The China Shock Impact on Brazil's Manufacturing Labor Market

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Abstract

The vigorous growth of the Chinese economy together with its successful increasing role in international trade has raised fears of deindustrialization among developing countries. This study exploits the large increase in the international trade exposure of the Brazilian economy during 2000–2012 to assess the impacts of trade on its manufacturing sector. In this period, import penetration increased by 25%, and at the same time, the Chinese share of the import penetration increased from 3% to 20%. Using household survey data that encompass both formal and informal workers, this paper's estimates indicate that a higher import penetration reduces the employment level and the informality share. The impacts of Chinese imports are found to be even stronger on those outcomes. The hourly wage appears to not be affected by any of the trade environment variables. The new macroeconomic policy implemented in 2008 magnified the negative effects of imports on the employment level. The results presented in this paper are found to be robust to endogeneity concerns, which are addressed using instrumental variable approach.

Keywords: Brazil, China, employment, import penetration, informality, wages

JEL codes: F1, O1

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1. Introduction

In the last three decades, China has experienced an impressive economic transformation in terms of fast economic growth and of increasing participation in international trade. For example, in 2000, China accounted for 3.35% of world imports and 4% of world total exports. These figures later changed to 9.77% of world imports and 11.42% of world exports in 2012. Given that the world trade flows grew by 75% in this period, China accomplished an unprecedented expansion both in trade flows and in world trade participation, which became known as the *China shock*.

This rapid ascension of China as a major manufacturing powerhouse—about 90% of its exports are made of manufactured goods—raised fears of deindustrialization in developing countries, especially those in Latin America. Such concerns are grounded on the fact that China is a populous country that still has a substantial amount of its labor force employed in agriculture. This huge labor endowment makes China a labor-abundant country relative to those in the developing world. Moreover, its large economy leads to economies of scale that are important in several manufacturing industries. On top of that, Moreira (2006) points out that although in the early 2000s China presented lower productivity levels than some Latin American countries, its wages were more than proportionately lower than those in Latin American countries. All these features provide China a strong competitive edge in world markets.

This naturally raises the question whether Latin American economies have been impacted by the China shock. In this vein, the case of Brazil is emblematic. Besides being the most populous country in Latin America, it has the largest economy and a sizable manufacturing industry. In the 2000–2012 period, as illustrated by panel a of Figure 1, Brazil experienced a 25% increase in its manufacturing import penetration, and at the same time a six-fold increase in the Chinese share of such imports from 3% to 20%, as seen in panel b of Figure 1. This converted China into the largest exporter to Brazil with a 20.4% share of the total Brazilian imports. Interestingly, Facchini et al. (2010) point out that that Chinese manufacturing good seem to be close substitutes of those produced in Brazil. Furthermore, China became the second largest destination for Brazilian exports with a share of 14.6%. Such trade flows are uneven in terms of their contents, though. Manufactured goods constitute less than a third of the Brazilian exports to China, but more than 90% of the Chinese exports to Brazil. Additionally, China's trade expansion may also have affected Brazil in the export side of the economy. Figure 2 shows that China gained substantial market share in foreign markets already served by Brazilian exporters. In fact, Brazil's share in the world trade increased by roughly 50%. This poor performance also extended to manufacturing share of the Brazilian gross domestic product that declined from 18% to 13%.

These remarks make the China shock a good candidate to explain the weak performance of the manufacturing sector, which suggests a deindustrialization of the Brazilian economy. This is an important question because many observers point out that the manufacturing sector is the driving force of economic growth and development. In addition to typically pay higher wages than jobs in agriculture or services. Given the importance of manufacturing, there is surprisingly a dearth of research on the impacts of the China shock on developing countries, especially for Latin America.

This study represents a step towards filling this gap by studying how the China shock affected Brazil's manufacturing labor market in the 2000–2012 period. More precisely, a rigorous empirical analysis is conducted to examine how the level, wage, and informality of the manufacturing employment in Brazil were affected by the changes in the import penetration and in the Chinese market share in foreign markets served by Brazilian firms. The empirical exercise utilizes data from the Pesquisa Nacional por Amostra de Domicilios (PNAD) and from the Brazilian demographic census. These pooled cross-section household-level data contain detailed demographic and employment information. Most important, both formal and informal workers are encompassed. This is a major advantage of these data because the share of informal workers is larger than 20% in manufacturing as a whole, and approximately a third of the workers are informal in some industries like furniture and other products.

This paper's estimates at the industry-level indicate that a raise in the import penetration and in the Chinese share of imports reduces the employment level and the informality share. The hourly wage is not affected by any of the trade environment variables; however, the inter-industry wage premium is positively affected by the import penetration. Both the employment level and the informality share are fostered by the Chinese market share abroad. The implementation of a new macroeconomic policy in 2008 magnified the effects of the import penetration and the Chinese share on the employment level.

At the end of the day, this paper provides new evidence that the *China shock* negatively affected manufacturing in Brazil in terms of its employment level. Most important, there is also evidence suggesting that the effect of Chinese imports are different than those from imports from other countries. These findings constitute an important subsidy to policymakers facing the new challenges of addressing this new potentially harmful effects from the China shock.

The remainder of this paper is organized as follows. The next section describes the data, and presents some raw data patterns to illustrate the effects of increased trade exposure on labor market outcomes. The empirical methodology developed to assess causal effects of trade on manufacturing labor markets is laid out in Section 3. Section 4 reports the estimates and discusses the results. Finally, conclusions are drawn in Section 5.

2. Raw Data Description and Patterns

In this section, I explain the source of each component and the assembly procedure used to prepare the dataset employed in the estimations. Next, I present descriptive statistics about the evolution of the import penetration and the labor market outcomes in Brazil for 2000–2012, which motivates the causal inference exercise conducted in this paper.

2.1 Data Description

The dataset used in this study contains information on international trade flows, on Brazilian national accounts, and on household surveys. The international trade flow figures at the 1996 six-digit harmonized system (1996 HS-6) come from Comtrade (United Nations, 2003) and cover the period of 1998–2012. The trade flows of interest are the Brazilian imports from China and from the remaining countries of the world (hereafter called ROW), and the Brazilian and the Chinese exports to the ROW. These data will be used to compute ratios, hence there is no need to make adjustments for inflation.

The Brazilian national accounts data come from IBGE (2015). This dataset consists of the *Séries Retropoladas* 2000—2012 that encompass data on employment level, total output level, imports and exports at an industry classification that resembles IBGE's *nível* 56 industry classification. For 1998, the national account data come from the IBGE's *Tabelas de Usos e Recursos* at *nível* 80 product classification. The number of firms in each CNAE 1.0 industry at the state level comes from IBGE's CEMPRE-*Cadastro de Empresas* for 1998. The raw Brazilian import tariff data at the product level comes from the Secretaria de Comércio Exterior from the Brazilian Ministry of Development. The tariff series used in this paper is the simple average of the effective tariff applied that takes into account the incidence of the PIS and the Cofins taxes, which have being levied on imports since 2004.

The labor market data comes from the PNAD-Pesquisa Nacional por Amostra de Domicilios (Brazilian household survey) and from the Brazilian demographic censuses of 2000 and 2010, since the PNAD household surveys are not conducted in a census year. These surveys provide information on the workers characteristics such as industry affiliation, earnings, job formality status, age, education, gender, marital status, race, and Brazilian state of residence. The PNAD surveys' questions about these characteristics do not change over time, and they are practically identical to those used in the Brazilian censuses. Nevertheless, the industry classification used changes over time. The 2002–2012 PNADs employ

the CNAE-Domiciliar classification.[2] The 2000 Census also uses the CNAE-Domiciliar, whereas the 2010 Census uses the CNAE-Domiciliar 2.0. The concordance tables for these classifications and also for the 1996 HS-6 are available at IBGE (2016). Unfortunately, such concordances are not in a one-to-one fashion. Accordingly, the industry classification used in this paper has 26 manufacturing industries.

2.2 Raw Data Patterns

The examination of the manufacturing sector data begins with the exposure measures of the Brazilian economy to international trade. Brazil's share of world trade experienced a much more modest growth relative to China. Brazil's exports increased from 0.88% in 2000 to 1.35% in 2012, while its import share went from 0.83% to 1.22% in 2012. Interestingly, the average effective import tariff in 2000 was 17.28% and declined to 14.51% in 2012; however, the incidence of PIS and Cofins—since 2004—raises the average effective applied tariff from 17.28% to 26.72%, as depicted in Figure 3. This suggests an increase in trade protection enjoyed by Brazilian producers. Yet, tariffs are an imperfect measure of protection since the applied tariffs does not reflect the impact of non-tariff barriers (NTB) such as anti-dumping duties. A shortcoming of this trade protection measure is that the tariff series does not show much variability across industries and over time.

Another measure of trade exposure of Brazilian firms is the industry-level import penetration. It is the ratio between imports and the apparent consumption (production plus imports minus exports). The overall import penetration in manufacturing increased from 14% in 2000 to 18% in 2012. Although the effects of both tariffs and non-tariffs barriers are reflected in the import penetration measure, its evolution may not clearly depict the changes in competitive pressure faced by Brazilian firms over time, since it may increase as a results of an expansion of domestic production coupled with an even larger increase in exports. In light of these remarks, I will employ the import penetration as the trade exposure measure in the estimates conducted here.

China was the tenth largest exporter to Brazil in 2000 accounting for 2.7% of Brazilian imports and was the ninth largest importer of Brazilian goods with 2.2% of Brazilian exports. In 2012, such figures changed dramatically. China became the largest exporter to Brazil with 20.4% of total Brazilian imports and accounted for 14.6 % of Brazilian exports, being the second largest importer of Brazilian goods. Note that more than 90% of the Chinese exports to Brazil consists of manufactured good, while less than 30% of Chinese imports from Brazil are made of manufactured goods. In fact, in 2012 this share dropped to

[2] The 2001 PNAD is not included in our sample since it employs the (very cursory) PNAD/CD91 classification, which would lead to a dataset with only 21 industries.

17%. This means that Brazilian exports to China consists of mainly primary commodities (minerals and agricultural products).

The increasing Chinese market share in the ROW indicates that competing countries lost access to such market. Figure 2 shows the behavior of the simple average of the industry-level ratio between the Chinese and the Brazilian market share in the foreign markets served by Brazilian firms. Such ratio displayed an upward trend throughout the period. More precisely, the trend was different according to the destination. It was steeper for developed nation markets and relatively flatter for Latin American markets. The significance of this is that Chinese export expansion may have constrained the expansion of Brazilian exports.

2.2.1 Industry-level data

Turning to the descriptive statistics at the industry-level, Table 1 data show that the upward trend in the effective tariffs, the import penetration, and the Chinese share of the import penetration shown in Figures 1 and 2 is also present in most industries. In fact, the effective tariff increased in every industry. Part of this increase is due to the incidence of PIS and Cofins of approximately 10%. Nevertheless, the printing and publishing industry exhibited a tariff increase smaller than those 10 percentage points from PIS-Cofins, whereas automobiles, buses, and trucks, footwear, apparel, and textiles experienced a raise in tariffs much larger than 10 percentage points; that is, the rise in protection also came from pure import tariff increases.

The import penetration increased by more than 20% in sixteen industries out of 26. Such industries account for more than 50% of the employment in manufacturing. Seven industries exhibited a decline in import penetration, namely food and beverages, wood products, paper products, paint and varnishes, machinery, auto parts, and other transportation equipment. Interestingly, the Chinese participation in the import penetration presented a strong increase in 24 out of 26 industries. Table 1 also shows that the market share of Brazilian exports on foreign markets increased in ten industries, which are natural resource (such as paper products and biofuels) or capital intensive, like steel, automobiles and auto parts, for instance.[3] The export share for industries that are typically labor intensive declined considerably, furniture, apparel, and especially footwear and leather products. In contrast, the Chinese

[3] The Brazilian market share in foreign markets is calculated as the weighted average of the Brazilian market share in each destination. The weights are the 1998 Brazilian exports for each destination.

market share in the foreign markets served by Brazilian firms increased vigorously in every industry, except for biofuels and petroleum refining.[4]

The descriptive statistics for the labor market outcomes are reported in Table 2. The manufacturing industry level employment share of population fell only in textiles and wood products.[5] This reduction is more than offset by the expansion in employment in the remaining industries, especially in food and beverages. Changes in the share of employment in manufacturing total employment level indicates labor reallocation among manufacturing industries. Of the 26 industries, thirteen industries that are natural-resource intensive and capital intensive—for example biofuels, food and beverages, appliances, automobiles, trucks, and buses—exhibited an expansion in their employment share within manufacturing. The remaining industries, mostly labor intensive, displayed a decline in the share in employment. This decline was considerable for apparel, textiles, wood products, footwear, and furniture.

The natural logarithm of the real hourly wage increased in seven industries only, and diminished substantially in thirteen industries. The inter-industry wage premium represents the premium attributed to the worker's industry affiliation as a percentage deviation from the average manufacturing wage.[6] We can see in Table 2 that the wage premium variation is positively correlated to that of the average log of hourly wage. Hence, the log wage variation cannot be entirely attributed to changes in the skill of the workers.

Table 3 displays the average worker's characteristics at the industry level for 2000 and for 2012. The share of workers with an informal job increased in nine industries, and traditionally labor-intensive industries—such as apparel, wood products, and furniture—showed a robust growth. There is a sharp increase in the average years of schooling and in the share of workers with a high school diploma in all industries. The share of workers with a college degree experienced a more modest growth. Part of this skill upgrade may be due to an expansion in high school and college supply in the 1990s and in the 2000s. Nonetheless, both the high-school and the college share growth were heterogeneous across industries,

[4] The Chinese market share in foreign markets served by Brazilian firms is calculated as the weighted average of the Chinese market share in each destination. The weights are the 1998 Brazilian exports for each destination.

[5] A better measure would be employment share of economically active population. Unfortunately there are no annual and nationwide data available on economically active population for Brazil.

[6] The wage premium is estimated as follows. For every year of the sample, hourly wages will be regressed on educational and demographic controls, industry fixed effects, and state fixed effects. The state fixed effects are included to account for differences in labor regulation enforcement and to account for the state-specific minimum wages that were implemented in 2002. Once the Haisken-Denew transformation is applied to the estimated industry effects, they will represent the wage premium as a percentage deviation from the wage of the base industry. This makes the estimated wage premia comparable over time. The sum of wage premium is zero every year.

which indicate that this supply increase is not the sole driver of this observed skill upgrade. In fact, in some cases, the college share actually decreased in industries like auto parts, automobiles, trucks, and buses.

2.2 Policy background

After 2004, Brazil displayed a robust economic growth not experienced since the 1970s. To alleviate the impacts of the 2007–2008 world financial crisis and to continue in the path of strong economic growth, the Brazilian government decided to change the course of its macroeconomic and development policy in the second semester of 2008. This new policy became known as "Nova Matriz Econômica", henceforth NME.

The NME has five pillars, namely (i) fiscal expansionary policy, (ii) artificially low interest rates by means of subsidized loans to large firms provided by government owned banks, (iii) higher import tariffs and adoption of NTBs for sensitive goods, (iv) central bank intervention in the exchange rate market to prevent a major appreciation of the currency, and (v) increases in the minimum wage in excess of inflation rate.[7]

These significant policy changes have the potential to deeply impact the manufacturing sector. Most important, these policies affected firms differently according to their size. Pillars (ii) and (iii) would enhance large firms' profits since they are more capital intensive and more prone to lobbying for trade protection. Pillar (iv) would benefit all firms by reducing competition from imports, but large firms benefit more because a depreciated exchange rate boosts their profits from exporting. Finally, pillar (v) would harm the profits of labor-intensive firms and of smaller firms in general, since these firms tend to pay lower wages and thus are more likely to face binding minimum wages. The paper now turns to the description of the methodology employed to infer causality and to distinguish the effects of each trade exposure measure on the labor market outcomes. To do so, I employ the econometric methods described in the next section.

3. Empirical methodology

The two identification strategies employed to estimate the effect of each trade exposure variable on the labor market outcomes exploit the variation at industry-level and at the state-by-industry level. The first strategy focus on the effects of trade exposure changes at the industry-level on the following industry-

[7] For more details about the NME, the interested reader is referred to Alves (2015), for instance.

level outcomes (y): natural logarithm of the employment level, average log of real hourly wage, inter-industry wage premium, and informality share. To do so, the specification depicted by equation (1) is estimated.

$$\Delta y_{jt} = \alpha + \beta \Delta IMP_{jt} + \mu \Delta CS_{jt} + \theta \Delta CEXP_{jt} + \delta_t + u_{jt} \quad (1)$$

where $\Delta IMP_{j,t}$ is the change in the import penetration of industry *j* between years *t* and *t*-1, ΔCS_{jt} is the change in the Chinese share of imports, $\Delta CEXP_{j,t}$ is the change in the Chinese market share in the foreign markets served by Brazilian exporters, δ_t are year effects, and u_{jt} is the error term. The estimated coefficient of ΔCS_{jt} will indicate whether imports from China affected the Brazilian economy differently than imports from elsewhere. The effects of the NME are inferred by augmenting equation (1) with interaction between the import penetration and the Chinese share variables with an indicator variable (NME_t) that is "1" for 2009 and the following years, and "0" else.

There are some aspects of the above econometric specification that merit further discussion. The first issue is that first-difference in panel data may exacerbate measurement error and introduce serial correlation on the error term. Thus, I also estimate equation (1) in long-difference which should be less affected by these two problems.

The second issue is the omitted variable bias. More precisely, omitted factors that may affect both the outcome and the trade exposure measures. For instance, a government averse to unemployment may protect more labor-intensive industries. As a result, this industry characteristic affects the import penetration and the industry employment share (outcome). This renders the estimates inconsistent. Since equation (1) is in differences, industry-specific and time-invariant omitted variables are simply differenced out. The year fixed effects account for time-varying factors that affect industries equally, such as business cycles. For example, if firms employing formal workers are more likely to reduce employment during a recession, and, at the same time, the government raises tariffs in response to the recession, a spurious relationship will be found between tariffs and the share of informal workers unless year effects are used.

Yet, there may still be industry-specific and time variant shocks that simultaneously affect outcomes and regressors, like Brazil-specific demand or supply shocks. An example of such shocks is a larger than expected import penetration growth that is counteracted by import tariffs or by government imposed safeguards or countervailing duties. For instance, in this period there were close to 100 antidumping procedures in Brazil, about 25% of them against Chinese producers (WTO Antidumping

Gateway). Since these non-tariff trade protection measures at the product level cannot be accounted for at the industry or the state-by-industry level, the estimates will present an omitted variable bias. This issue is addressed by an instrumental variable strategy described next.

We can see from Table 4 that the change in import penetration is negatively related to its initial level in 1998, and that the change in the Chinese share is positively related to its 1998 level. The rationale behind the use of these excluded instruments is that such correlation suggests that the 1998 levels of import penetration may indicate the industry comparative (dis)advantage, i.e. the industries with larger initial import penetration are the ones exhibiting larger change in import penetration. Thus, the 1998 levels of import penetration are good predictors of the 2000–2012 change in import penetration. The 1998 levels of import tariffs and Chinese share are time invariant. Thus, I interact them with the industry-level Brazilian real exchange rate (hereafter called RER) calculated according to Goldberg (2004) methodology. This exchange rate measure consists of a weighted average of the Brazilian real exchange rate with its major partners, and the weights are the source country shares in the Brazilian industry *j* market in 1998. The RER fluctuations do affect the exposure measure to the extent that a depreciated RER curbs imports and reduces the need for protection via tariffs and non-tariff barriers.

The real exchange rate is taken as given by all industries since Brazilian exports are relatively diversified and there is no dominant (manufacturing or non-manufacturing) industry that is individually capable of setting the exchange rate. Furthermore, throughout this period, the Brazilian economy underwent two major unexpected real exchange rate devaluations, first in January 1999 and later in the second semester of 2002. The exclusion restriction requires the RER to affect the outcomes solely through the trade exposure variable. I believe this restriction is not violated because the specification is in first difference, which means that all industry-specific factors are controlled for, and of the year effects that account for all aggregate shocks affecting the economy. We now turn to the estimates obtained using the empirical specifications discussed above.

4. Results

In this section I present the estimates of the equation (1) that exploit the industry variation in trade exposure both in first- and in long-difference. Also, a discussion of these results is provided at the end of the section.

Table 5 reports the OLS estimated coefficients of equation (1). The log of the employment level is negatively affected by import penetration and the estimated coefficient is statistically significant at the

5% level. The effect of the Chinese share is also negative, albeit not statistically significant. Interestingly, a positive and statistically significant coefficient of the Chinese market share abroad is found. These estimates are interpreted as follows. An increase of one percentage point in the import penetration reduces the employment level by 1.6%, a percentage point increase in the Chinese share results in a 0.6% decrease in employment, and a percentage point increase in the Chinese market share abroad raises employment by 4.9%. The implementation of the new macroeconomic policy (NME) resulted in a stronger impact of both the import penetration and Chinese share of imports. The estimated coefficients of these interaction terms are significant at the 5% level.

The hourly wage is only affected by the Chinese market share abroad, which has a negative and statistically significant coefficient. The wage premium seems not to be affected by any of the explanatory variables. Now, the informality share is negatively impacted by the Chinese share of imports (significant at the 10% level). This means that a higher Chinese share leads to a smaller informality share. After the implementation of the NME, this effect becomes stronger, and the interaction with the import penetration is statistically significant at the 5% level and negative. The Chinese market share abroad has a significant and positive impact on informality share.

The IV estimates are reported in Table 6. We can see a larger effect of trade variables on the employment level in the specification that accounts for NME policy implementation. As before, the hourly wage specifications displayed no statistically significant coefficients. The import penetration exhibited a positive effect on the wage premium, and such effect was not altered by the NME policy. The informality share is negatively affected by both the import penetration and the Chinese share, and their effects were magnified after the NME was enacted. The null hypothesis of exogeneity cannot be rejected in all IV specifications of Table 6.[8]

The analysis now proceeds to the estimates obtained using a long-difference version of equation (1). These estimated coefficients are exhibited in Table 7. Only the employment level specification presents a statistically significant coefficient, and it is for the import penetration. This coefficient implies that a percentage point increase in the import penetration leads to a 4.7% decline in the employment level. The lack of statistical significance in Table 7 regressions is likely to be caused by the small number of observations, which is 25.

In sum, the results obtained in this paper support that: i) increased import penetration and Chinese share reduces the log of employment level, and Chinese market share abroad raises employment;

[8] All IV estimates in this paper exhibited a first-stage *F*-statistic of at least 20. These regressions and their *F*-statistics are available upon request.

ii) hourly wage is not affected by any of the trade environment variables; iii) the inter-industry wage premium is positively affected by the import penetration; iv) informality share is negatively impacted by both the import penetration and the Chinese share, albeit it is fostered by Chinese market share abroad.

5. Conclusions

China, one of the most populous countries in the world, entered the twenty-first century not only as one of the largest and fast growing economies but also as a major player in world trade. This rather quick ascension together with its cost advantage in manufacturing production prompted several concerns in developing countries as whether they would still be able to sustain a dynamic manufacturing sector in view of this Chinese competitive edge. Such concern is built on the fact that many observers perceive a strong manufacturing sector as key driver of economic growth and as a provider of higher wage jobs relative to those available in agriculture and services.

To assess such concerns, the changes underwent by the Brazilian economy in 2000–2012 provide a good case study. Besides being the most populous and the largest economy of Latin America, Brazil also has a large and diversified manufacturing sector. In this period, the import penetration in Brazil increased by more than 25% and the Chinese share of such imports increased from 3% to 20%. Equally important, Chinese exporters' market share increased vigorously in markets also served by Brazilian exporters. At the same time, the share of manufacturing in the gross domestic product in Brazil declined by more than 20% in this period.

This study employed Brazilian census and household survey data to examine the impacts of the increasing trade exposure experienced by the Brazilian economy on the labor market outcomes of the manufacturing sector for 2000–2012. An important feature of these data is encompassing both formal and informal workers, given that the latter represent more than 20% of the workforce employed in the manufacturing sector. Besides estimating the effects of the Brazilian import tariffs, this study presents two novel features. The first is the use of an empirical methodology that decomposes the effects of imports into that generated by import penetration and Chinese share of imports. And the second is the estimation of the effect of Chinese competition on foreign markets also served by Brazilian exporters.

The econometric analysis conducted in this study reveals that at the industry-level a raise in the import penetration or in the Chinese share reduces the employment level. The hourly wage is not affected by any of the trade environment variables. The inter-industry wage premium is positively affected by

import penetration. The informality share is negatively impacted by the import penetration and the Chinese share, albeit it is fostered by Chinese market share abroad. The new macroeconomic policy implemented in 2008 seems to have magnified the negative effects of imports on the employment level. In light of these findings, this study provides evidence at the industry level suggesting that the *China shock* negatively affected manufacturing in Brazil in terms of employment. The decline in informality seems good news at first, but the fact that it likely took place via reduction in employment levels.

The implications of these findings toward economic growth is that a smaller employment level in manufacturing leads to a lower growth in aggregate productivity, since manufacturing typically exhibits higher productivity growth rates than services and agriculture. The effects on income inequality are not clear. A substantial number of workers were displaced from manufacturing. And this could increase inequality if these workers remained unemployed or switched to a lower wage industry. This suggests that understanding the labor reallocation throughout the whole economy can be a very interesting avenue for future research, and may prove to be very helpful to determine the effects of the China shock in income inequality.

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Table 1. International trade exposure measures at the industry-level for Brazil.

	Effective Applied Import Tariffs (%)		Import Penetration(%)		Share of China in Imp. Penetration		Share of Brazilian Exports in Foreign Markets		Share of Chinese Exports in Foreign Markets	
Industry / Year	2000	2012	2000	2012	2000	2012	2000	2012	2000	2012
Food and Beverages	16.44	24.76	4.38	4.18	1.06	15.62	1.98	3.07	5.58	6.49
Tobacco	21.33	28.05	27.83	29.57	0.78	7.42	4.46	3.69	5.49	6.64
Textiles	19.69	34.98	9.68	15.64	2.40	41.17	1.86	2.53	10.35	23.67
Apparel	22.81	44.98	3.07	11.76	5.47	46.33	0.15	0.06	17.40	30.79
Footwear and leather products	22.43	37.18	6.24	8.33	9.05	31.94	2.57	1.31	27.75	36.51
Wood products	12.90	21.93	2.61	1.81	2.59	26.06	3.13	4.19	5.23	11.93
Paper products	15.32	24.86	10.60	8.30	0.09	10.28	2.71	3.97	0.98	4.54
Printing and Publishing	18.22	21.62	0.63	1.65	0.57	9.04	0.96	0.93	2.62	5.39
Petroleum refining	1.94	12.88	8.99	13.76	1.22	0.86	0.63	0.61	0.98	0.25
Biofuel	25.00	31.62	0.00	4.33	0.00	0.00	5.99	33.51	5.20	0.19
Pharmaceutical products	9.02	18.44	21.07	28.28	2.06	5.84	0.28	0.40	1.40	1.95
Cleaning products	17.22	26.79	19.62	26.98	0.02	3.59	0.50	1.05	1.01	4.30
Paint and varnish	16.69	25.38	7.03	6.80	0.10	3.06	0.47	1.04	0.26	1.70
Rubber and plastic products	18.48	26.02	9.70	13.33	1.46	19.11	0.78	0.95	6.53	14.77
Steel	13.63	21.71	6.94	12.52	1.50	23.00	2.95	3.17	2.10	5.93
Non-ferrous metals	10.64	19.66	22.81	26.38	1.17	5.98	1.84	1.43	1.36	2.29
Metal products	19.39	27.51	7.91	11.25	3.75	27.12	0.64	0.78	8.15	19.53
Machinery and equipment	17.42	24.93	26.38	26.27	1.00	17.63	0.81	1.24	2.28	10.87
Appliances	21.52	29.79	1.60	3.33	14.79	72.79	0.69	0.27	18.92	38.61
Auto Parts	19.90	28.63	24.72	23.42	0.07	5.57	1.33	1.74	0.67	5.38
Other transportation equipment	17.97	25.27	55.89	36.47	0.46	9.89	1.91	0.92	2.50	6.02
Non-metallic minerals and products	12.80	21.23	5.02	6.98	2.34	34.08	1.33	1.79	8.53	18.80
Office, electrical, electronic, optical, precision, and communication equipment	17.65	24.71	47.15	50.65	4.38	35.97	0.32	0.28	7.41	30.37
Automobiles, trucks, and buses	28.81	42.22	13.73	15.76	0.00	2.49	0.79	1.31	0.05	0.97
Other chemical products	11.70	20.12	27.27	33.61	2.15	10.27	0.98	1.39	1.92	6.20
Furniture and other products	20.46	29.38	6.11	9.34	20.84	56.88	0.48	0.37	23.44	35.54

Notes: Foreign markets consist of all countries except for Brazil and China. Number of observations is 312.

Table 2 – Labor market outcomes at the industry-level for Brazil.

	Share of employment in the population(%)		Employment share of manufacturing(%)		Log(hourly wage)		Wage premium(%)	
Industry / Year	2000	2012	2000	2012	2000	2012	2000	2012
Food and Beverages	0.82	1.17	16.83	19.11	3.23	2.12	-0.07	-0.05
Tobacco	0.01	0.01	0.21	0.18	2.12	2.13	0.04	0.08
Textiles	0.32	0.31	6.49	5.08	3.03	2.10	-0.14	-0.20
Apparel	0.83	0.97	17.06	15.74	2.39	1.67	-0.11	-0.10
Footwear and leather products	0.27	0.29	5.61	4.76	1.98	1.94	-0.11	-0.06
Wood products	0.26	0.22	5.42	3.54	3.19	1.96	-0.06	-0.03
Paper products	0.09	0.11	1.85	1.74	2.83	2.11	0.07	-0.05
Printing and Publishing	0.10	0.11	2.15	1.74	2.98	2.66	0.18	0.07
Petroleum refining	0.01	0.01	0.19	0.22	3.33	3.36	0.49	0.62
Biofuel	0.03	0.04	0.58	0.61	1.64	2.54	-0.12	0.09
Pharmaceutical products	0.05	0.05	0.92	0.85	2.88	3.23	0.32	0.37
Cleaning products	0.08	0.08	1.74	1.25	2.55	2.45	0.10	0.05
Paint, varnish, and laqueur	0.02	0.02	0.38	0.33	2.35	2.33	0.17	0.11
Rubber and plastic products	0.18	0.25	3.77	4.13	2.55	2.74	0.03	0.12
Steel	0.05	0.07	1.09	1.21	2.79	2.76	0.30	0.27
Non-ferrous metals	0.05	0.06	1.01	0.95	2.26	2.97	0.17	0.15
Metal products	0.32	0.41	6.46	6.64	2.42	2.20	0.05	0.07
Machinery and equipment	0.25	0.52	5.20	8.51	2.69	2.43	0.15	0.15
Appliances	0.09	0.14	1.89	2.21	2.23	2.08	0.10	-0.01
Auto Parts	0.11	0.18	2.24	2.95	2.39	2.65	0.13	0.20
Other transportation equipment	0.03	0.06	0.55	1.03	2.90	2.32	0.20	0.12
Non-metallic minerals and products	0.27	0.35	5.56	5.70	2.84	1.90	-0.01	-0.03
Office, electrical, electronic, optical, precision, and communication equipment	0.10	0.13	1.96	2.12	2.57	2.50	0.15	0.14
Automobiles, trucks, and buses	0.08	0.10	1.58	1.69	2.79	2.72	0.47	0.19
Other chemical products	0.07	0.08	1.36	1.27	2.54	2.72	0.21	0.16
Furniture and other products	0.39	0.40	7.92	6.47	2.75	2.00	-0.05	-0.09

Notes: Hourly wage is in 2012 R$. Wage premium is the premium paid relative to the average manufacturing log hourly wage paid in a given year that is attributed to the worker's industry affiliation. Number of observations is 312.

Table 3 – Workers' average characteristics at the industry level.

	Informal share(%)		Years of Schooling		High school share(%)		College share(%)	
Industry / Year	2000	2012	2000	2012	2000	2012	2000	2012
Food and Beverages	20.40	21.05	6.44	8.62	21.28	45.82	3.09	6.21
Tobacco	6.96	11.51	7.55	8.89	33.02	54.40	6.54	10.80
Textiles	17.78	46.67	6.76	8.46	21.66	44.83	2.02	5.21
Apparel	22.28	53.31	6.61	8.26	18.74	39.66	1.14	2.95
Footwear and leather products	20.16	19.59	6.73	8.55	17.56	43.66	1.35	2.50
Wood products	25.00	51.95	5.07	6.63	9.79	25.28	0.96	2.19
Paper products	11.25	10.34	8.11	10.03	36.06	63.35	6.09	8.31
Printing and Publishing	25.81	24.86	9.16	11.12	45.50	76.50	9.57	19.77
Petroleum refining	6.79	12.86	10.40	12.42	62.17	91.00	24.93	32.72
Biofuel	7.36	1.17	6.09	9.18	21.40	56.02	2.56	10.75
Pharmaceutical products	8.90	6.08	10.68	12.07	64.43	84.60	23.56	38.74
Cleaning products	15.63	8.63	8.77	9.97	44.24	62.27	7.61	10.60
Paint, varnish, and laqueur	9.13	5.83	8.86	10.56	44.41	69.74	10.25	14.39
Rubber and plastic products	11.52	12.75	7.86	9.61	31.45	61.82	4.62	7.25
Steel	6.18	5.47	8.79	10.54	43.53	69.48	9.54	13.07
Non-ferrous metals	12.28	5.78	8.47	10.00	40.24	65.93	6.94	7.97
Metal products	17.42	31.57	7.34	8.69	26.20	45.29	3.20	3.57
Machinery and equipment	13.76	12.42	8.31	10.03	36.57	66.08	6.16	8.84
Appliances	6.57	5.06	9.24	10.59	48.32	74.92	8.11	8.46
Auto Parts	11.01	6.53	8.45	9.56	38.32	61.59	5.73	4.61
Other transportation equipment	21.33	14.60	8.58	9.69	43.71	63.43	9.09	9.25
Non-metallic minerals and products	30.31	24.00	5.75	7.62	16.46	33.17	2.41	3.85
Office, electrical, electronic, optical, precision, and communication equipment	13.97	13.89	9.30	10.86	50.08	75.02	8.49	15.28
Automobiles, trucks, and buses	5.20	3.60	9.76	10.78	53.15	78.72	14.15	12.23
Other chemical products	13.44	11.02	8.59	10.50	43.14	70.31	12.22	19.99
Furniture and other products	28.04	44.86	6.84	8.67	20.30	45.66	2.22	5.48

Notes: Number of observations for 2000 is 434,796 and for 2012 is 18,583. Household survey weights are used.

Table 4 – Simple correlations between endogenous regressors and excluded instruments at the industry level.

Endogenous regressor\Excluded instrument	ΔImport penet.$_{1998} \times$ Real exch. rate$_t$	ΔChinese share$_{1998} \times$ Real exch. rate$_t$
ΔImport penetration$_{t-}$	-0.142	0.016
ΔChinese share$_t$	-0.257	0.535

Table 5 – Industry-level OLS regression of trade exposure measures on labor market outcomes using equation (1).

	Empl. level	Empl. level	Hourly wage	Hourly wage	Wage premium	Wage premium	Informal share	Informal share
ΔImport penet.	-0.016***	-0.013**	0.003	0.002	0.003*	0.002	-0.180	-0.089
	(0.004)	(0.005)	(0.004)	(0.004)	(0.001)	(0.001)	(0.150)	(0.154)
ΔImp. pen.×NEM		-0.008***		0.002		0.001		-0.222***
		(0.002)		(0.004)		(0.001)		(0.048)
ΔChina share imp.	-0.007	-0.006	0.002	0.001	0.001	-0.001	-0.239*	-0.127
	(0.004)	(0.004)	(0.004)	(0.005)	(0.002)	(0.002)	(0.124)	(0.128)
ΔCh. share imp.×NEM		-0.003**		0.002		0.002		-0.162*
		(0.001)		(0.002)		(0.001)		(0.081)
ΔChinese mkt share	0.046***	0.049***	-0.029***	-0.029***	-0.006	-0.005	1.195**	1.220***
	(0.012)	(0.010)	(0.010)	(0.010)	(0.004)	(0.004)	(0.465)	(0.400)

Notes: Number of observations is 286. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Year and effects included in the specification. Standard errors clustered at the industry level. Regressions for wage premium uses the inverse of the estimated wage premium variance as weights, and for the remaining outcomes, the weights are the inverse of the number of observations used to compute the industry-level variable.

Table 6 – Industry-level IV regression of trade exposure measures on labor market outcomes using equation (1).

	Empl. level	Empl. level	Hourly wage	Hourly wage	Wage premium	Wage premium	Informal share	Informal share
ΔImport penet.	-0.023	-0.030***	0.009	0.010	0.007*	0.004**	0.059	-0.228
	(0.026)	(0.006)	(0.021)	(0.010)	(0.004)	(0.002)	(0.688)	(0.268)
ΔImp. pen. × NEM		-0.018**		0.014		0.005		-0.458***
		(0.007)		(0.009)		(0.004)		(0.168)
ΔChinese share imports	-0.005	-0.088*	0.026	0.084	0.010	0.019	0.985	-1.197
	(0.075)	(0.045)	(0.060)	(0.059)	(0.019)	(0.024)	(2.575)	(1.056)
ΔCh. share imp. × NEM		0.014		-0.017		-0.002		-0.013
		(0.013)		(0.016)		(0.005)		(0.278)
ΔChinese mkt share	0.041	0.146***	-0.064	-0.128*	-0.016	-0.026	-0.668	2.564**
	(0.117)	(0.052)	(0.090)	(0.067)	(0.025)	(0.026)	(3.595)	(1.210)

Notes: Number of observations is 286. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Year fixed effects included in the specification. Standard errors clustered at the industry level. Regressions for wage premium uses the inverse of the estimated wage premium variance as weights, and for the remaining outcomes, the weights are the inverse of the number of observations used to compute the industry-level variable. The excluded instruments used in all IV estimates are Import penet.$_{1998}$×Real exch. rate$_{t-1}$, Chinese share$_{1998}$×Real exch. rate$_{t-1}$, and their interactions with the NEM indicator variable..

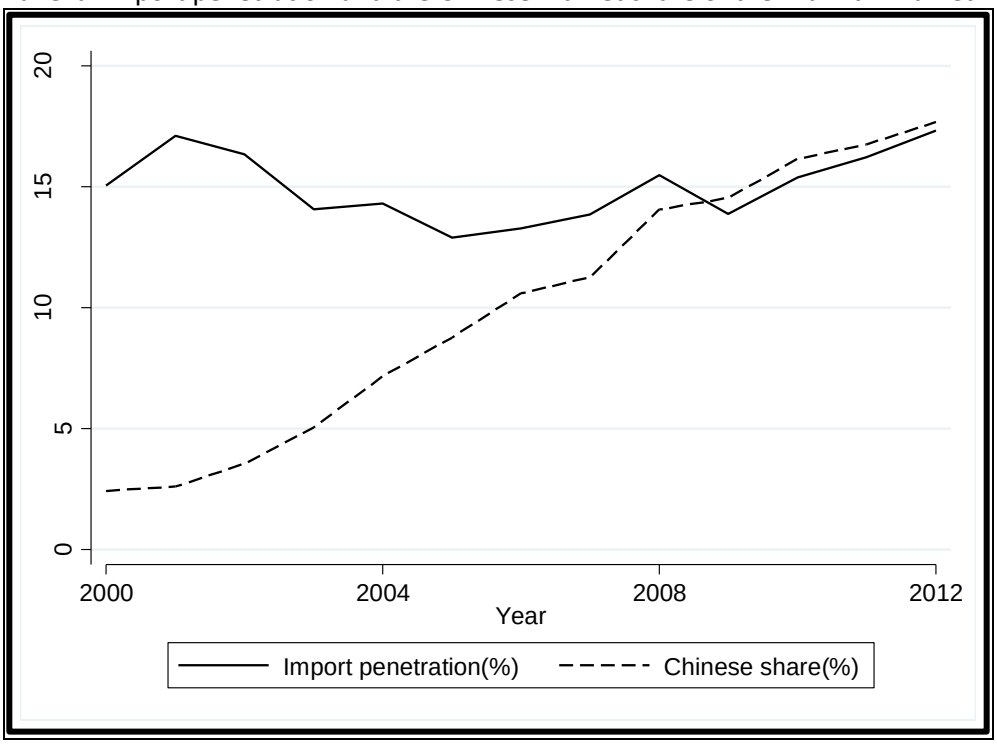
Table 7 – Long difference regression of trade exposure measures on labor market outcomes using equation (1).

	Log(employment)		Wage premium		Informality share	
Import penet.	-0.027***	-0.047**	-0.085	0.883	0.130	0.333
	(0.006)	(0.019)	(0.350)	(0.984)	(0.179)	(0.367)
Chinese share	0.004	-0.002	0.103	-0.159	0.421	0.310
	(0.007)	(0.007)	(0.272)	(0.260)	(0.295)	(0.409)
China mkt share	0.001	0.013	-0.339	-0.104	-0.439	-0.219
	(0.017)	(0.017)	(0.429)	(0.483)	(0.473)	(0.726)
Technique	OLS	IV	OLS	IV	OLS	IV

Notes: Number of observations is 286. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Robust standard errors reported in parenthesis. Regressions for wage premium uses the inverse of the estimated wage premium variance as weights, and for the remaining outcomes, the weights are the inverse of the number of observations used to compute the industry-level variable. The excluded instruments used in all IV estimates are Import penet.$_{1998}$ and Chinese share$_{1998}$.

Figure 1 – Evolution of manufacturing import penetration in Brazil and market share of source countries.

Panel a. Import penetration and the Chinese market share of the Brazilian market.



Panel b. Share of Brazilian market according to the income level of source country.

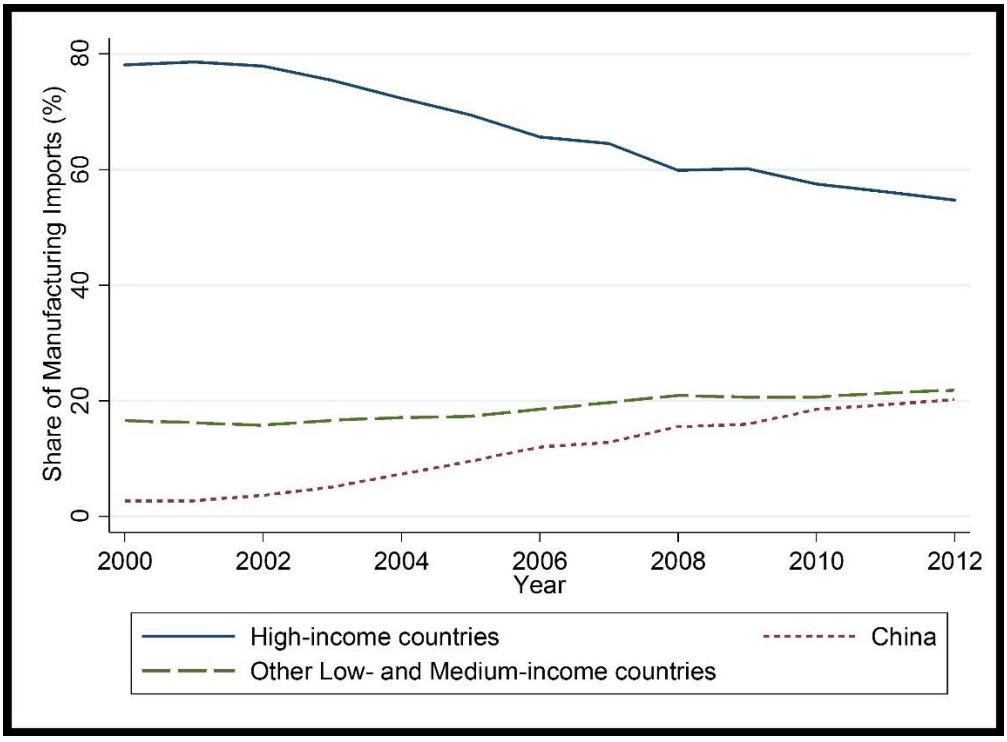


Figure 2 - Simple average across industries the ratio between Chinese and Brazilian market share in foreign markets.

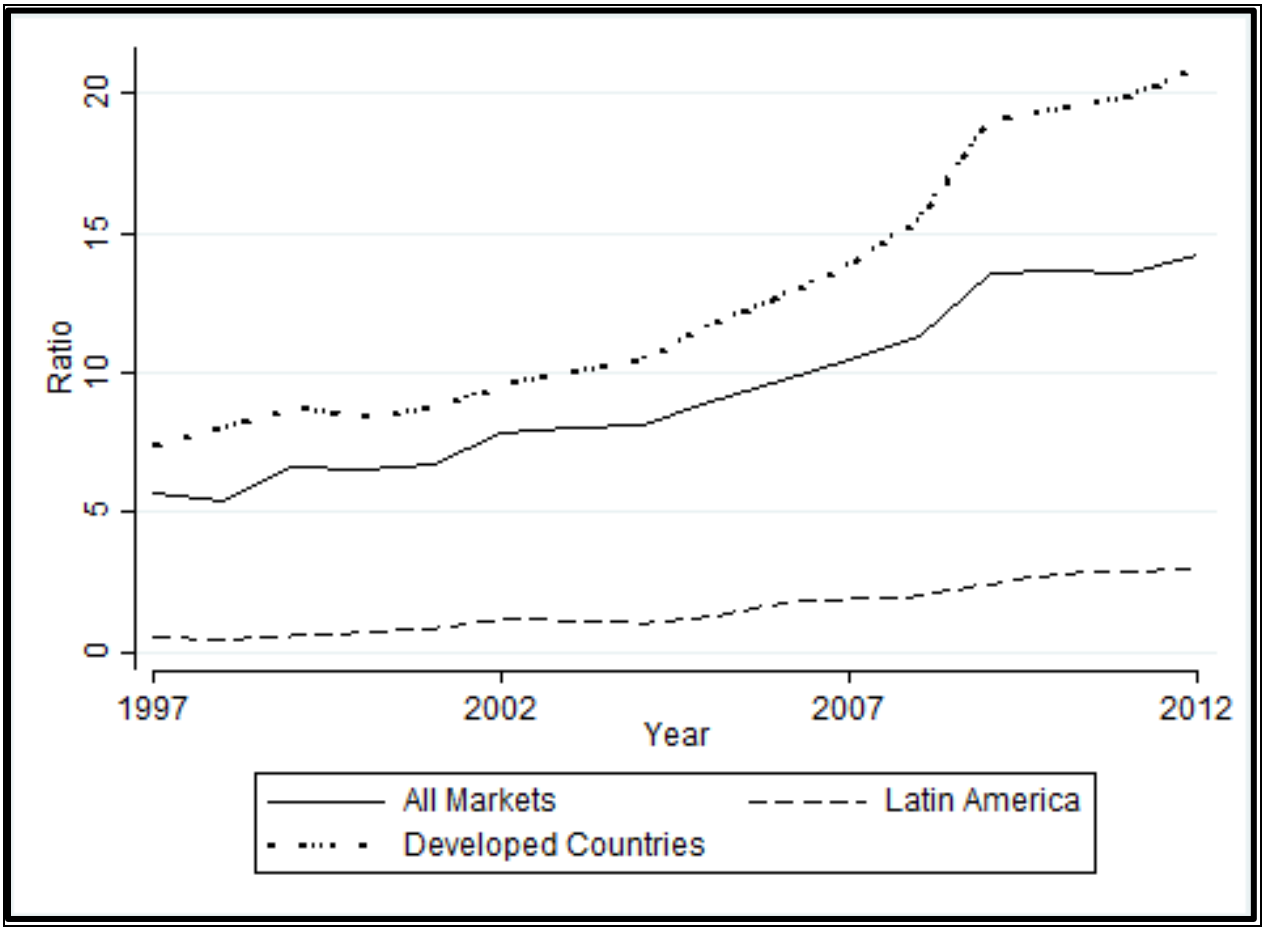


Figure 3 – Simple average of import tariff and effective applied import tariffs in Brazil for 2000–2012.