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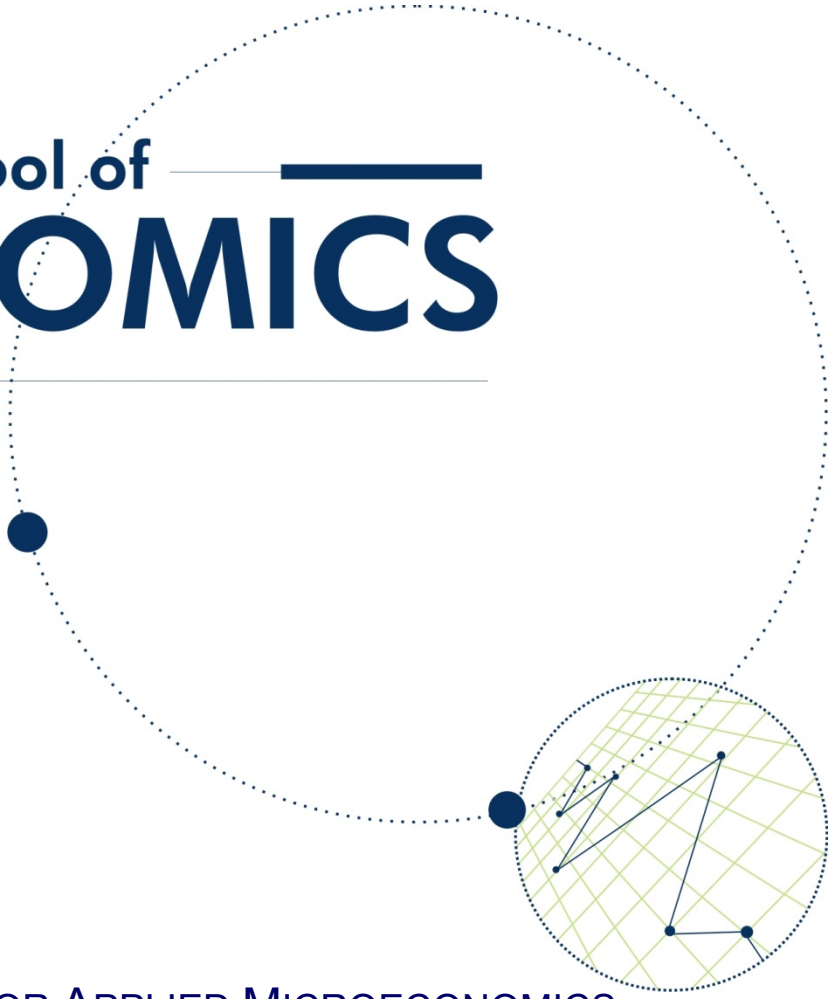

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Structural change, productivity growth and trade policy in Brazil

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Understanding the key factors that induce economic growth is certainly one of the most important topics in development economics. As there is no consensus on what those factors are, growth-enhancing policies in developing countries have varied substantially over time and across countries. Recently, McMillan and Rodrik (2011) have provided some empirical evidence on the relationship between movements of workers across sectors and economic growth for several countries over the last decades. They name this phenomenon as a 'structural change.' Their findings suggest that periods of rapid economic growth were those in which the labor force migrated from less productive sectors, such as agriculture, to more productive ones, like the industrial sector. In this paper, we use their insight and dig deeper into the Brazilian economy's recent history. In particular, we provide detailed evidence of how productivity evolved over time between and within sectors of the Brazilian economy from 1950-2005. We also use household level micro data for 1995-2005, in order to understand the main factors behind the relative slowdown of productivity during this period compared to the post-war 'golden period.' Our findings suggest that Brazil experienced a structural change from 1950 to 1970, a time when diversifying and industrializing the Brazilian economy was important. Following this period, the role of structural change to explain economic growth seemed to have had a limited scope. We show that the sectors that recently faced the highest increases in productivity were those with a workforce that experienced increased schooling levels and decreased informality at faster rates than the rest of the country. We interpret this as evidence of the important role that within-sector productivity growth has had in explaining overall productivity growth within the Brazilian economy.

Understanding the key factors that induce economic growth is certainly one of the most important topics in development economics. As there is no consensus on what those factors are, growth-enhancing policies in developing countries have varied substantially over time and across countries. It is not clear, however, whether these policies have worked for all countries in all periods, as some policies may be effective only under specific circumstances.

In a recent paper, McMillan and Rodrik (2011) decompose economic growth into two components. The first component, named "structural change," corresponds to the impact on total productivity coming from sectoral rearrangements of the labor force from low productivity sectors to high ones. The second component of economic growth, the "within-sector" component, corresponds to overall increases in productivity within sectors. McMillan and Rodrik (2011) have provided some empirical evidence on the relationship between structural change (movements of workers across sectors) and economic growth for several countries over the last decades. Their findings suggest that periods of rapid economic growth were those in which the labor force migrated from less productive sectors, such as agriculture, to more productive ones, like the industrial sector. Given that structural changes may have a direct impact on economic growth, policies that promoted these types of sectoral rearrangements can be understood as growth-enhancing policies.

In this paper, we use McMillan and Rodrik's (2011) insight to provide detailed evidence of how productivity evolved over time between and within sectors of the Brazilian economy during the period from 1950-2005. In particular, we use household level micro data for 1995-2005 to understand the main factors behind the relative slowdown of productivity during this period compared to the post-war 'golden period.' Our findings suggest that structural change was the main force behind the diversification and growth of the Brazilian economy for the period between 1950 and 1970. However, after that period, most of the increase in productivity came from the within-sector component.

After a decade of mediocre growth during the 1980s, the Brazilian economy's prosperity resumed with a re-integration into international markets after a long period of economic isolationism. Such unilateral movement was initiated during the late 1980s and was fundamental for growth recovery. In particular, the trade openness introduced in the late 1980s and early 1990s, had an important impact on productivity, as was documented by Ferreira and Rossi (2003).

In that sense, a more successful growth-enhancing strategy during the 1970s and 1980s would most likely have been to promote increases in productivity within sectors by means of investment in human capital and exposure to foreign competition. This diagnosis is in line with some analyses of the Brazilian economy in the early 1970s that professed that the government should have invested in general human capital formation, as the returns on education were much higher than those from physical capital. (Langoni, first edition: 1973, third edition: 2005).

The interpretation that policies oriented to overall increases in productivity could have been far superior after the 1970s relies on the prescription that follows policies supporting infant industries. Helpman and Krugman (1985), for example, point out that in an economy with imperfect competition and scale economies, government can create a big-push for the industrial sector, by protecting less competitive sectors from international competition. This would allow the industrial sector to grow relatively to the other sectors. Once it would gain a certain scale, the economy would be able to compete with foreign companies. However, after that initial period, protection would become costly in terms of social welfare.

McMillan and Rodrik (2011) show that between 1990-2005, Asian countries experienced productivity-enhancing structural changes, whereas African and Latin American countries did not experience the same changes. A possible interpretation of these findings would be that for the Brazilian case, economic reforms towards openness could have negatively affected economic growth. Rationale for this type of interpretation is that openness can potentially trap a developing economy and keep it specialized within sectors with comparative advantages, like agriculture and mining, but with low productivity levels. This is certainly true for countries that had not suffered a structural change before trade openness, as is the case of most African countries. However, for an emerging economy, such as Brazil, reintegration into the world economy helped its economy improve productivity within each sector as incentives were created to adopt efficient technologies not only in the export-driven sectors, but also in the manufacturing one (Ferreira and Rossi, 2003).

Given the empirical evidence of the benefits that trade liberalization have on the Brazilian economy in terms of productivity (Muendler, 2004, and Ferreira and Rossi, 2003) and in terms of inequality reduction (Gonzaga, Menezes-Filho and Terra, 2006); and our findings on a decrease in the importance of the structural change component to productivity, we interpret the relative slowdown of the Brazilian economic growth from

1995-2005 as an upper bound for growth. Without the liberalization process, the most likely scenario for the country's economic performance would have been worse.

This paper is divided into six sections, including this introduction. In the next section we present an overview on the Brazilian institutional background, highlighting how Brazil changed from an autarky to a more open economy. In order to do this, we discuss the development of trade policies in some detail. We then describe the data we used to decompose productivity growth into the two components of interest. Following this, we address the way in which we precisely define how we measure those decomposition components, giving particular emphasis to measures of structural changes and productivity. The final sections present our main results and conclusions.

Institutional Background

Import Substitution System and the beginning of industrialization

Between 1950-2005 in Brazil, the share of workers participating in the agriculture sector dropped from 63 percent to 19 percent (Timmer and de Vries, 2009). Throughout the course of a few decades the population in the country fled rural areas in exchange for urban ones and an internal market emerged. Overall, one can say that Brazil experienced a structural change during this period. The country experienced an intense and fast process of industrialization and urbanization driven by external constraints and internal market growth.

The process of industrialization began in the 1930s as a consequence of chronic current account deficits (Abreu, 2000). As dollars started to become scarce in Brazil after the Great Depression, imported consumption goods and production inputs were in shortage. In fact, the scarcity of those imported goods generated incentives for the Brazilian economy to promote the substitution of foreign industrial goods for their domestic counterparts. The systematic process of substitution became a policy goal in the post-war era and was named the Import Substitution System (ISS). It is fair to say that this process was at the heart of Brazilian industrial policies until the end of the 1970s.

Baer (1964) argues that industrialization should be viewed against a background of declining income coming from Brazil's traditional exports, which consisted mainly of coffee, cocoa, sugar, and cotton. For the author, at least initially, the ISS did not consist of a conscious state program, but was a natural response for problems with the national current account. However, by the 1950s a set of policies were applied with the explicit objective of protecting Brazilian industries from foreign competition. Among these policies Baer (1964) emphasizes the creation of systems of multiple exchange rates and import licensing. The establishment of "the law of similar" was also significant in that manufacturers who were producing, or even intended to produce, goods similar to the ones being imported, could apply for protection.

As a result of such measures, the share of agriculture in the net domestic product declined from 27 percent in 1947 to 22 percent in 1961, while industry increased from 21 percent to 34 percent during the same period (Baer, 1964). Another important consequence of this shift was a strong flow of migration from rural areas to cities. Fields (1977) argues that the urbanization process explains much of the reduction in poverty observed between 1960 and 1970. Earnings became higher in urban areas than in rural areas, as well as higher in the industrial sector than in the agriculture sector. As a result, Brazil experienced a shift in its income distribution and a reduction of poverty led by the transfer of the population from rural areas and the agriculture sector to urban areas and the industrial sector. However, since the industrialization process did not affect the whole population, a rapid industrialization process may also have contributed to increased earnings inequality, as the sectoral wage gap increased (Fishlow, 1972; Fields, 1977 and Langoni, 2005).

Although the labor force migrated to urban areas and the manufacturing sector expanded, which had a direct effect on productivity growth, Baer, Fonseca and Guilhoto (1987) also point out a second source of increase in productivity. The authors mention that a strong process of vertical integration had been occurring since the early 1950s. It is worth noting, however, that the efficiency gains from rearrangements in the production chain were not alone responsible for increasing the country's economic autarky. On the contrary, increased vertical integration occurred at the same time as the degree of the outward-orientedness of the Brazilian economy increased. This was especially observed from the point of view of the export share of various industrial sectors.

The end of using the ISS as an instrument for economic policy coincided with the long recession of the 1980s, which began after the two Oil Crises, created large deficits on the current account and hyperinflation (Abreu, 2004a). Within this context, the political support and economic basis for the ISS was no longer available and a new trade policy was needed for recovering the path of productivity growth. In the late 1980s, after the installation of the democratic regime, Brazil experienced an intense and fast-paced process of unilateral trade liberalization.

Trade liberalization

We follow the characterization proposed by Kume (2003) regarding the Brazilian trade protection system enforced until the late 1980s. According to him, the system had four main aspects: a) the widespread presence of tariffs with redundant plots; b) the collection of various additional taxes; c) an extensive use of Non Trade Barriers (NTB), such as a list of products with the issuance of a suspended import tab prior authorizations specific to certain products (steel, computers), and annual quotas for the import company; and d) the existence of 42 special regimes, allowing the exemption or reduction of taxes.

The Brazilian trade liberalization experiment consisted of three distinct phases from 1988 to 1994. Between 1988 and 1989 tariffs were decreased –even though they were kept higher than initially proposed–; the collection of taxes on some imports, such as those created to fund ports' maintenance, was abolished; and special import regimes were partially eliminated.

During the second phase from 1991 to 1993, tariffs fell heavily. Virtually all products experienced drastic reductions in tariffs, except for sectors that included information technology, fine chemical, automobiles, and others considered high-tech. However, it was the elimination of NTBs that caused the greatest impact in terms of openness. Abreu (2004b) and Kume et al. (2003) emphasize that this was the period during which the list of products being issued suspended import licenses was extinguished. Also occurring during this three-year period was the full abolishment of special import regimes and import programs for companies. It was only after the end of NTBs that tariffs in fact became the main instrument of trade protection and directly reflected a degree of protection for each industry.

The third stage of this process occurred in 1994 and followed monetary stabilization. Import tariffs were set at zero or two percent for products with greater weight on the price index and the anticipated duration of the Mercosur Common External Tariff, scheduled for 1995. Thus, by 1994 tariff rates in Brazil averaged 10.2 percent, a level that is compatible with other developing economies open to international trade (Abreu, 2004b, Kume et al., 2003).

Ferreira and Rossi (2003) analyzed the effects of trade liberalization and concluded that observed tariff reduction in the period brought a six percent increase in the Total Factor Productivity (TFP) and had a similar impact on labor productivity. Kovak (2011) provides some evidence that the exogenous fall in prices of final goods produced within sectors, directly affected by trade liberalization, had an impact on sectoral employment and earnings. Nevertheless, internal migration was not affected, as the population of Brazilian states increased or decreased by only 0.5 percent due to this process.

In the next section, we present the data used to investigate how policies such as the ISS and the trade liberalization of the 1990s may have accelerated or blocked the structural change process initiated in post-war period Brazil

Data

Our data come from two sources: Groninger Data, which is data from the Groninger Growth and Development Centre (Timmer and de Vries, 2009), and the PNAD (Portuguese acronym for *Pesquisa Nacional por Amostra de Domicílios*).

The PNAD is the annual Brazilian Household Survey, collected by the IBGE (Brazilian Census Bureau). The PNAD covers the whole country, with the exception of some rural areas. It is the largest and most important Brazilian household survey, interviewing more than 75,000 households every year, which corresponds to about 300,000 individuals. We have used several PNAD waves, beginning with 1993 and ending with 2008. The advantage of using the PNAD is that we have information about several demographic and labor characteristics for individual workers including gender, years of schooling, tenure, weekly hours worked and some other variables. Finally,

Groninger Data provides us with the number of employees and the Gross Value Added of each economic sector from 1950 to 2005.

We aggregate sectors into eight major groups: Agriculture, Forestry and Fishing; Mining and Quarrying; Manufacturing; Construction; Wholesale and Retail Trade/ Hotels and Restaurants; Public Utilities; Transport, Storage and Communication; Financial and Personal Services.

Methodology

For the Groninger Data, we define productivity in sector *i* at time *t* as the logarithm of the share of the gross value added per capita in the overall economy. Mathematically, we have,

$$P_{t,i,GR} = \ln\left(\frac{VA_{t,i,GR}}{L_{t,i,GR}} \Big/ \frac{VA_{t,GR}}{L_{t,GR}}\right)$$

$$= \ln\left(\frac{VA_{t,i,GR}}{L_{t,i,GR}}\right) - \ln\left(\frac{VA_{t,GR}}{L_{t,GR}}\right) = \ln\left(\frac{VA_{t,i,GR}}{VA_{t,GR}}\right) - \ln\left(\frac{L_{t,GR}}{L_{t,i,GR}}\right), \quad (1)$$

where 'ln' is the natural logarithm operator, *P* refers to the productivity level, *t* denotes the year, *i* the economic sector, GR means Groninger Growth and Development Centre, *VA* means Gross Value-Added, *L* means number of workers employed, such that $VA_{GR} = \sum_{j=1}^{9} VA_{j,GR}$ and $L_{GR} = \sum_{j=1}^{9} L_{j,GR}$.

For the PNAD we do not observe the productivity of each sector. Therefore, we assume that productivity can be approximated by wages paid in each sector. Thus, our measure of productivity of an individual worker *m* will be the logarithm of her hourly wage. In other words,

$$P_{m,t,i,PNAD} = \ln(Hourly\ Wage_{m,t,i,PNAD}). \quad (2)$$

Although Equation (2) may not be an accurate measure of productivity, in equilibrium we expect that labor productivity equals wages. In this sense, we expect that a strong correlation between productivity and hourly wages should at least exist.[3]

Given our measures of productivity, we can implement McMillan and Rodrik's (2011) decomposition of time changes in productivity, ΔP_t, through two terms: a 'structural' and a 'within' component.

$$\Delta P_t = \sum_{i=9} \theta_{t,i} \Delta P_{t,i} + \sum_{i=9} P_{t,i} \Delta \theta_{t,i}, \quad (3)$$

where $P_{t,i}$ denotes the sectoral labor productivity level and $\theta_{t,i}$ is the share of employment in sector i. The Δ operator designates time changes in productivity or employment shares between *t*-1 and *t*.

Equation (3) allows us to decompose the productivity change into two terms: the first one is the "within effect," in which we keep constant the initial labor share and measure variation coming from sectoral labor productivity. The second term, defined as "structural change," captures changes in labor shares across sectors, once we keep the final productivity level of each sector constant.

In the next section, we show the results of the Rodrik-McMillan decomposition in reference to the Brazilian case for several different time periods.

Results

Table 1 shows some descriptive statistics for the Brazilian labor force from 1993 to 2008. In general, half of Brazilian workers do not have formal contracts and their earnings in real terms were kept constant throughout the period. Also, we observe a huge increase in years of schooling, changing from six years to more than eight years on average. Moreover, there seems to be an increase in the participation of women and non-white workers in the labor market.

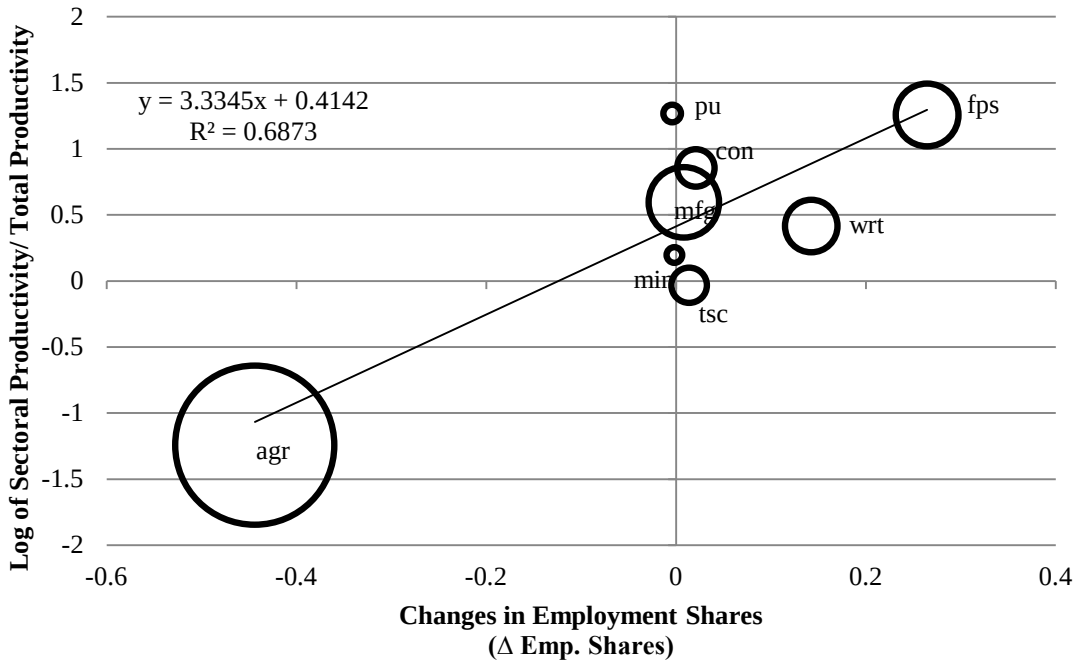
Table 1 - Descriptive statistics

	1993-1995	1996-1997	1998-1999	2002-2003	2004-2006	2007-2008
Formal Contract Employees	0.505	0.500	0.496	0.511	0.526	0.552
Employed	0.920	0.906	0.882	0.883	0.891	0.908
Earnings	963.53	1064.34	1020.95	917.06	932.89	1022.51
White	0.567	0.570	0.563	0.547	0.525	0.509
Male	0.644	0.630	0.620	0.603	0.594	0.589
Age	34.085	34.367	34.641	35.168	35.472	36.054
Weekly Hours	43.528	43.528	43.327	43.170	42.683	42.146
Rural area	0.161	0.157	0.158	0.118	0.127	0.120
Tenure	84.240	85.857	86.439	86.297	86.961	88.633
Experience (Years)	21.275	21.121	21.538	21.687	21.755	21.915
Schooling Years	6.098	6.437	6.726	7.504	7.924	8.309
North Region	0.045	0.045	0.047	0.056	0.072	0.072
South Region	0.161	0.162	0.162	0.159	0.157	0.157
Southeast Region	0.480	0.476	0.471	0.468	0.459	0.456
Central-West Region	0.072	0.074	0.076	0.076	0.077	0.078
Northeast Region	0.243	0.243	0.244	0.240	0.236	0.236

Source: PNAD

The positive correlation is even stronger for the first period, between 1950 and 1964 (regression coefficient=17.25; R^2=0.74; n=8), as shown in Figure 2. This period benefited from a rapid urbanization process with a large share of the labor force fleeing from rural areas. We characterize this period as the 'golden age' for structural change.

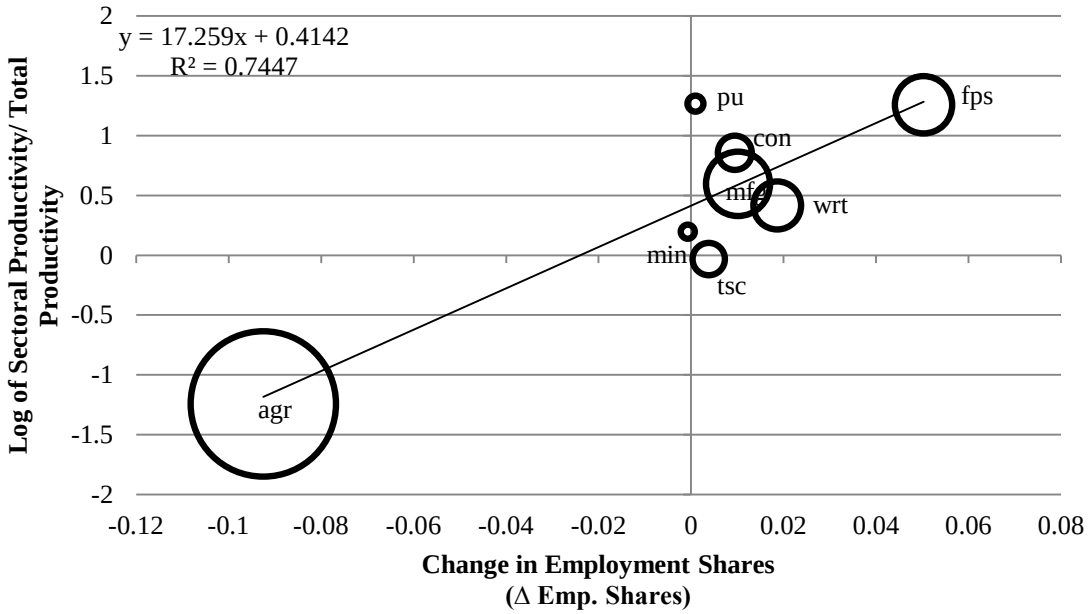
Figure 1 – Correlation between Sectoral Productivity and Changes in Employment Shares in Brazil (1950-2005)



Source: Timmer and de Vries, 2009
Notes: Size of circles represents employment shares in the initial year.
The line represents fitted values of a linear regression of changes in sectoral productivity by changes in employment shares.
Abbreviations: (agr) Agriculture, (min) Mining, (mfg) Manufacturing, (pu) Public Utilities, (con) Construction, (wrt) Wholesale Trade, (tsc) Transport and Communication, (fps) Financial and Personal Services

We then present some evidence regarding the pattern of structural change in Brazil from 1950 to 2005, by breaking this timeframe down into several different periods. Figure 1 shows that for the whole period, Brazil experienced a classical structural change, as there is a positive correlation (regression coefficient=3.33; R^2=0.68; n=8) between sector productivity and changes in employment shares. In other words, during this period of more than 50 years, the labor force migrated to more productive sectors.

Figure 2 - Correlation between Sectoral Productivity and Changes in Employment Shares in Brazil (1950-1964)



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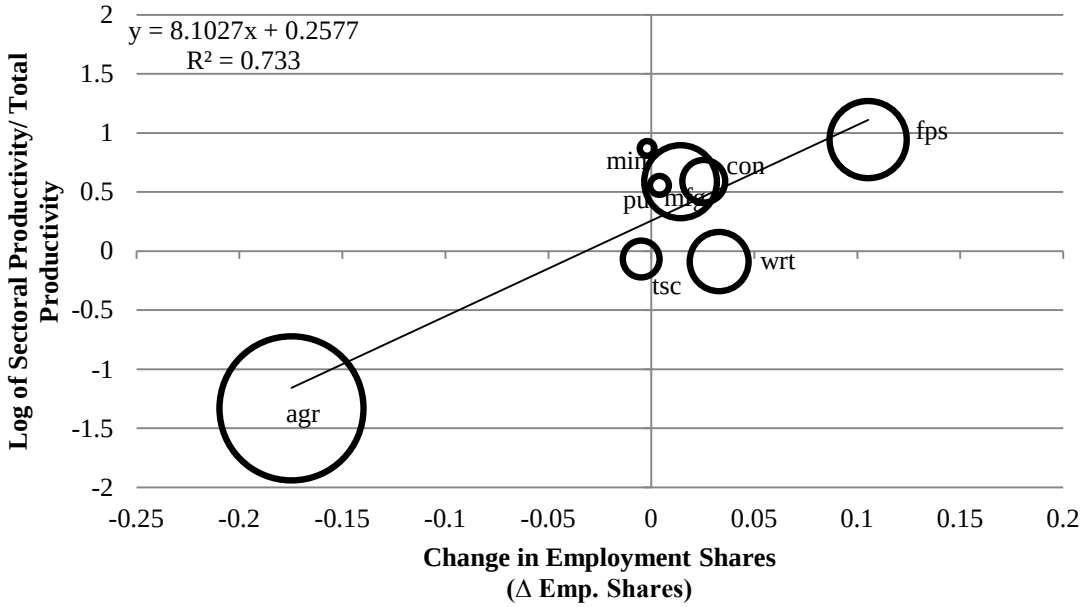
We can see that the correlation between sector productivity and changes in employment shares became progressively weaker as time passed. In fact, rapid inspection of Figures 3 to 5, that present disaggregated evidence for the periods 1965-79, 1980-94 and 1995-2005, reveals that the fitted line gets closer to a null-slope line for more recent years.

Figure 3 - Correlation between Sectoral Productivity and Changes in Employment Shares in Brazil (1965-1979)



Source: Timmer and de Vries, 2009
Notes: Size of circles represents employment shares in the initial year.
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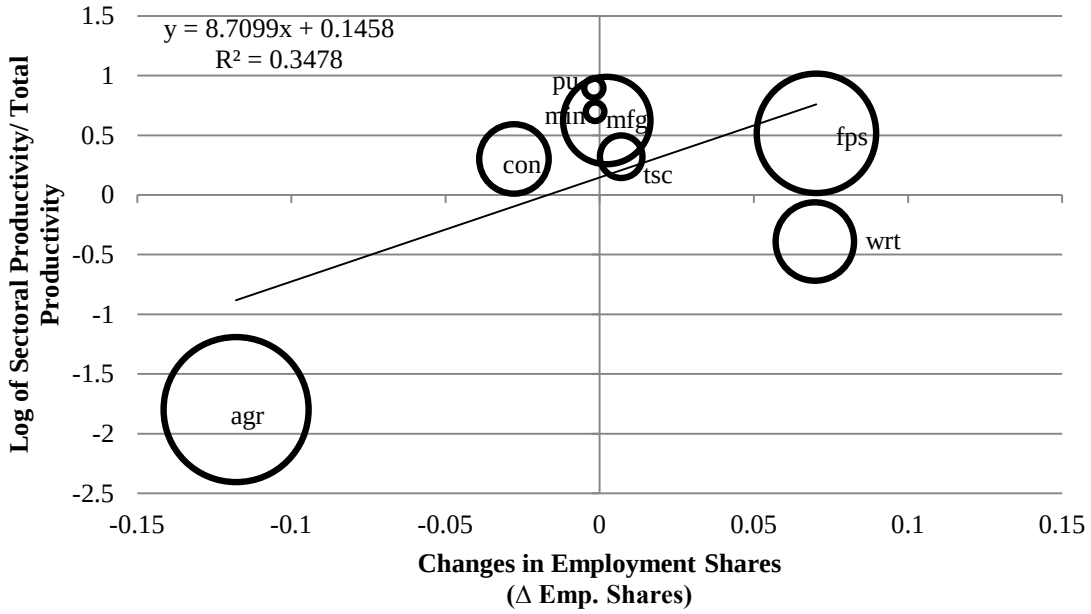
McMillan and Rodrik (2011) estimated the components of Equation (3) and showed that most of productivity gains in Latin America from 1990 to 2005 were due to the within effect and came little from the structural change component. Their interpretation of the findings is that the region was suffering from a reverse structural change, during which the labor force migrated from the most to the least productive activities. This interpretation is not necessarily true for the Brazilian case. In fact, informality, which is associated with low productivity jobs, and the percentage of workers who live in rural areas have slightly decreased over the period (see Table I).

Figure 4 - Correlation between Sectoral Productivity and Changes in Employment Shares in Brazil (1980-1994)



Source: Timmer and de Vries, 2009
Notes: Size of circles represents employment shares in the initial year.
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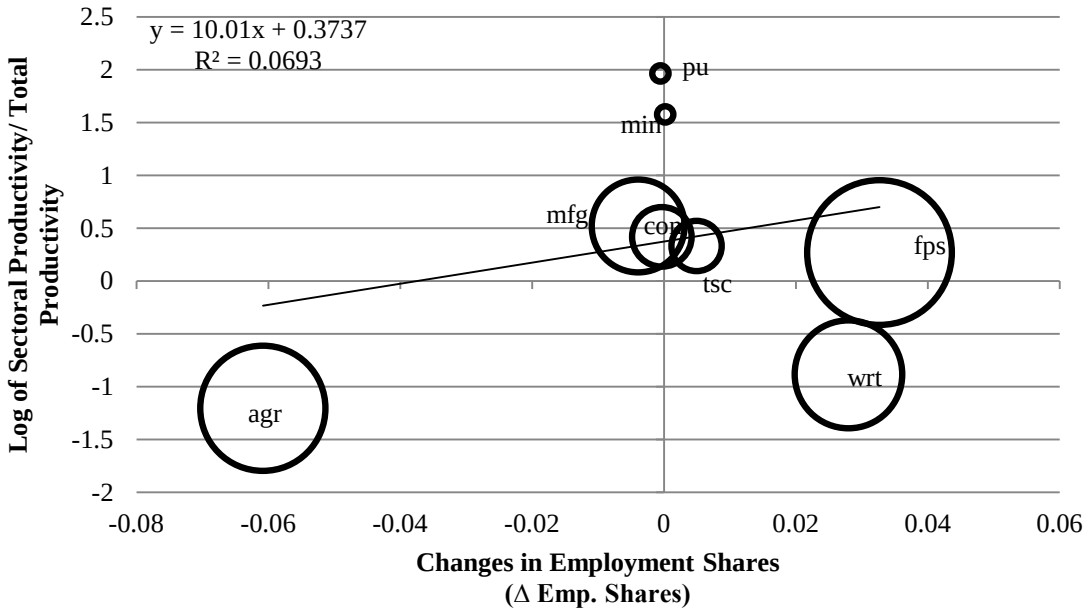
Finally, but not less interestingly, we note that in all figures, the manufacturing sector is not, as was customarily thought, the highest productivity sector. This sector was also not the main attractor of the labor force. For all years, the service sectors, including the Financial and Personal Services or the Public Utilities sector, were the most productive. At the same time, these sectors mostly attracted displaced workers from rural areas. Indeed, employment shares in the Manufacturing sector have remained basically constant for the entire period.

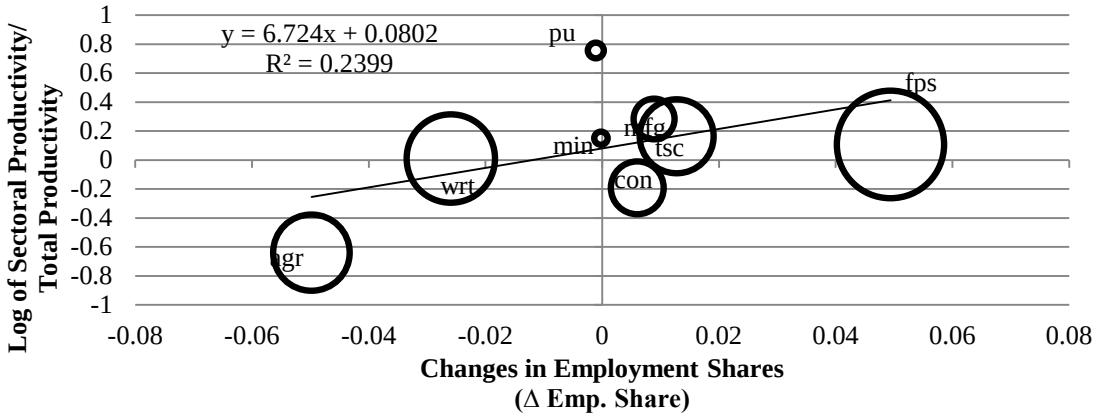
Figure 5 - Correlation between Sectoral Productivity and Changes in Employment Shares in Brazil (1995-2005)



Source: Timmer and de Vries, 2009
Notes: Size of circles represents employment shares in the initial year.
The line represents fitted values of a linear regression of changes in sectoral productivity by changes in employment shares.
Abbreviations: (agr) Agriculture, (min) Mining, (mfg) Manufacturing, (pu) Public Utilities, (con) Construction, (wrt) Wholesale Trade, (tsc) Transport and Communication, (fps) Financial and Personal Services

Figure 6 provides evidence for the period from 1993-2008 using PNAD data. In this figure, we can see a consistency in our results, when compared to Figure 5. Even changing the data set, we can see that there is a positive, but very weak correlation (regression coefficient is 6.72, R^2=0.24 and n=8) between sector productivity and changes in employment shares for that period.

Figure 6 - Correlation between Sectoral Productivity and Changes in Employment Shares in Brazil (1993/95-2007/08)-PNAD



Source: PNAD

Notes: Size of circles represents employment shares in the initial year.
The line represents fitted values of a linear regression of changes in sectoral productivity by changes in employment shares.
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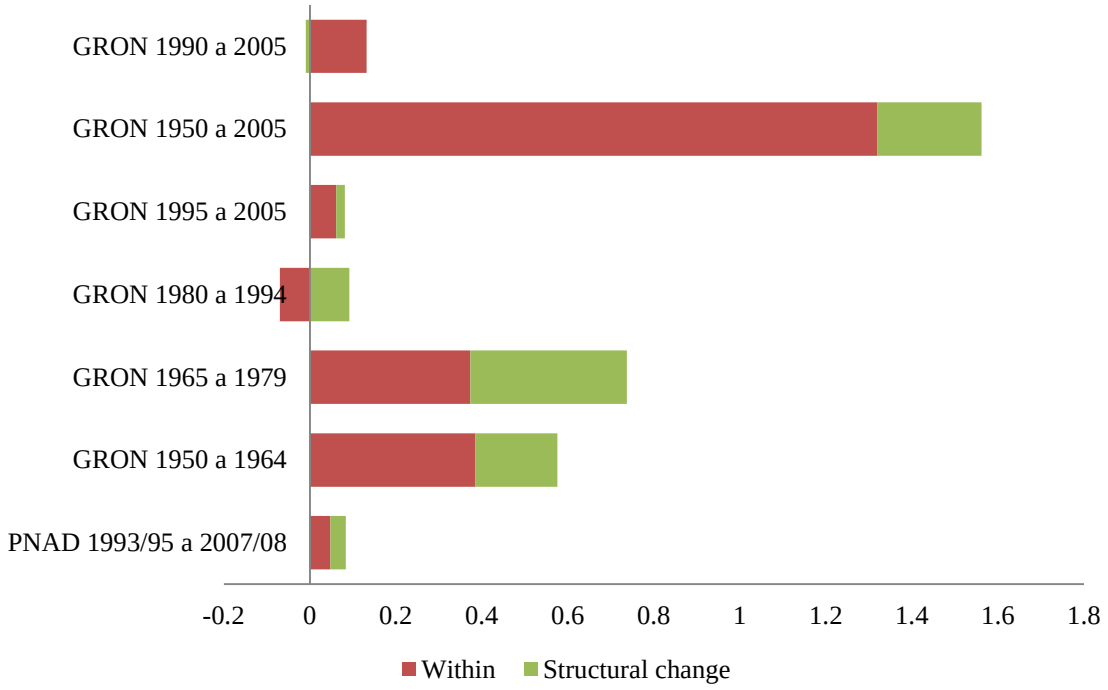
The decline in the 'structural change' effect over time might serve as evidence that policies, like the Brazilian ISS, that protected some specific sectors have lost effectiveness when compared to the first several post-World War II years. Although the agriculture sector still employs almost 20 percent of the labor force, it is no longer a net supplier of workers. Therefore, in more recent years, the most effective policies oriented at promoting economic growth in an emerging economy like Brazil, a country that has already suffered a 'structural change,' seem to be policies oriented at increasing within-sector productivity for all economic sectors.

This interpretation is endorsed by empirical evidence. We performed an estimation of Equation (3) for several periods. Figure 7 graphically summarizes our findings. For the entire period from 1950-2005, the within-sector effect was four times larger than the structural change effect. The two effects reached about the same magnitude only for the periods of 1950-1964 and 1965-1979. The period from 1980 to 1994, which includes the end of the autarkic regime, was the worst period in terms of productivity growth. In fact, during those years the Brazilian economy experienced a within-sector productivity decrease and mediocre overall growth. Only after the

consolidation of the trade liberalization process, did the Brazilian economy recover its productivity growth. For the period between 1995 and 2005, most of the growth was due to increases in the within-sector component of productivity changes.

As can also be noted in Figure 7, the period analyzed by McMillan and Rodrik (2011), ranging from 1990 to 2005, is the one in which there was no structural change. All observed changes in productivity came from the within-sector component. One possible explanation for the growth led by the within effect, is that the economy became more exposed to international competition during this period. Muendler (2004) also observed evidence regarding this pattern. The author verified a modest (but positive) impact of trade liberalization on the elimination of inefficient firms and an increase in productivity.

Figure 7 - Decomposition of productivity growth by period and database



Source: PNAD; Timmer and de Vries, 2009

Using PNAD data, we investigate the main forces driving structural and within sector changes in productivity for the period 1993 to 2008. Tables 2 through 5 present some information, by economic sector, from 1993-95 and 2007-2008.

Table 2 relates the average monthly earnings by economic sector. We can see that workers in the Agriculture and Mining sectors have encountered the highest increases in earnings for that period. On the other side of the spectrum, workers in the Public Utilities sector faced the greatest losses. A possible explanation for this phenomenon is related to sectoral employment shares. As Agriculture experienced a sharp decrease in its employment shares, it is plausible that the productivity within the sector increased, either as a cause or as a consequence of this reduction. This increase in productivity is captured in Table 2. Finally, it is worth noting the 12 percent earnings growth of the Financial and Personal Services sector. Interestingly, this sector, unlike Agriculture, increased its employment shares during the same period.

Table 2 - Average monthly earnings by sector

Sectors	1993-1995	2007-2008	Difference (in p.p.)
Agriculture, Forestry and Fishing	508.586	598.487	17.68
Mining and Quarrying	1120.166	1539.344	37.42
Manufacturing	1135.916	1029.030	-9.41
Construction	794.869	819.726	3.13
Wholesale and Retail Trade, Hotels and Restaurants	974.233	978.760	0.46
Public utilities	2052.403	1628.540	-20.65
Transport, Storage and Communication	1278.819	1202.321	-5.98
Financial and Personal Services	1073.234	1199.739	11.79

Source: PNAD

Note: Earnings are measured in 2008 Reais

Table 3 offers an explanation of reasons for the changes in sectoral earnings. In all sectors, workers have acquired more years of schooling than had been obtained 20 years ago. However, we note that for the sectors whose increase in years of schooling was below overall growth (36 percent), earnings either fell or did not grow. Agriculture and Mining faced substantial increases in the levels of schooling received by their labor force, 60 percent and 72 percent respectively, and earnings substantially increased. Positive selection into these sectors is therefore, the most likely explanation for our findings.

That interpretation of positive selection into Agriculture and Mining, and negative selection into some other sectors is corroborated by changes in sectoral informality, as is seen in Table 4. The few sectors that saw an increase in informality

were Manufacturing, Public Utilities and Transport, Storage and Communication. Not surprisingly, these sectors faced a decrease in earnings and the years of schooling of their labor force increased below that of the national average.

Table 3 - Average years of schooling by sector

Sectors	1993-1995	2007-2008	Difference (in p.p.)
Agriculture, Forestry and Fishing	2.376	3.797	59.81
Mining and Quarrying	4.789	8.262	72.52
Manufacturing	6.426	8.430	31.19
Construction	4.224	5.923	40.22
Wholesale and Retail Trade, Hotels and Restaurants	6.544	8.721	33.27
Public utilities	8.610	9.585	11.32
Transport, Storage and Communication	6.433	8.364	30.02
Financial and Personal Services	7.884	9.934	26.00

Source: PNAD

Table 4 - Percentage of formal contract workers by sector

Sectors	1993-1995	2007-2008	Difference (in p.p.)
Agriculture, Forestry and Fishing	0.199	0.252	5.30
Mining and Quarrying	0.545	0.761	21.60
Manufacturing	0.752	0.703	-4.90
Construction	0.312	0.329	1.70
Wholesale and Retail Trade, Hotels and Restaurants	0.409	0.549	14.00
Public utilities	0.951	0.856	-9.50
Transport, Storage and Communication	0.643	0.590	-5.30
Financial and Personal Services	0.626	0.620	-0.60

Source: PNAD

Informality can be understood as a barrier to creating longer capital-work relationships. Thus, sectors with higher levels of informality also have larger turnover rates. Thus, workers in these sectors are accumulating less experience or specific human capital. This might explain the correlation between informality decreases and earnings increase for the sectors being analyzed.

Table 5 shows that the changes in employment shares do not correlate with changes in earnings. We have seen that for Mining and Agriculture, increases in earnings can be partially explained by Fagerberg's (2000) interpretation of

technological change, which expelled workers by adopting capital intensive technologies. This explanation is very plausible in regards to Agriculture. In fact, this sector had a decrease in employment shares of five percentage points, but an increase of 18 percent in real earnings for the period.

Table 5 - Employment rate by economic sector and period – PNAD

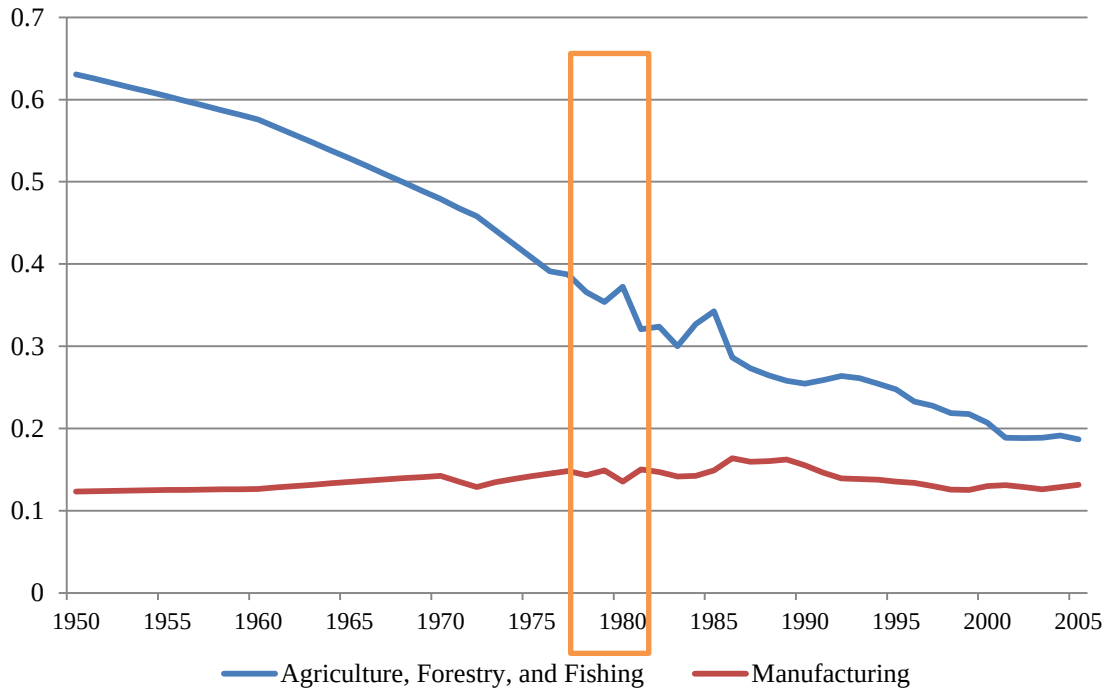
Sectors	1993-1995	2007-2008	Difference (in p.p.)
Agriculture, Forestry and Fishing	0.164	0.114	-4.98
Mining and Quarrying	0.005	0.005	-0.02
Manufacturing	0.153	0.166	1.28
Construction	0.079	0.085	0.60
Wholesale and Retail Trade, Hotels and Restaurants	0.219	0.194	-2.59
Public utilities	0.007	0.006	-0.11
Transport, Storage and Communication	0.047	0.056	0.89
Financial and Personal Services	0.325	0.374	4.94

Source: PNAD

For other sectors, we see no obvious relationship between earnings and employment share changes. For example, Public Utilities, which faced a substantial loss in earnings, did not suffer any change in terms of employment shares throughout the period. Another important change was the employment growth of Financial and Personal Services. For this sector, employment shares increased by about five percentage points and earnings grew by about 12 percent.

Finally, Figure 8 provides evidence that trade liberalization was not the reason for any movements in the employment shares of the Manufacturing and Agriculture sectors. We observe a historical trend in the decrease of employment shares in Agriculture, whereas manufacturing has kept its shares at about 11 percent of employed workers for more than 50 years. This suggests that both types of policies, those pro and anti the promotion of structural changes, were not able to undo a natural trend of the Brazilian economy. Given the rapid industrialization process that was consolidated by the 1960s, the most effective way policies could affect productive growth in Brazil did not seem to select winning sectors, but created the right incentives for economic agents to invest in efficient technologies and allow workers to accumulate human capital.

Figure 8 - Employment shares for selected sectors



Source: Timmer and de Vries, 2009
Notes: The orange rectangle represents the period of trade liberalization

We reconcile our findings with the stylized fact observed in McMillan and Rodrik (2011), by emphasizing the fact that in an emerging economy like Brazil, structural changes have become much less important to explaining productivity growth than in the past. One possible explanation for this is that the country has already become industrialized, and the economy's exceeding labor force that historically migrated from Agriculture has found other destinations. Some potential destinations, as shown in Table 2, present better perspectives, in terms of future earnings, than in the Manufacturing sector. This indicates that productivity growth has spilled over to other sectors, mainly as a result of increases in the human capital of individual workers.

Conclusions and policy discussion

We presented evidence that Brazil has suffered a structural change in its economy since the early 1950s, as was recently defined by McMillan and Rodrik (2011). Employment shares from the least productive sectors have fallen and increased in the most productive ones. However, by breaking this event down into shorter periods,

we have shown that structural change was only important until the 1970s. By this period, the country had dramatically increased the participation of its manufacturing sector in the overall GDP to 45 percent, according to the Brazilian Bureau of Labor and Statistics (IBGE). The scope for continuous and long-term structural change had lost momentum. In fact, we argue that policies that tried to invert this natural trend were unsuccessful, and the early years of the 1980s can serve as witness reflecting those efforts.

The key to promoting productivity growth in the Brazilian economy after the 1970s seems to have been investing in within-sector productivity growth. More efficient firms and technologies, and workers with higher levels of schooling explain part of the success of the Brazilian economy in the 2000s. This movement towards efficiency began in the late 1980s with the Democratic Regime and reached its peak during the late 1990s.

Descriptive data suggests that the trade liberalization of the 1990s did not have an impact on structural change, but was probably the major reason for productivity increases within sectors. Muendler (2004) provides some evidence for these productivity gains through the channel of competitive push.

During the 2000s, policy makers were able to shift attention towards another important by-product of the country's rapid process of urbanization and industrialization: high levels of income inequality. Thus, policies oriented at mitigating economic inequalities were put into action, sometimes at the expense of efficiency. Interestingly, as has been pointed out since the seminal work by Langoni (2005) and Fishlow (1972), rapid industrialization was the major cause of increases in earnings inequality. Also of note, Gonzaga et al. (2006) showed that trade liberalization had an important impact on decreasing the schooling wage gap, which is a relevant source of wage inequality in the country.

Nowadays, Brazilian policy-makers seem too focused on the short term; resulting in few actions being taken seriously that are aimed at improving economic efficiency. The lessons from the past, especially those from the 1980s, should serve as an alert. If the policy goal is to increase welfare, let this process happen for all sectors, through investments in universal policies like improving the quality of education, for example. We learned that protecting national companies from foreign competition could nullify

an important channel that has driven overall productivity growth to be positive. In this context, the recent setback observed in the process of trade liberalization with a rise in tariffs for cars, electronics, and other manufactured goods may no longer be justified as a growth-enhancing policy.

Notes

1. Sao Paulo School of Economics - FGV, C-Micro - FGV, and IZA. Corresponding author. E-mail: sergio.firpo@fgv.br.
2. Sao Paulo School of Economics - FGV, C-Micro - FGV.
3. Calculating productivity using Groninger Table and PNAD for 1995 to 2005 (excepting 2000 and 2001) we found 55% Pearson correlation coefficient. Regressing productivity coefficient calculated from (1) by productivity calculated from (2) we found a coefficient of 2.25 and a standard deviation of 0.031. This presents some evidence that both measures of productivity we use in the paper are positive correlated.
4. In Figure 3 regression coefficient is 8.10, R^2=0.73 and n=8. In Figure 4 regression coefficient is 8.70, R^2=0.34 and n=8. In Figure 5 regression coefficient is 10.01, R^2=0.07 and n=8.

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Appendix A: Other descriptive statistics by sectors

Table A.1 - Percentage of whites by sector

Sectors	1993-1995	2007-2008	Difference (in p.p.)
Agriculture, Forestry and Fishing	0.445	0.388	-5.70
Mining and Quarrying	0.428	0.428	0.00
Manufacturing	0.645	0.566	-7.90
Construction	0.477	0.398	-7.90
Wholesale and Retail Trade, Hotels and Restaurants	0.620	0.554	-6.60
Public utilities	0.619	0.538	-8.10
Transport, Storage and Communication	0.598	0.533	-6.50
Financial and Personal Services	0.592	0.543	-4.91

Source: PNAD

Table A.2 - Percentage of males by sector

Sectors	1993-1995	2007-2008	Difference (in p.p.)
Agriculture, Forestry and Fishing	0.897	0.896	-0.10
Mining and Quarrying	0.936	0.909	-2.70
Manufacturing	0.741	0.657	-8.40
Construction	0.977	0.974	-0.30
Wholesale and Retail Trade, Hotels and Restaurants	0.645	0.634	-1.10
Public utilities	0.853	0.801	-5.20
Transport, Storage and Communication	0.898	0.861	-3.70
Financial and Personal Services	0.377	0.367	-1.02

Source: PNAD

Table A.3 - Average age by sector

Sectors	1993-1995	2007-2008	Difference (in p.p.)
Agriculture, Forestry and Fishing	38.726	41.053	6.01
Mining and Quarrying	34.369	37.101	7.95
Manufacturing	32.362	35.052	8.31
Construction	34.991	37.977	8.53
Wholesale and Retail Trade, Hotels and Restaurants	33.705	34.566	2.55
Public utilities	38.072	38.359	0.75
Transport, Storage and Communication	36.163	37.299	3.14
Financial and Personal Services	34.314	37.257	8.58

Source: PNAD

Table A.4 - Average tenure (months) by sector

Sectors	1993-1995	2007-2008	Difference (in p.p.)
Agriculture, Forestry and Fishing	143.173	153.497	7.21
Mining and Quarrying	75.710	89.546	18.27
Manufacturing	63.700	74.521	16.99
Construction	73.617	93.171	26.56
Wholesale and Retail Trade, Hotels and Restaurants	66.480	69.139	4.00
Public utilities	134.968	111.872	-17.11
Transport, Storage and Communication	82.348	79.057	-4.00
Financial and Personal Services	78.143	88.610	13.39

Source: PNAD

Table A.5 - Average experience (years) by sector

Sectors	1993-1995	2007-2008	Difference (in p.p.)
Agriculture, Forestry and Fishing	28.028	29.663	5.83
Mining and Quarrying	21.893	22.484	2.70
Manufacturing	18.981	20.544	8.23
Construction	22.638	24.495	8.20
Wholesale and Retail Trade, Hotels and Restaurants	20.143	19.789	-1.76
Public utilities	23.585	23.100	-2.06
Transport, Storage and Communication	22.681	22.722	0.18
Financial and Personal Services	19.506	21.527	10.36

Source: PNAD

Table A.6 - Percentage of workers in North region by sector

Sectors	1993-1995	2007-2008	Difference (in p.p.)
Agriculture, Forestry and Fishing	0.029	0.087	5.80
Mining and Quarrying	0.056	0.091	3.50
Manufacturing	0.031	0.059	2.80
Construction	0.042	0.082	4.00
Wholesale and Retail Trade, Hotels and Restaurants	0.052	0.077	2.50
Public utilities	0.055	0.076	2.10
Transport, Storage and Communication	0.044	0.066	2.20
Financial and Personal Services	0.050	0.071	2.05

Source: PNAD

Table A.7 - Percentage of workers in South region by sector

Sectors	1993-1995	2007-2008	Difference (in p.p.)
Agriculture, Forestry and Fishing	0.171	0.155	-1.60
Mining and Quarrying	0.100	0.092	-0.80
Manufacturing	0.212	0.207	-0.50
Construction	0.151	0.150	-0.10
Wholesale and Retail Trade, Hotels and Restaurants	0.157	0.165	0.80
Public utilities	0.170	0.192	2.20
Transport, Storage and Communication	0.152	0.158	0.60
Financial and Personal Services	0.149	0.149	-0.02

Source: PNAD

Table A.8 - Percentage of workers in Southeast region by sector

Sectors	1993-1995	2007-2008	Difference (in p.p.)
Agriculture, Forestry and Fishing	0.298	0.269	-2.90
Mining and Quarrying	0.444	0.482	3.80
Manufacturing	0.580	0.526	-5.40
Construction	0.502	0.447	-5.50
Wholesale and Retail Trade, Hotels and Restaurants	0.487	0.449	-3.80
Public utilities	0.468	0.479	1.10
Transport, Storage and Communication	0.548	0.506	-4.20
Financial and Personal Services	0.505	0.474	-3.11

Source: PNAD

Table A.9 - Percentage of workers in Central-West region by sector

Sectors	1993-1995	2007-2008	Difference (in p.p.)
Agriculture, Forestry and Fishing	0.084	0.082	-0.20
Mining and Quarrying	0.115	0.068	-4.70
Manufacturing	0.037	0.055	1.80
Construction	0.074	0.085	1.10
Wholesale and Retail Trade, Hotels and Restaurants	0.073	0.081	0.80
Public utilities	0.085	0.072	-1.30
Transport, Storage and Communication	0.066	0.070	0.40
Financial and Personal Services	0.080	0.086	0.58

Source: PNAD

Table A.10 - Percentage of workers in Northeast region by sector

Sectors	1993-1995	2007-2008	Difference (in p.p.)
Agriculture, Forestry and Fishing	0.418	0.408	-1.00
Mining and Quarrying	0.285	0.268	-1.70
Manufacturing	0.140	0.154	1.40
Construction	0.231	0.238	0.70
Wholesale and Retail Trade, Hotels and Restaurants	0.231	0.228	-0.30
Public utilities	0.221	0.182	-3.90
Transport, Storage and Communication	0.190	0.199	0.90
Financial and Personal Services	0.216	0.221	0.56

Source: PNAD

Appendix B: Decomposition of informality

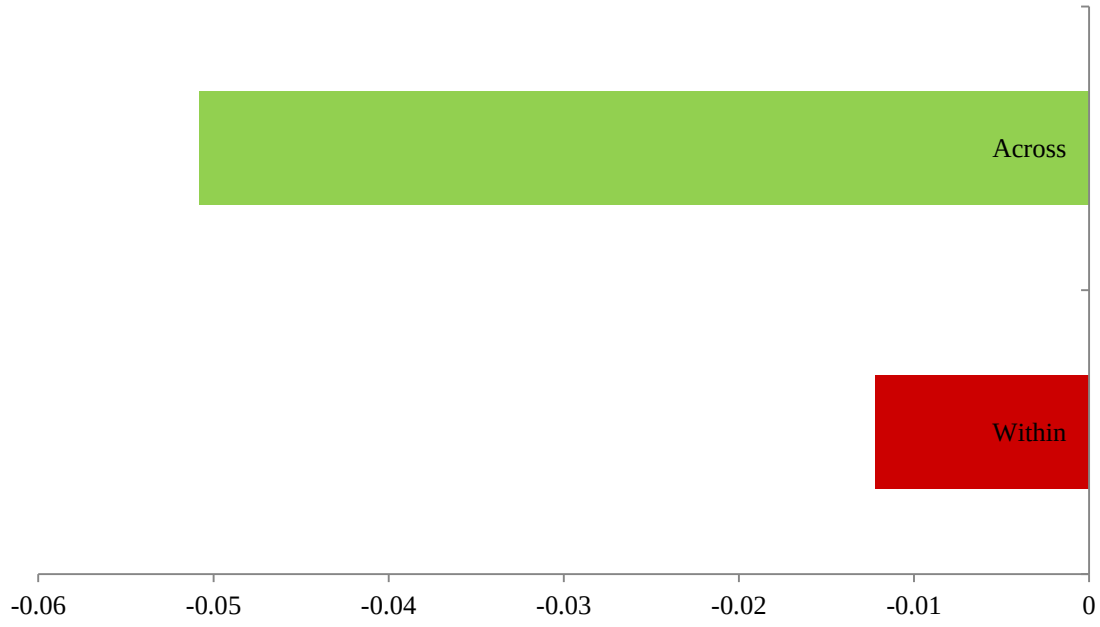
Here we decompose the informality growth (variation in the percentage of informal contract workers) by the following equation:

$$\Delta I_t = I_t - I_\tau = \sum_j^9 \Delta i_{jt} E_{j.} + \sum_j^9 \Delta E_{jt} i_{j.} \qquad \text{(B.1)}$$

where E_{jt} is the share of industry *j*'s employment by total employment at time t, i_{jt} is the share of informal workers by total employment in industry *j*, $E_{j.}=0.5(E_{jt}+E_{j\tau})$, and $i_{j.}=0.5(i_{jt}+i_{j\tau})$. The first term of the decomposition is the "within effect" and represents changes in informality on each sector, keeping employment shares constant. The second is the "between effect" and it denotes changes in informality due to the migration of workers across sectors, keeping the rate of informality of each sector constant.

Figure B.1 presents the decomposition for the period 1993 to 2008. The figure suggests that greatest decrease in informality observed in the period is due to the movement of the labor force to the direction of sectors with higher rates of formality.

Figure B.1 - Decomposition of informality growth - 1993/95-2007/08



Source: PNAD

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