputs.[2] The tax rate of PIS was 0.65%.[3] When introduced in 1991, the tax rate of COFINS was 2%[4] and the rate was increased to 3% in 1998.[5]

Between December 2002 and December 2003 the Brazilian Federal Congress passed two separate laws that modified the regime of both PIS and COFINS. First, the Law no. 10637 of the 30th December 2002 allowed to deduct the cost of intermediate inputs from the the tax base of PIS, effectively converting it into a VAT.[6] The law also increased the tax rate of PIS by 1 percentage point, to 1.65%, in order to avoid a fall in fiscal revenues. Second, on the 29th of December 2003, Congress passed Law no. 10833, that allowed to

[2]PIS was introduced with the Complementary Law no. 7 on the 7th of September 1970. COFINS was created by the Complementary Law no. 70 on the 31st of December 1991; it replaced the existing Fundo de Investimento Social (FINSOCIAL) which had been introduced by the Decree no. 1940 of the 25th of May 1982 and abolished in 1991 by the same law that introduced COFINS.

[3]See clause 3 on the Complementary Law no. 7 of the 7th of September 1970 as modified by the clause 1 of the Complementary Law no. 17 on the 12th of December 1973.

[4]See clause 2 of the Complementary Law no. 70 on the 31st of December 1991.

[5]See clause 8 of the Law no. 9718 on the 27th of November of 1998.

[6]See clause 3 of the law. The law converted the Provisionary Measure 66 enacted by the Cardoso Government on the 29th of August 2002. It came into effect on the 1st of December 2002 (clause 68).

deduct the cost of intermediate inputs from the tax base of COFINS.[7] The new tax rate for COFINS was increassed from 3% to 7.6%, a number that was chosen by applying the same multiplier adopted to set the new rate of PIS under the VAT regime (roughly 2.53; see Werneck (2006) for a discussion about the debate that led to this choice).

The laws excluded from the new system a number of firms that continued paying PIS and COFINS as turnover taxes at lower rates. The most relevant of these exception concerns small firms that opt to pay taxes under a simplified tax regime called *SIMPLES*.[8] These firms were not allowed to adopt the new PIS and COFINS and still today pay them on the total value of their turnover at a rate of 0.65% and 3%. In my analysis I focus on firms that do not opt for SIMPLES and thus are affected by the reform.

The reforms were highly visible and publicized even to the general public. Moreover, firms pay both PIS and COFINS monthly, and they had incentives to adapt to the new system quickly after the reform. This may help explain the reason of the speed with which some of the outcomes reacted to the reform.

The stated objective of the reforms was to increase competitiveness of the Brazilian manufacturing sector, and the policies were strongly encouraged by the International Monetary Fund (IMF) as part of the agreements reached with the international organization to obtain recovery loans in the aftermath of the capital account crisis of 1998.[9] The reform was received with criticism by representatives of agriculture and the service sectors, who were worried that the savings generated by lower intermediate input taxation would be offset by the increase in the tax rate for firms that operated in in sectors where intermediate inputs do not account for a large share of the final value of production. In what follows I focus on manufacturing firms, which arguably stood to gain most from the reform.[10]

Finally, PIS and COFINS reforms can be analyzed together because the two laws were passed in a relatively short period. Moreover, the structure of PIS and COFINS was very similar before 2002, and the laws that modified them in 2002 and 2003 were similar in content, structure and even wording. Finally, the first of the two laws, beside modifying PIS, also contained the express provision that within one year the Government should present to the Congress a law proposal to turn COFINS into a VAT.[11] Thus, firms and

[7] See clause 3 of the law. The law converted the Provisionary Measure 135 enacted by the Lula Government on the 30th of October 2003. It came into effect on the 2nd of February 2004 (clause 93).

[8] SIMPLES was introduced on the 5th of December 1996 by the Law 9317. The system allows firms that report revenues below 720 thousand Brazilian Reais to opt for a simplified tax regime where most taxes are paid together, and tax rates are lower. The threshold below which firms can opt for the SIMPLES was raised to 1,2 millions Brazilian Reais by the law 9732 of the 11th of December 1998 and to 2,4 millions Brazilian Reais by the Law no. 11196, of the 21st of November 2005.

[9] See press releases IMF (2002) and IMF (2003), for instance.

[10] Note also that most of the sectors that could have lost due to the reform successfully lobbied and obtained either a reduction in the tax rate or the possibility to remain under the old regime.

[11] See clause 12 in the Law no. 10637 of the 30th December 2002.

the general public were expecting a change in COFINS already in 2002 when PIS was modified.

3 Data

I source firm and plant-level data from the *Pesquisa Industrial Anual*, (PIA), the Brazilian yearly industrial survey carried out by the *Instituto Brasileiro de Geografia e Estatística* (IBGE), the Brazilian National Statistical Office.

The survey contains yearly information for the years 1997 through 2009.[12] It covers formal firms operating in the manufacturing sectors, recorded under the *Classificação Nacional de Atividades Econômicas* (CNAE) codes 15 through 37 (corresponding to the ISIC, Rev.3 categories *C* and *D*).[13] Firms sampled in PIA are drawn from two strata. First, manufacturing firms employing 30 or more employees are sampled with probability 1 every year. Second, every year IBGE interviews a random sample of manufacturing firms employing between 5 and 29 workers. The sample is designed in order to be representative of the Brazilian manufacturing sector within Federal Units and 3-digits CNAE sectors, and for each firm in this second stratum IBGE computes expansion weights.[14] The database is an unbalanced panel, since anonimized fiscal identifiers allow to track firms from one year to another.

PIA is made of two parts. The first one, has information on firms, while the second one covers establishments. Both parts are designed after the U.S. Census of Manufactures (CM) and the Annual Survey of Manufactures (ASM). At the firm level, IBGE uses two different questionnaires for the two strata: firms that are sampled with probability 1 answer to a questionnaire that is more thourough than the questionnaire that is presented to firms that are sampled only probabilistically. Basic information on revenues, costs, employement, investments and whether or not the firm opted to pay taxes under the SIMPLES regime is available for firms in both strata.[15] Every firm that operates more

[12]The survey is available since 1996, but I exclude the first year because the *SIMPLES* regime was introduced only in 1997. As explained in section 2, the PIS and COFINS reform did not affect the firms that opted for the simplified regime *SIMPLES*. For this reason, I show all my results only looking at the group of affected firms, and drop the year 1996 where I can not identify firms that would opt for *SIMPLES*.

[13]CNAE classification changed twice during the years under study. In 2003, with the introduction of the ISIC Rev. 3.1, CNAE 1.0 replaced the original CNAE classification. In 2007, with the fourth revision of the ISIC, CNAE 2.0 replaced the CNAE 1.0. IBGE classifies all firms in PIA according to the current classification, and in order to construct a time consistent sector indicator I build a bridge across the three version of CNAE following the concordances suggested by the *Comissão Nacional de Classificação* (CONCLA), the Brazilian National Commission of Classifications.

[14]Every year, IBGE constructs the two strata of firms by using the administrative records kept by the Ministry of Labor in the *Relação Anual de Informações Sociais* (RAÍS), the yearly report of social information. The report is carried out yearly and covers the population of Brazilian formal employees (IBGE (2008)).

[15]Firms sampled with probability 1 report more disaggregated information on investments, work in

than one establishment reports information both for the whole firm and for each of the establishments that it owns. At the establishment level, PIA records information on the municipality where the plant is located, the revenues, costs and employment.

The PIA database contains a total of 483222 firm-year observations from 107790 unique firms. Of these, 364454 observations (or 75%) are from firms that are sampled with probability 1 and completed the longer questionnaire. Although these large firms account for around 21% of the total number of Brazilian manufacturing firms with 5 or more employees, they employ around 80% of the total manufacturing workers, and account for around 95% of total value of shipments.[16] The establishment database contains 242165 establishment-year observations, from 53685 unique establishments.[17] Table 1 presents descriptive statistics for both firms and plants.

4 Empirics

4.1 Baseline results

In this section I document how the conversion of PIS and COFINS into VATs led to a reallocation of production shares towards sectors that use intermediate inputs more intensively.

Turnover taxes distort the allocation of resources across sectors because, by taxing intermediate inputs, they effectively levy a higher tax rate on sectors that rely more on them. As a result, sectors that use relatively more intermediate inputs per unit of output grow less than they would absent the turnover tax. Since a VAT introduces no such distortion, the conversion of PIS and COFINS into VATs should lead sectors that use intermediate inputs more intensively to grow faster after the 2002-2003 reforms.

In order to test this prediction I adopt a difference-in-difference approach, and test whether sectors that are more intermediate intensive grow faster after the reform compared to sectors that are less intermediate intensive. I obtain a measure of "intermediate-intensity" that is exogenous to the structure of the Brazilian economy and to the 2002-2003 reform by using the United States as a benchmark. In particular, for every U.S. manufacturing sector, I use the NBER Productivity database (Bartelsman and Gray (1996)) to compute a measure of intermediate input intensity. This is constructed as the expendi-

progress and trade participation.

[16] Informal employment is very common in Brazil and PIA entirely misses it. The 2000 Brazilian Population Census records almost 8.8 millions people employed in manufacturing, which means that the 5 millions people covered by PIA in that year account for around 58% of the total employment in the sector.

[17] Of these, only 178637 observations are manufacturing establishments (38875 unique establishments): the others are commercial outlets of manufacturing firms.

ture on all materials except fuels and electricity divided by the total value of shipment.[18] Table 2 reports intermediate input intensity for all U.S. 4-digits manufacturing sectors.

I use this measure of intermediate intensity to explain the performance of Brazilian sectors with the following difference-in-difference specification:

$$y_{st} = \alpha_s + \alpha_t + \beta \cdot Post2002_t \times \text{Intermediate Intensity}_s + e_{st} \quad (1)$$

In (1) subscripts identify years (t) and 4-digits CNAE sectors (s). As dependent variable y_{st} I consider different measures of industrial performance (described shortly). On the right-hand side, α_t and α_s are year and sector fixed effects; $Post2002$ is a dummy equal to 1 every year between 2003 and 2009 and *Intermediate Intensity* is the share going to intermediate inputs in U.S. sectors described above. The coefficient of interest is β and I expect sectors that are more intermediate intensive to grow faster after the reform: $\beta > 0$.

On the left-hand side, I regress 4 different outcomes: the total number of workers employed in establishments operating in year t and sector s, the total value of revenues collected by establishments operating in year t and sector s, the total value of industrial goods sold by establishments operating in year t and sector s and the total number of establishments operating in year t and sector s.[19] Since the reform affected only firms that did not pay taxes according to the simplified tax regime SIMPLES I construct the four outcomes by using the information from firms that did not opt for this regime. These represent around 30% of Brazilian firms with at least 5 employees, but account for 97% of revenues and 75% of employment.

Consistent identification of β requires that sectors with different intermediate intensity were not following different paths before the reform (common trends assumption) and that the composition of sectors did not change differentially after the reform (this requires for instance that the fastest growing firms were not more likely to enter a specific sector

[18] More precisely, the measure of intermediate input intensity is calculated for every sector as the average between 1996 and 2002 of the total expenditure on materials (*matcost*) minus the value of fuel and electricity (*energy*), divided by the total value of shipments (*vship*). The NBER Productivity database is classified according to the NAICS 1997 sector classification, while plants and firms in the PIA database are classified according to the Brazilian CNAE, CNAE 1.0 or CNAE 2.0, depending on the year. I use the correspondence between NAICS 1997 and CNAE proposed by Muendler (2002) and the correspondences between CNAE and CNAE 1.0 and CNAE 1.0 and CNAE 2.0 proposed by the Brazilian CONCLA to bridge US sectors to Brazilian sectors between 1997 and 2009.

[19] In principle I would like to use only the total value of industrial sales, as turnover taxes affects primarily industrial production, while revenues include resales and revenues from business services. Unfortunately, PIA reports either industrial sales gross of taxes or after tax revenues. Since the 2002-2003 tax reform that converted PIS and COFINS into VATs increased the tax rate of both taxes, it is important to use a measure of sales that does not contain taxes neither before nor after the reform. For this reason I estimate industrial sales net of taxes following the procedure suggested by IBGE (2010) and report results both with this estimated variable and with the less correct (but directly observed) after tax revenue.

in response to the reform). Given the relatively long time series I am going to be able to present results that suggest that the common trends assumption is warranted in this setup.

Table 3 presents the estimates of equation (1). The 4 columns of the table report the estimates of β for the four outcomes analyzed: employment, industrial sales, revenues and number of firms. These coefficients are all positive and significant at the 1% level with the exception of the coefficient of the number of firms. The magnitude of the effect is large. The interquartile range of the intermediate intensity measure is 0.09, thus the point estimates in table 3 imply that, relative to the sector in the 25^{th} percentile (Manufacture of spirits), the sector on the 75^{th} percentile (Manufacture of knitted clothing) expanded employment by 6.12% more, revenues by 8.78%, industrial sales by 9.48% and the number of operating establishments by 3.14% (not significant). During the same period, the average manufacturing sector grew by 2.71% in employment, 4.13% in revenues and 4.14% in industrial sales.

4.2 Robustness

In this section I show that the results presented in table 3 are robust to a wide range of tests.

A first concern with the findings shown in section 4.1 is that the effect is entirely driven by a change in misreporting behavior of Brazilian firms induced by the reform. Pomeranz (2013) has shown that value added taxes facilitate tax enforcement by creating a paper trail on transactions between firms. Since the 2002-2003 Brazilian fiscal reform converted PIS and COFINS into VATs, it is possible that it also affected the incentives of Brazilian firms to misreport their revenues and sales. If firms operating in sectors that use intermediate inputs more intensively had greater incentives to misreport their activity with a turnover tax than with a value added tax, then the effect shown in table 3 would be driven by a change in misreporting behavior and not by real changes in the economy. Although it is not possible to exclude that the reform affected differentially the incentives to misreport, table 3 shows that the reform had an effect also on employment. Since the reform did not change the incentives to report employment truthfully, this result suggests that changes in the incentives to misreport revenues or sales can not explain all the findings, and that the reform had some real effects too.

A second concern with the results shown in table 3 is that the intensity of intermediate input use is correlated with other characteristics of sectors that affected their performance differentially. First, sectors that are more intensive in the use of capital may have benefited more of the quieter financial atmosphere during the recovery of the 1998 capital account crisis. Capital intensity and intermediate intensity are correlated (correlation = 31%,

significant $< 0.01\%$) and it is possible that the measure of intermediate intensity is picking up part of this variation after 2002. Also skill intensity is significantly correlated with intermediate intensity (correlation $= -29\%$, significant $< 0.01\%$) and, although it is not obvious why less skill intensive sector should grow less after 2002, one may still worry that the measure of intermediate intensity picks up some of the variation generated by skill intensity. In order to control for these possible omitted variable I augment regression (1) in the following way:

$$\begin{aligned} y_{st} &= \alpha_s + \alpha_t + \beta \cdot Post2002_t \times \text{Intermediate Intensity}_s + \\ &\quad + \gamma \cdot Post2002_t \times \text{K Intensity}_s + \delta \cdot Post2002_t \times \text{Skill Intensity}_s + e_{st} \end{aligned} \quad (2)$$

I compute both capital intensity and skill intensity using information in the NBER Productivity database and following the procedure proposed by Nunn (2007).[20] Table 4 reports the results of (2) for all outcomes including capital and skill intensity. All results shown in the previous section go through: the coefficients of interest remain significant, the point estimate increases in size slightly and the β on the number of firms becomes significant at the 10% level. In contrast, neither of the coefficients on the two new interactions is significant in any specification.

A third concern is that sectors that use relatively more intermediate inputs may have grown faster everywhere in the world, maybe driven by innovation or world demand. If the results shown in table 3 were replicated for the sectors in the United States, then we would worry that the effect documented above is not driven by the Brazilian tax reform but rather by some trend that is common around the world. In order to dispel this concern, I run regression (1) using the U.S. data on value of workers, shipments, and value added from the NBER Productivity database. I focus on the same period on which I ran regression (1) for Brazil and look only at the years between 1997 and 2009. Notice that the data are very comparable because the Brazilian PIA is designed after the US ASM survey, and the NBER Productivity database is constructed using yearly information from this source (Bartelsman and Gray (1996)). Table 5 reports the results for the 3 regressions run on US data. The table shows that sectors that relied on intermediate inputs did not experience faster growth in the US after 2002.

A fourth concern is that faster growth of sectors that use intermediate inputs more intensively is driven by a demand trend that is unrelated to the tax reform. For instance it is possible that sectors that use intermediate inputs more intensively are also sectors

[20] More precisely, I compute capital intensity as the natural logarithm of the real value of capital divided by value added between 1996 and 2002: *cap* / *vadd*. I compute skill intensity as 1 minus the percentage of wages to production worker in total payroll between 1996 and 2002: 1 - (*prodw* / *pay*). Note also that the results shown in table 4 are robust to adopting the definition of skill and capital intensity proposed by Levchenko (2007) instead (results available upon request).

that produce goods with higher income elasticity. Since real income has grown steadily in Brazil during the last decade, this may be driving the results shown in table 3. However, if a trend that is common to the whole Brazil is truly driving these results, then the effects documented in table 3 should be common to all the firms operating in Brazil, not only the ones affected by the reform. Since firms that opted for the SIMPLES were not affected by the reform, I can use the information coming from them to perform a simple test of whether firms operating in intermediate intensive sectors grew relatively faster after the reform even when they were not interested by the reform. Table 6 reports the test. It shows the coefficients of regression (1) when the outcome y_{st} are computed using the information from firms that opted to pay taxes according to the simplified tax regime SIMPLES. In this case all coefficients are statistically equal to 0. These results should be taken with care, because the firms that opted for SIMPLES are systematically smaller than the firms that did not opt for the SIMPLES, and thus they can not be considered a valid counterfactual for them. Nevertheless, the test is informative, because it allows to rule out the possibility that the results in table 3 are driven by an underlying trend that is common to the whole Brazil.

Finally, as mentioned in the previous section, the β reported in table 3 would not be a consistent estimate of the effect of the reform if sectors that use relatively more intermediate inputs were growing faster than other sectors already before the reform (the common trend assumption). PIA covers 6 full years before the reform (1997 through 2002), and thus it allows to perform a suggestive test of the common trends assumption. Table 7 reports the test. It shows the results of running regression (1) using only data between 1997 and 2002 and by assuming that a "placebo" tax reform happened in 1999. The coefficient reported in the table are thus the coefficient of the interaction $Post1999_t \times$ Intermediate Intensity$_s$, where $Post1999_t$ is a dummy variable equal to 1 for all years between 2000 and 2002. As table 7 shows, no significant growth can be found in sectors that use intermediate inputs more intensively before 2002. However, a possible critique to this test is that it is performed on a sample of sectors-years that is less than half of the sample used for the results reported in table 3. A more valid comparison would be with a regression performed over exactly 6 years that straddle the year of the reform. Table 8 shows the results of such a regression. It reports the coefficient of regression (1) using only data for the years 2000 through 2005 and the "correct" date for the tax reform (i.e. $Post2002_t$). Table 8 makes it clear that the insignificant effect estimated before 2002 can not be explained by the sample size, as regressions performed with roughly the same sample size in the correct period are all significant at the 5% level.

5 Conclusions

Misallocations of factors of production have the potential to explain a large portion of the cross-country differences in productivity (Hsieh and Klenow (2009), Restuccia and Rogerson (2008)). Yet, despite the potential importance of misallocations in explaining differences in development around the world, there is still scarce empirical evidence relating existing productivity differences to observable policy distortions. In this paper I exploit a fiscal reform that happened in Brazil between 2002 and 2003 to provide direct empirical evidence of the distortions introduced by some types of taxes. In particular, I focus on turnover taxes, a type of business tax that is levied on the full value of production rather than on the value added, and that for this reason hits more heavily those sectors in which intermediate inputs account for a larger share of the final value of production.

Using a difference-in-difference approach, I show that after the reform sectors that rely more on intermediate inputs grow faster in employment, revenues and industrial sales. The effect is not present when I look at a set of firms that was not affected by the reform, and does not appear to be driven by omitted sectoral characteristics nor existing pre-trends. To the extent that the new allocation of resources better reflects the technological possibilities of the Brazilian economy as well as the tastes of Brazilian consumers, the reform brought net welfare gains, because it did not reduce tax revenues. These results provide the first empirical quantification of the distortions introduced by turnover taxes, and they have relevant policy implication as these taxes are very common around the world.

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Tables

Table 1
Summary Statistics

	Firms			Multi-plant firms	
	SIMPLES	Non-SIMPLES		Firms	Plants
Firm-years	205'655	269'493	Observations	46'336	180'584
	Workers			Workers	
Mean	35	200	Mean	556	111
Median	28	66	Median	129	18
St. Dev.	54	796	St. Dev.	1774	413
	Revenues (million 2000 R$)			Revenues (million 2000 R$)	
Mean	0.56	27.55	Mean	94.61	25.53
Median	0.30	3.40	Median	8.39	0.78
St. Dev.	10.13	378.66	St. Dev.	892.14	217.55

Note: Source: *Pesquisa Industrial Anual* (PIA), years 1997-2009 (IBGE (2010)). The first two columns of the table reports summary statistics for number of observations, employment and revenues for all firms in the survey. The first column reports statistics for firms that opted for the simplified tax regime (SIMPLES) and the second column for firms that did not opt for it. The third column reports summary statistics for all firms that report more than one non-administrative establishment (multi-plant firms). The last column reports summary statistics for each establishment owned by a multi-plant firm.

Table 2
Intermediate intensity of 4-digits NAICS sectors

NAICS code	NAICS definition	Intermediate Intensity	NAICS code	NAICS definition	Intermediate Intensity
3241	Petroleum and Coal Products Manuf.	0.751	3359	Other Electrical Equip. and Component Manuf.	0.472
3361	Motor Vehicle Manuf.	0.712	3321	Forging and Stamping	0.469
3343	Audio and Video Equip. Manuf.	0.671	3332	Industrial Machinery Manuf.	0.468
3211	Sawmills and Wood Preservation	0.667	3353	Electrical Equip. Manuf.	0.464
3115	Dairy Product Manuf.	0.658	3114	Fruit and Vegetable Preserving and Specialty Food Manuf.	0.463
3116	Animal Slaughtering and Processing	0.648	3251	Basic Chemical Manuf.	0.462
3362	Motor Vehicle Body and Trailer Manuf.	0.641	3261	Plastics Product Manuf.	0.462
3131	Fiber, Yarn, and Thread Mills	0.632	3259	Other Chemical Product and Preparation Manuf.	0.459
3117	Seafood Product Preparation and Packaging	0.621	3262	Rubber Product Manuf.	0.457
3111	Animal Food Manuf.	0.610	3371	Household and Institutional Furniture and Kitchen Cabinet Manuf.	0.455
3161	Leather and Hide Tanning and Finishing	0.610	3342	Communications Equip. Manuf.	0.454
3314	Nonferrous Metal (except Aluminum) Production and Processing	0.608	3366	Ship and Boat Building	0.449
3312	Steel Product Manuf. from Purchased Steel	0.606	3326	Spring and Wire Product Manuf.	0.441
3313	Alumina and Aluminum Production and Processing	0.590	3399	Other Miscellaneous Manuf.	0.437
3141	Textile Furnishings Mills	0.586	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manuf.	0.437
3341	Computer and Peripheral Equip. Manuf.	0.578	3333	Commercial and Service Industry Machinery Manuf.	0.434
3363	Motor Vehicle Parts Manuf.	0.569	3325	Hardware Manuf.	0.431
3212	Veneer, Plywood, and Engineered Wood Product Manuf.	0.566	3113	Sugar and Confectionery Product Manuf.	0.428
3365	Railroad Rolling Stock Manuf.	0.563	3351	Electric Lighting Equip. Manuf.	0.425
3219	Other Wood Product Manuf.	0.557	3273	Cement and Concrete Product Manuf.	0.424
3369	Other Transportation Equip. Manuf.	0.556	3221	Pulp, Paper, and Paperboard Mills	0.417
3331	Agriculture, Construction, and Mining Machinery Manuf.	0.556	3346	Manuf. and Reproducing Magnetic and Optical Media	0.413
3324	Boiler, Tank, and Shipping Container Manuf.	0.549	3119	Other Food Manuf.	0.410
3252	Resin, Synth. Rubber, & Artificial Synth. Fibers & Filaments Manuf.	0.548	3329	Other Fabricated Metal Product Manuf.	0.408
3352	Household Appliance Manuf.	0.542	3169	Other Leather and Allied Product Manuf.	0.403
3222	Converted Paper Product Manuf.	0.536	3372	Office Furniture (including Fixtures) Manuf.	0.398
3133	Textile and Fabric Finishing and Fabric Coating Mills	0.530	3274	Lime and Gypsum Product Manuf.	0.392
3311	Iron and Steel Mills and Ferroalloy Manuf.	0.526	3231	Printing and Related Support Activities	0.382
3132	Fabric Mills	0.523	3315	Foundries	0.374
3255	Paint, Coating, and Adhesive Manuf.	0.519	3328	Coating, Engraving, Heat Treating, and Allied Activities	0.372
3149	Other Textile Product Mills	0.510	3256	Soap, Cleaning Compound, and Toilet Preparation Manuf.	0.370
3151	Apparel Knitting Mills	0.507	3279	Other Nonmetallic Mineral Product Manuf.	0.359
3334	Ventilation, Heating, Air-Conditioning, & Comm. Refrigeration Manuf.	0.506	3345	Navigational, Measuring, Electromedical, & Control Instr. Manuf.	0.351
3336	Engine, Turbine, and Power Transmission Equip. Manuf.	0.505	3335	Metalworking Machinery Manuf.	0.346
3162	Footwear Manuf.	0.499	3322	Cutlery and Handtool Manuf.	0.344
3379	Other Furniture Related Product Manuf.	0.497	3118	Bakeries and Tortilla Manuf.	0.344
3112	Grain and Oilseed Milling	0.493	3272	Glass and Glass Product Manuf.	0.336
3152	Cut and Sew Apparel Manuf.	0.493	3327	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manuf.	0.332
3323	Architectural and Structural Metals Manuf.	0.491	3391	Medical Equip. and Supplies Manuf.	0.305
3121	Beverage Manuf.	0.489	3344	Semiconductor and Other Electronic Component Manuf.	0.304
3339	Other General Purpose Machinery Manuf.	0.485	3254	Pharmaceutical and Medicine Manuf.	0.299
3159	Apparel Accessories and Other Apparel Manuf.	0.482	3271	Clay Product and Refractory Manuf.	0.286
3364	Aerospace Product and Parts Manuf.	0.475	3122	Tobacco Manuf.	0.151

Note: Source: NBER Productivity database (Bartelsman and Gray (1996)). Intermediate intensity is calculated for every sector as the average between 1996 and 2002 of the total expenditure on materials (*matcost*) minus the value of fuel and electricity (*energy*), divided by the total value of shipments (*vship*).

Table 3
The effect of the reform on sectoral allocation of production

	Employment	Revenues	Industrial Sales	Firms
*Post*2002×				
Intermediate Intensity	0.654***	0.976***	1.013***	0.349
	(0.235)	(0.285)	(0.281)	(0.243)
Sector FE (245 sectors)	Yes	Yes	Yes	Yes
Year FE (13 years)	Yes	Yes	Yes	Yes
Observations	2,978	2,978	2,978	2,978
R-squared	0.951	0.943	0.943	0.939

Note: The table reports OLS estimates of the coefficient β in equation (1) in the text. The units of observation are 4-digits CNAE sector-year. Employment is the natural logarithm of the total number of workers employed in establishments operating in year t and sector s. Revenues is the natural logarithm of the total value of after tax revenues collected by establishments operating in year t and sector s. Industrial sales is the natural logarithm of the after tax value of industrial goods sold by establishments operating in year t and sector s, where the after tax value of sales is estimated using the procedure suggested by IBGE (2010). Number of firms is the natural logarithm of the total number of establishments operating in year t and sector s. Intermediate intensity is calculated for every sector as the average between 1996 and 2002 of the total expenditure on materials (*matcost*) minus the value of fuel and electricity (*energy*), divided by the total value of shipments (*vship*). *Post*2002 is a dummy variable equal to 1 every year after 2002, and 0 otherwise. The source of dependent variables is *Pesquisa Industrial Anual* (PIA), years 1997-2009 (IBGE (2010)). The source of intermediate intensity is the NBER Productivity database (Bartelsman and Gray (1996)). Robust standard errors clustered at sector level are reported in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table 4
The effect of the reform on sectoral allocation of production
Robustness of results reported in table 3 to the inclusion of sectoral characteristics

	Employment	Revenues	Industrial Sales	Firms
*Post*2002×				
Intermediate Intensity	0.852***	0.968***	0.999***	0.488*
	(0.273)	(0.349)	(0.347)	(0.250)
Skill Intensity	0.130	-0.136	-0.156	0.146
	(0.243)	(0.266)	(0.266)	(0.212)
Capital Intensity	-0.095	-0.024	-0.025	-0.055
	(0.068)	(0.107)	(0.107)	(0.050)
Sector FE (245 sectors)	Yes	Yes	Yes	Yes
Year FE (13 years)	Yes	Yes	Yes	Yes
Observations	2,978	2,978	2,978	2,978
R-squared	0.951	0.943	0.943	0.939

Note: The table reports OLS estimates of the coefficient β in equation (2) in the text. The units of observation are 4-digits CNAE sector-year. Employment is the natural logarithm of the total number of workers employed in establishments operating in year t and sector s. Revenues is the natural logarithm of the total value of after tax revenues collected by establishments operating in year t and sector s. Industrial sales is the natural logarithm of the after tax value of industrial goods sold by establishments operating in year t and sector s, where the after tax value of sales is estimated using the procedure suggested by IBGE (2010). Number of firms is the natural logarithm of the total number of establishments operating in year t and sector s. Intermediate intensity is calculated for every sector as the average between 1996 and 2002 of the total expenditure on materials (*matcost*) minus the value of fuel and electricity (*energy*), divided by the total value of shipments (*vship*). Capital intensity is the natural logarithm of the average real value of capital divided by value added between 1996 and 2002: *cap* / *vadd*. Skill intensity is the average of 1 minus the percentage of wages to production worker in total payroll between 1996 and 2002: 1 - (*prodw* / *pay*). *Post*2002 is a dummy variable equal to 1 every year after 2002, and 0 otherwise. The source of dependent variables is *Pesquisa Industrial Anual* (PIA), years 1997-2009 (IBGE (2010)). The source of the intermediate intensity, capital intensity and skill intensity is the NBER Productivity database (Bartelsman and Gray (1996)). Robust standard errors clustered at sector level are reported in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table 5
The effect of the reform on sectoral allocation of production

Falsification test of results reported in table 3: checking for the effect on U.S. sectors

	Employment	Shipments	Value Added
*Post*2002×			
Intermediate Intensity	-0.059	0.014	0.149
	(0.127)	(0.154)	(0.163)
Sector FE (473 sectors)	Yes	Yes	Yes
Year FE (13 years)	Yes	Yes	Yes
Observations	6,149	6,149	6,149
R-squared	0.960	0.953	0.946

Note: The table reports OLS estimates of the coefficient β in equation (1) in the text when the dependent variables are constructed using U.S. data. The units of observation are 6-digits NAICS sector-year. Employment is the natural logarithm of the total number of employees working in year t and U.S. sector s (*emp*). Shipments is the natural logarithm of the total value of industry shipments in year t and U.S. sector s (*vship*). Value added is the natural logarithm of the value added by manufactures in year t and U.S. sector s. Intermediate intensity is calculated for every sector as the average between 1996 and 2002 of the total expenditure on materials (*matcost*) minus the value of fuel and electricity (*energy*), divided by the total value of shipments (*vship*). *Post*2002 is a dummy variable equal to 1 every year after 2002, and 0 otherwise. The source of dependent variables and intermediate intensity is the NBER Productivity database (Bartelsman and Gray (1996)). Robust standard errors clustered at sector level are reported in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table 6
The effect of the reform on sectoral allocation of production
Falsification test of results reported in table 3: checking for the effect on firms opting for the SIMPLES regime

	Employment	Revenues	Industrial Sales	Firms
*Post*2002×				
Intermediate Intensity	0.364	-0.224	-0.209	0.374
	(0.564)	(0.745)	(0.764)	(0.474)
Sector FE (245 sectors)	Yes	Yes	Yes	Yes
Year FE (13 years)	Yes	Yes	Yes	Yes
Observations	2,770	2,775	2,775	2,775
R-squared	0.881	0.772	0.771	0.919

Note: The table reports OLS estimates of the coefficient β in equation (1) in the text when the dependent variables are constructed using information from firms that did not opt for the simplified tax regime SIMPLES. The units of observation are 4-digits CNAE sector-year. Employment is the natural logarithm of the total number of workers employed in establishments operating in year t and sector s that did not opt for SIMPLES. Revenues is the natural logarithm of the total value of after tax revenues collected by establishments operating in year t and sector s that did not opt for SIMPLES. Industrial sales is the natural logarithm of the after tax value of industrial goods sold by establishments operating in year t and sector s that did not opt for SIMPLES, where the after tax value of sales is estimated using the procedure suggested by IBGE (2010). Number of firms is the natural logarithm of the total number of establishments operating in year t and sector s that did not opt for SIMPLES. Intermediate intensity is calculated for every sector as the average between 1996 and 2002 of the total expenditure on materials (*matcost*) minus the value of fuel and electricity (*energy*), divided by the total value of shipments (*vship*). *Post*2002 is a dummy variable equal to 1 every year after 2002, and 0 otherwise. The source of dependent variables is *Pesquisa Industrial Anual* (PIA), years 1997-2009 (IBGE (2010)). The source of intermediate intensity is the NBER Productivity database (Bartelsman and Gray (1996)). Robust standard errors clustered at sector level are reported in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table 7
The effect of the reform on sectoral allocation of production
Falsification test of results reported in table 3: checking for pre-existing trends

	Employment	Revenues	Industrial Sales	Firms
*Post*1999×				
Intermediate Intensity	0.330	0.453	0.443	0.007
	(0.213)	(0.300)	(0.299)	(0.229)
Sector FE (245 sectors)	Yes	Yes	Yes	Yes
Year FE (6 years)	Yes	Yes	Yes	Yes
Observations	1,393	1,393	1,393	1,393
R-squared	0.973	0.969	0.968	0.960

Note: The table reports OLS estimates of the coefficient β in equation (1) in the text when the regression is run on the years before the reform and the reform is supposed to happen in 1999. The units of observation are 4-digits CNAE sector-year. Employment is the natural logarithm of the total number of workers employed in establishments operating in year t and sector s. Revenues is the natural logarithm of the total value of after tax revenues collected by establishments operating in year t and sector s. Industrial sales is the natural logarithm of the after tax value of industrial goods sold by establishments operating in year t and sector s, where the after tax value of sales is estimated using the procedure suggested by IBGE (2010). Number of firms is the natural logarithm of the total number of establishments operating in year t and sector s. Intermediate intensity is calculated for every sector as the average between 1996 and 2002 of the total expenditure on materials (*matcost*) minus the value of fuel and electricity (*energy*), divided by the total value of shipments (*vship*). *Post*1999 is a dummy variable equal to 1 every year after 1999, and 0 otherwise. The source of dependent variables is *Pesquisa Industrial Anual* (PIA), years 1997-2002 (IBGE (2010)). The source of intermediate intensity is the NBER Productivity database (Bartelsman and Gray (1996)). Robust standard errors clustered at sector level are reported in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table 8
The effect of the reform on sectoral allocation of production
Robustness of results reported in table 3: the effect of the reform estimated on 6 years of data

	Employment	Revenues	Industrial Sales	Firms
*Post*2002×				
Intermediate Intensity	0.548**	0.789**	0.810**	0.309
	(0.232)	(0.382)	(0.374)	(0.203)
Sector FE (245 sectors)	Yes	Yes	Yes	Yes
Year FE (6 years)	Yes	Yes	Yes	Yes
Observations	1,395	1,395	1,395	1,395
R-squared	0.968	0.948	0.949	0.958

Note: The table reports OLS estimates of the coefficient β in equation (1) in the text when the regression is run on only 6 years (2000-2005). The units of observation are 4-digits CNAE sector-year. Employment is the natural logarithm of the total number of workers employed in establishments operating in year t and sector s. Revenues is the natural logarithm of the total value of after tax revenues collected by establishments operating in year t and sector s. Industrial sales is the natural logarithm of the after tax value of industrial goods sold by establishments operating in year t and sector s, where the after tax value of sales is estimated using the procedure suggested by IBGE (2010). Number of firms is the natural logarithm of the total number of establishments operating in year t and sector s. Intermediate intensity is calculated for every sector as the average between 1996 and 2002 of the total expenditure on materials (*matcost*) minus the value of fuel and electricity (*energy*), divided by the total value of shipments (*vship*). *Post*2002 is a dummy variable equal to 1 every year after 2002, and 0 otherwise. The source of dependent variables is *Pesquisa Industrial Anual* (PIA), years 2000-2005 (IBGE (2010)). The source of intermediate intensity is the NBER Productivity database (Bartelsman and Gray (1996)). Robust standard errors clustered at sector level are reported in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.