Connecting to Global Value Chains: The Dynamic General Equilibrium Effects of a PTA between China and Mercosur over the economy of Brazil

Lucas P. do C. Ferraz[1]
Marcel B. Ribeiro[2]

1. Introduction

International trade governance and the very nature of trade have changed significantly over the last decades. Firstly, the difficulties faced by the multilateral trade system at the WTO prompted the escalation of preferential trade agreements (PTA's) at the bilateral, regional and even plurilateral levels. Just over the last two decades, more than four hundred PTAs were notified. Secondly, regarding the nature of trade, countries have been progressively trading in tasks (Grossman and Rossi-Hansberg, 2008) instead of trading in goods. Nowadays, more than two-thirds of global exports correspond to trade in intermediate goods and services, reflecting the increasing importance of the fragmentation of production (Baldwin and Lopez-Gonzales, 2013).

In this paper, we first contextualize the economy of Brazil into this new and challenging global environment. A recent and comprehensive data set comprised by global input-output tables such as TIVA (*Trade in Value Added*), WIOD (*World Input Output Database*) and GTAP (*Global Trade Analysis Project*) is used, conveying detailed information on how the economy of Brazil is currently positioned in terms of its integration to regional/global value chains. Particular emphasis is given to the manufacturing sector, once this is often considered a key sector for developing economies and it is usually the sector with the greatest potential for integration to relevant international supply chains. The second part of the paper is devoted to evaluate the possible implications of a preferential trade agreement between Brazil and China[3], currently one of Brazil's most relevant "natural trade partners" (Venables, 2006; Ferraz, 2012). A set of dynamic CGE simulations is carried out where the results are evaluated according to the logic of integration to international supply chains as well as trade in value added, instead of the usual 'gross" trade analysis. In this sense, we explore an innovative approach to evaluate the economic impacts of PTAs in an increasingly interconnected global economy. In both parts of the paper we draw extensively on the recent input-output framework developed by Johnson and Noguera (2012a,b) and extended by Koopman (2014) to evaluate trade in value added.

The methodological approaches taken in this paper offer original contributions both to the literature on PTAs as well as Gravity models applied to the estimation of nontrade barriers, such as TBT and SPS. Regarding PTAs, the existing literature is extensive and draws on the early theoretical works of Jacob Viner (1950), James Meade (1955) and Lipsey (1957) among others. Those authors were the first to formalize the concepts of trade creation and trade diversion in a preferential trade arrangement. A very important development of this literature derives from the empirical works with gravity models (Anderson, 1979), where the definition of a "natural trade partner" has its origins. This paper extends the concept of a "natural trade

[1] São Paulo School of Economics (Getúlio Vargas Foundation).

[2] São Paulo School of Economics (Getúlio Vargas Foundation).

[3] China nowadays is Brazil 's main trade partner, comprising more than 20% of Brazilian total imports and exports, followed by the USA and Argentina.

partner" to a world economy progressively interconnected through international supply chains. The extended concept traces out "backward" and "forward" linkages of trade in intermediates among countries, shedding some light on those potential trade partners where the formation of PTAs is more likely to lead to integration according to the value chain logic. In this regard, this paper also offers methodological alternatives to a recent empirical literature on the role of PTAs to the formation of global/regional value chains (Blyde et al (2013); Orefice and Rocha (2011); Hayakawa and Yamashita (2011)). Based on the results of varying econometric approaches, these authors find a positive correlation between the formation of PTAs and the integration of international production chains. However, problems associated with endogeneity and the fact that not all trade flows and foreign direct investments generated by PTAs are related to the formation of global/regional value chains do not allow this literature to come to safe conclusions regarding causality. The dynamic CGE approach adopted in this work seems more suitable to handle the methodological drawbacks of this recent empirical literature, since the simulation of a PTA can be always taken as an exogenous shock. Moreover, interregional CGE models - such as GTAP - are generally based on sufficiently detailed global input-output databases, where trade in value added as well as trade in intermediates can be traced out through the use of appropriate input-output techniques (Johson and Noguera, 2012).

Regarding the estimation of the ad valorem equivalents of nontrade barriers among Mercosur countries and China, this paper adopts a more sophisticated gravity estimation approach, based on the new insights brought about by Helpman, Melitz and Rubisntein (2008) on the possible existence of sample selection bias and firm heterogeneity in traditional applied works with gravity models. In this sense, we estimate the ad valorem equivalents of TBTs and SPSs using a two-stage Heckman selection model (Heckman, 1979). This approach seems more suitable to estimate ad valorem equivalents since it can discriminate the effects of NTBs on the extensive (industry's fixed costs) as well as the intensive (industry's variable costs) margins of trade, according to the new insights on the heterogeneity of exporting firms described in the seminal paper by Melitz (2003).

Results from our data analysis and simulations are suggestive of three important facts. First, the economy of Brazil is probably far from the ongoing global paradigm of specialization in stages of production (fragmentation) and connection to global/regional value chains. On the contrary, the low levels of foreign content embedded in Brazilian manufacturing exports suggest that they are still mostly "made in Brazil", whereas global exports are progressively "made in the world". Second, TBTs and SPSs measures may constitute significant trade barriers among China and Mercosur countries. Ignoring the existence of those barriers can significantly undermine sector-specific gains from trade if negotiations are restricted to the elimination of import tariffs and quotas. Third, joining a PTA involving Mercosur and China may pave the way to the integration of Brazil's manufacturing sector to relevant GVCs in more dynamic regions in the world.

The structure of this paper is organized as follows. Section I presents a set of stylized trade facts about the Brazilian economy, exploring some of the new information available in the "so called" TIVA and WIOD databases. Section II discusses the extended concept of "natural trade partners" according to the logic of global/regional value chains. Section III describes the econometric model used to estimate the *ad valorem* equivalents of TBTs and SPSs imposed over bilateral trade flows among China and Mercosur countries. Section IV presents the impacts of a PTA involving Mercosur and China on the economy of Brazil, tracing out

bilateral trade in value added as well as bilateral trade in intermediates. Section V summarizes the main findings of this paper.

2. Contextualizing Brazilian economy in the era of Global Value Chains

From the post second world war till the end of the eighties, the import substitution model formed the basis of industrialization policies in Latin American countries, including Brazil.

Brazil's import substitution model succeeded in building a diversified and complex domestic manufacturing sector, based on a relatively dense and interconnected domestic supply chain of intermediates and final goods. By the beginning of the eighties, value added in manufacturing activities in Brazil peaked 25% of country's GDP, a level close to the average of OECD countries at the time. The significant development of manufacturing activities in Brazil was followed by widespread productivity gains over the domestic economy. Along two decades, from 1960 to 1980, annual average growth in total factor productivity in Brazil reached 2.3%, a level by far the highest among Latin American countries, and also higher than in the USA, South Korea, China and the average of OECD countries during the same period (Veloso et al, 2013).

The end of the seventies and beginning of the eighties comprised a period of market oriented reforms in China and the start of its emergence as a global trader. Instead of adopting the import substitution model, China and most of its Asian neighbors took advantage of their cheaper labor costs and decided to unilaterally open up to trade, attracting a whole set of less sophisticated manufacturing activities from richer offshoring nations such as the USA and western European countries. This period also coincided with the decline of the share of manufacturing value added over GDP in most developed regions in the world as well as some developing countries such as Brazil: in 1984, manufacturing valued added represented near 23% of GDP in OECD countries and Brazil. In 2010, this share had declined to less than 15% in both regions. Along the same period, the share of manufacturing value added over GDP in Asia raised from 22% to over 28% in 2010 (Bonelli et al, 2013). Those facts may explain why the Asian continent is nowadays called "factory Asia".

The emergence of Asia as a significant pole of manufacturing activity[4] in the world gave rise to a new global pattern of specialization. Increasingly interconnected through global/regional value chains, developed regions became relatively more specialized in the production and supply of high-skilled services as well as some high tech intermediate products whereas developing regions became relatively more specialized in the production and supply of low-skilled manufacturing tasks. Despite its concentration in the international trade of intermediates instead of final goods[5], this new global pattern of specialization seems to be in agreement with

[4] More recently, eastern European countries such as Czech Republic, Slovak and Hungary also became poles of manufacturing activities linked to regional value chains among European countries. Mexico is also another example of a developing country with significant poles of manufacturing activities deeply integrated to regional value chains in NAFTA.

[5] Based on the World Input-output database (WIOD), trade in intermediates represented more than two thirds of global exports in 2011.

Hecksher-Ohlin predictions regarding trade patterns established by comparative advantages embedded in distinct relative factor proportions among countries (Timmer et al, 2014).

Table 1. GVC workers directly and indirectly involved in the production of manufacturing goods (1995-2008).

	Manufactures GVC workers as (%) share of all workers in the economy		Manufactures GVC workers in 2008 by sector			Change in manufactures GVC workers 1995-2008 (%)			
Country	1995	2008	Agriculture (% of the total)	Manufacture (% of the total)	Services (% of the total)	Agriculture	Manufacturing	Services	Total
West. Europe	24.40	20.40	5.60	49.90	44.50	-35.30	-12.90	21.40	-2.50
East. Europe	31.20	28.20	17.30	53.80	28.90	-34.30	-3.50	18.70	-6.10
USA	16.04	11.12	6.77	52.38	40.85	-22.43	-26.24	-14.17	-21.47
Japan	22.6	19.4	10.64	53.18	36.19	-37.96	-25.53	3.47	-19.04
Canada	20.80	16.00	5.64	41.00	53.36	-39.52	-10.69	15.00	-1.60
South Korea	29.7	22.8	12.18	49.2	38.62	-41.67	-21.74	33.77	-11.20
Taiwan	30.90	29.90	3.73	62.48	33.79	-64.31	9.12	22.25	4.89
Mexico	30.3	24.4	23.18	50.43	26.38	-12.42	29.7	53.76	21.19
China	31.73	33.35	46.96	33.89	19.15	8.95	30.58	31.90	19.65
India	27.92	27.27	45.85	33.19	20.96	3.80	35.10	36.10	18.85
Brazil	29.6	28.7	30.18	34.31	35.51	-7.79	34.81	72.19	26.9

Source: Author`s calculation based on World Input-output database.

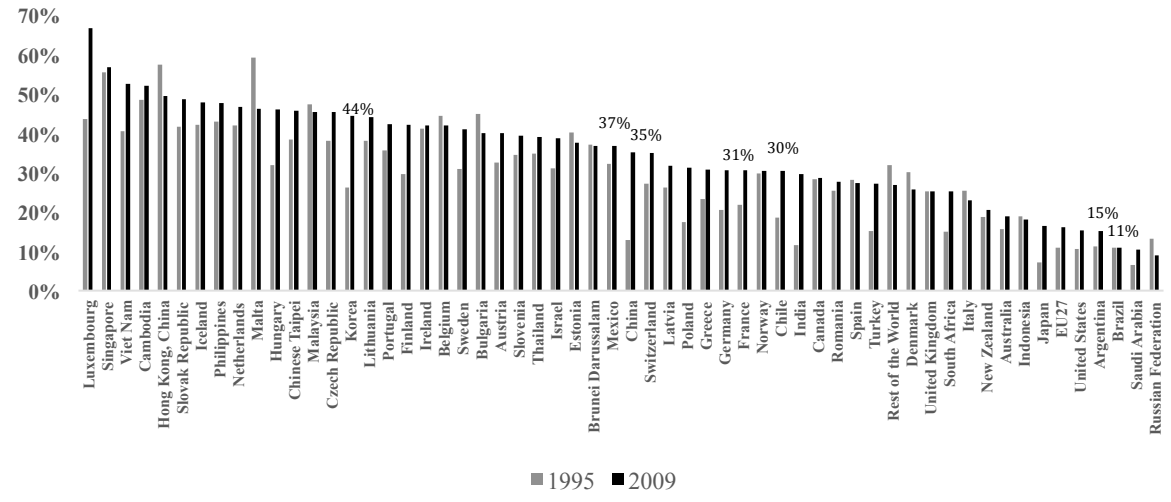
The new global pattern of specialization can be easily identified in the data shown in Table 1 for a set of regions over the period from 1995 up to 2008. Using a similar methodology as the one adopted by Timmer et al (2013), it is possible to trace out the number of workers directly and indirectly involved in the production of final manufacturing goods in each region. Results in Table 1 highlight four important facts. First, manufacturing related jobs have been losing importance as a share of total labor force for all countries and regions shown in the Table, except China (columns 1 and 2). Second, over 50% of manufacturing related jobs are not directly involved in manufacturing activity. Instead, they are involved in agriculture and services activities. In Brazil, near 65% of manufacturing related jobs are actually employed out of the manufacturing sector (columns 3 and 5). Third, direct manufacturing jobs have been losing importance in developed regions. On the other hand, they have been gaining relative importance in developing ones (column 7). Fourth, the production of final manufactured goods has become more intensive in services for all regions in the world. However, this process has been clearly more intensive in developed regions compared to developing ones (columns 6,7 and 8).

Regardless of being a developing economy, structural changes in Brazil are harder to interpret based on the information available in Table 1. On one hand, direct manufacturing employment has increased over the period 1995-2008, as in other developing regions such as Mexico, China and India. On the other hand, the growth of manufacturing related service jobs has increased nearly two times faster, a pattern of specialization that resembles the ones verified for the group of developed regions in the world. Indeed, a broader view of structural changes occurred

in the Brazilian economy for the larger period of 1984-2014 reveals that the share of services value added raised from 45% of country`s GDP to nearly 70%. Regarding the composition of its total exports, in 2011 manufactured and services exports corresponded to 41.4% and 16.2% of total exports in Brazil, respectively. However, when the composition of total value added exported is taken into consideration, those same shares change to 27.4% and 40.7%, suggesting that a lot of services intermediates are exported embedded in the exports of manufactured goods.

Therefore, the ongoing pattern of specialization in services activities for the economy of Brazil, rather than the result of deeper integration to global/regional value chains, as it seems to be the case for developed economies (Table 1), may be rather the consequence of its isolation. Excessive import protection for long periods, associated with the formalization of just a few and usually shallow PTAs over the last decades, might have contributed to the current low competitiveness of Brazil's manufacturing sector and its relative isolation from relevant international supply chains. For instance, despite the large size of its economy – Brazil is among the ten largest economies in the world - the share of Brazil's exports on global exports has stagnated around 1.5% for at least the last three decades. According to the GTAP database for 2007, import penetration in Brazil (total imports over GDP) corresponded to 11%, the lowest percentage in a sample of 133 countries. Regarding Brazil's manufacturing sector, Figure 1 shows the evolution of the foreign content embedded in manufactured exports for a group of 58 countries, from 1995 to 2009. While most of the countries in the sample seemed to have significantly increased its participation in the ongoing process of fragmentation of production, the share of foreign intermediates embedded in Brazil's manufactured exports have kept stagnated at the level of 11%. According to this criterion, the manufacturing sector in Brazil is one of the least integrated to value chains among its peers, showing a higher level of integration only in comparison to the manufacturing sectors in commodity exporters such as Saudi Arabia and Russia.

Figure 1. Foreign content in manufacturing exports over the period 1995-2009.

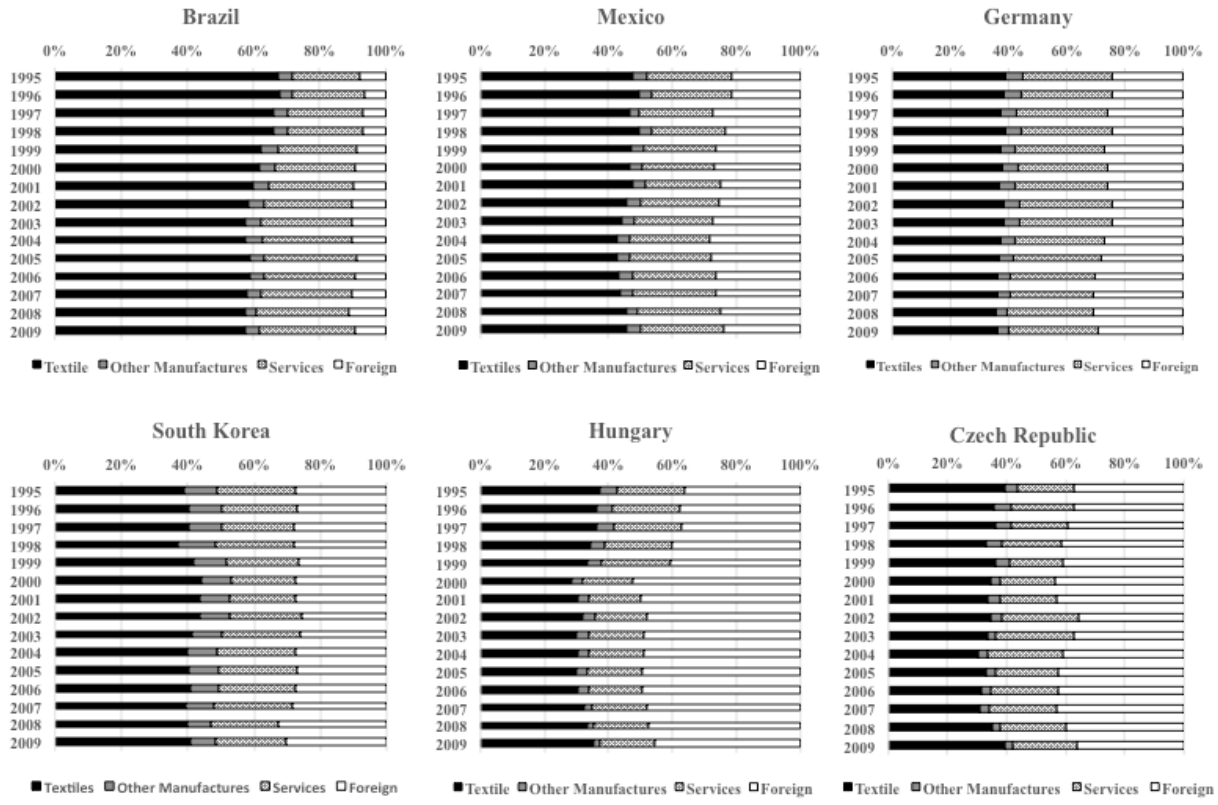


Source: Author`s calculation based on the "Trade in Value Added" database (TIVA - OECD).

More disaggregated sectorial evidence on how integrated the economy of Brazil is to GVCs can be found through the use of input-output techniques such as in Timmer et al (2013). Based on a methodology close to the one applied to calculate the evolution of jobs presented in Table 1, it is possible to trace out the sectorial value added created to produce a manufactured final good along its different stages of production (domestic and abroad) directly and indirectly involved in its value chain. Figure 2 slices up total value added created in the production of a final good in the textile sector for a sample of countries, including Brazil, over the period 1995-2009. The analysis of Figure 2 unravels two main facts. First, a significant share of total value added generated in the production of a final textile good remunerates factors of production in the domestic services sector. This is true for all the countries in the sample. Second, there is a significant foreign content embedded in the local production of a final textile good for all the countries in the sample, except Brazil. For instance, in 2009 nearly 30% of total value added created in the production of a final textile good in Germany was devoted to the payment of factors of production in foreign countries. For the same year, this share was nearly 10% in Brazil.

When the whole domestic economy is considered in its different sectors, calculated shares in Figure 4 confirm that nearly 87% (in average) of all inputs used in the production of a final good in the manufacturing sector in Brazil, in 2011, corresponded to intermediate goods produced locally. It is worthy note the relevance of China as a significant source of imported intermediates.

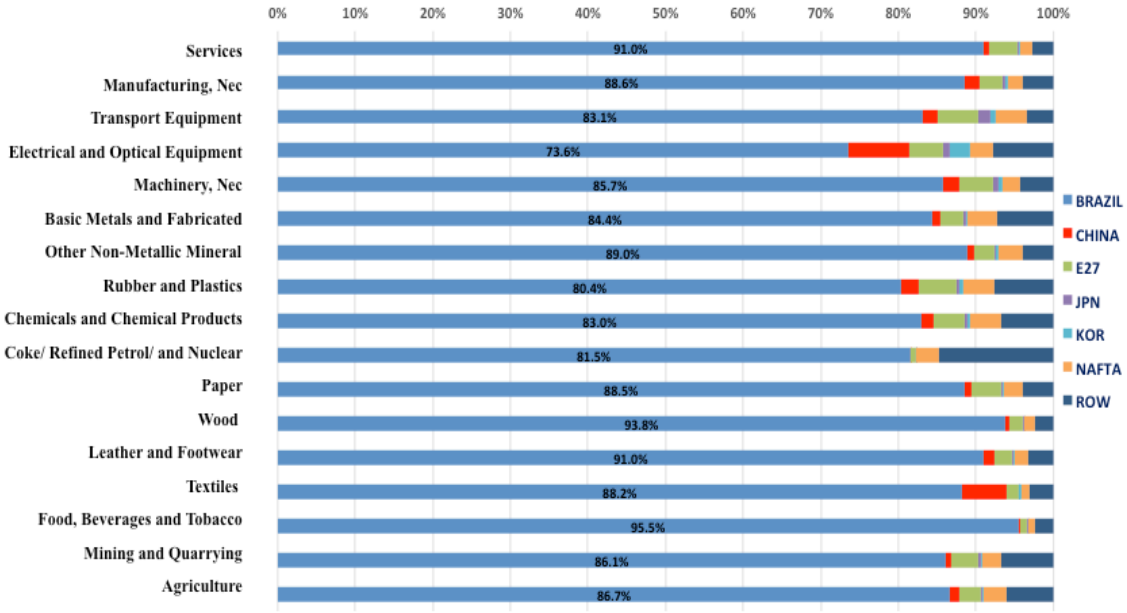
Figure 2. Value chain income created in the production of a final good in the textile sector for a group of countries (2011).



Source: Author`s calculation based on the "Trade in Value Added" database (TIVA - OECD).

The analysis of Figures 1 to 4 suggests that the manufacturing sector in Brazil is still little integrated to significant international supply chains. Currently isolated from this ongoing process and still locked in the old paradigm of import substitution policies, the manufacturing sector in Brazil has lost its prominence as the country's growth promoting engine. The flipside of this whole process is the increasing relevance of lower value added services activities in Brazil and the resulting fall in total factor productivity. The economy of Brazil and particularly its manufacturing industry need to open up to trade and to integrate to more dynamic and competitive regions in the world. The formalization of new PTAs may be a promising starting point in this regard.

Figure 4. Share of domestic inputs in total inputs consumption by each sector in the economy of Brazil (2011).



Source: Author`s calculation based on World Input-output database.

3. The "Natural Trade Partner" concept extended to Trade in Intermediates

The global unbundling of production has changed the concept of competitiveness. In the recent past, goods were bundles of local inputs and the key determinants of competitiveness were national. Nowadays, goods are bundles of many nation's inputs, allowing the exploration of comparative advantages throughout international supply chains at the level of each stage of production. It turns out that in this new world, the notion of competitiveness must extrapolate domestic borders and firms must envisage a global perspective.

Assuming that PTAs can create additional incentives for member countries to integrate their production structures and to build global/regional value chains, which partners should a country prioritize once it decides to open up to trade?

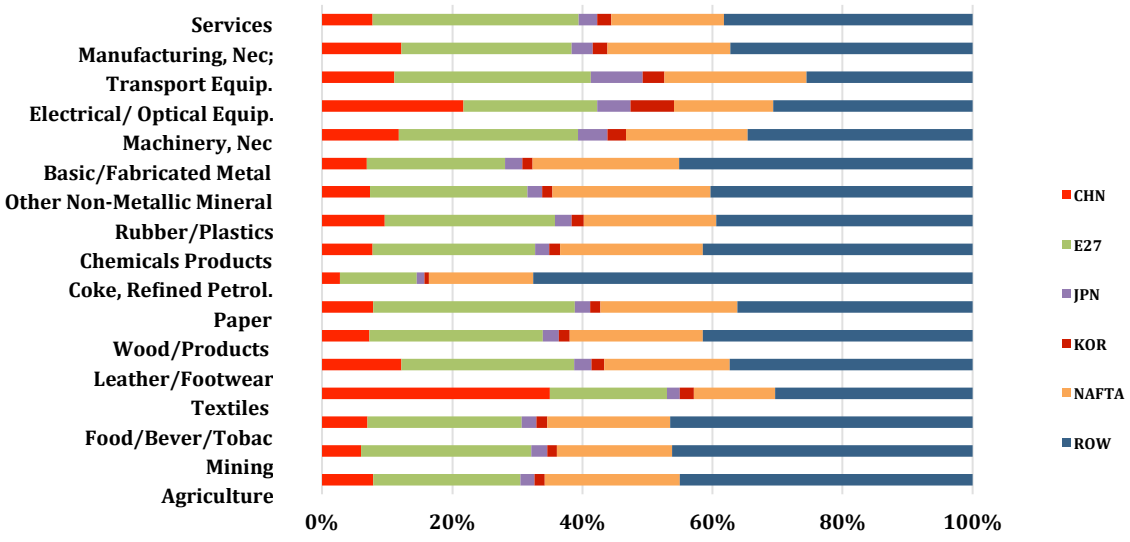
One possible way to tackle this issue is to measure the participation of a country in international supply chains according to its "backward" and "forward" linkages. On one hand,

the higher the foreign content embedded in a country's domestic exports, the stronger are its backward linkages. By the same token, the higher the share of a country's domestic exports of intermediates embedded in other foreign countries' exports, the stronger its forward linkages.

Therefore, the formalization of PTAs among countries with strong backward and forward linkages should be more prone to the formation of global/regional value chains, as long as it may reinforce bilateral trade in intermediates according to the supply chain logic. However, since mutual preferential market access is not necessarily given to the most efficient suppliers once a broader bilateral trade perspective is taken, trade creation cannot be taken for granted.

The Chinese economy is responsible for more than 20% of Brazilian imports and exports, suggesting that China can be considered a Brazil's natural trade partner according to Vinner's traditional definition[6]. When backward and forward linkages are considered, Figures 5 and 6 show that China is also a significant source of intermediates to Brazil's exports (backward linkages) as well as a significant consumer of Brazil's exports of intermediate goods that go embedded in Chinas's exports (forward linkages) to other trade partners (figures are for 2011). Therefore, a PTA involving Brazil and China may have a high potential to be welfare improving (net trade creation) for the Brazilian economy and may also increase bilateral trade in intermediates according to the supply chain logic. Backward and forward linkages therefore can extend the traditional view of a natural trade partner beyond trade creation and trade diversion to include how prone is a hypothetical PTA to create additional price/cost incentives to the formation of global/regional supply chains.

Figure 5. Share of China's backward linkages on Brazil's sectorial exports of final goods (2011).

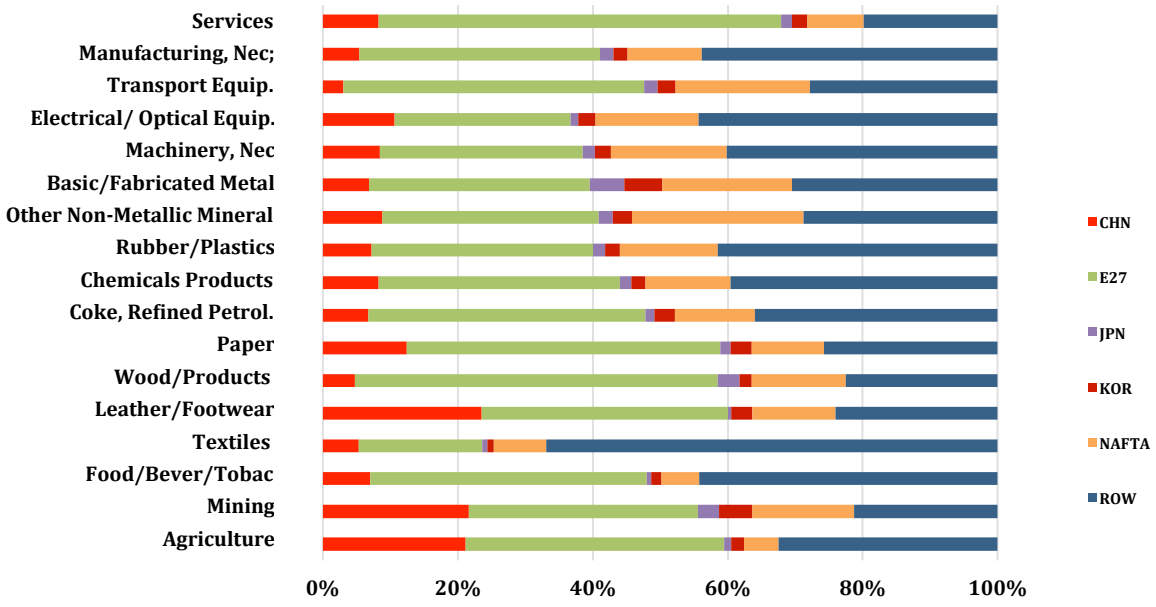


Source: Author`s calculation based on World Input-output database.

[6] China is currently Brazil's most relevant trade partner, followed by USA and the European Union.

Figures 5 and 6 also suggest that other regions in the world such as NAFTA and EU_27 could possibly be considered natural trade partners for Brazil, according to the value chain logic[7]. However, when a pure dynamic perspective is taken into consideration, China seems to take the lead as a preferential trade partner. This idea is made clearer by the analysis of Figures 7 and 8. Figure 7 shows the evolution of the share of imported intermediates over total intermediates consumption by a set of production sectors in Brazil, for the period 1995 to 2011. Accordingly, the share of imported intermediates over total intermediates consumption has risen for all sectors in the period, particularly in higher technological sectors such as Chemicals, Machinery, Transport equipment, Electrical/optical equipment and Rubber/Plastics. Figure 8 shows the relative dynamics of local consumption for each country-source of intermediates by sector in Brazil, suggesting that the increase in imported intermediates was made at the expense of local intermediates for all sectors. Furthermore, among the three regions, China was by far the economy that has benefited the most over the period, increasing its relative supply of intermediates for all sectors in Brazil, including high technological sectors such as Electrical/optical equipment, Transport equipment and machinery, as well as lower-skilled labor intensive sectors such as Textiles.

Figure 6. Share of China's forward linkages on Brazil's sectorial exports of intermediates (2011).



Source: Author`s calculation based on World Input-output database.

[7] The EUA and EU_27 could both be considered Brazil's natural trade partners according to Vinner's logic.

Figure 7. Evolution of the share of imported intermediates over total consumption of intermediates by sector in Brazil, from 1995 to 2011.

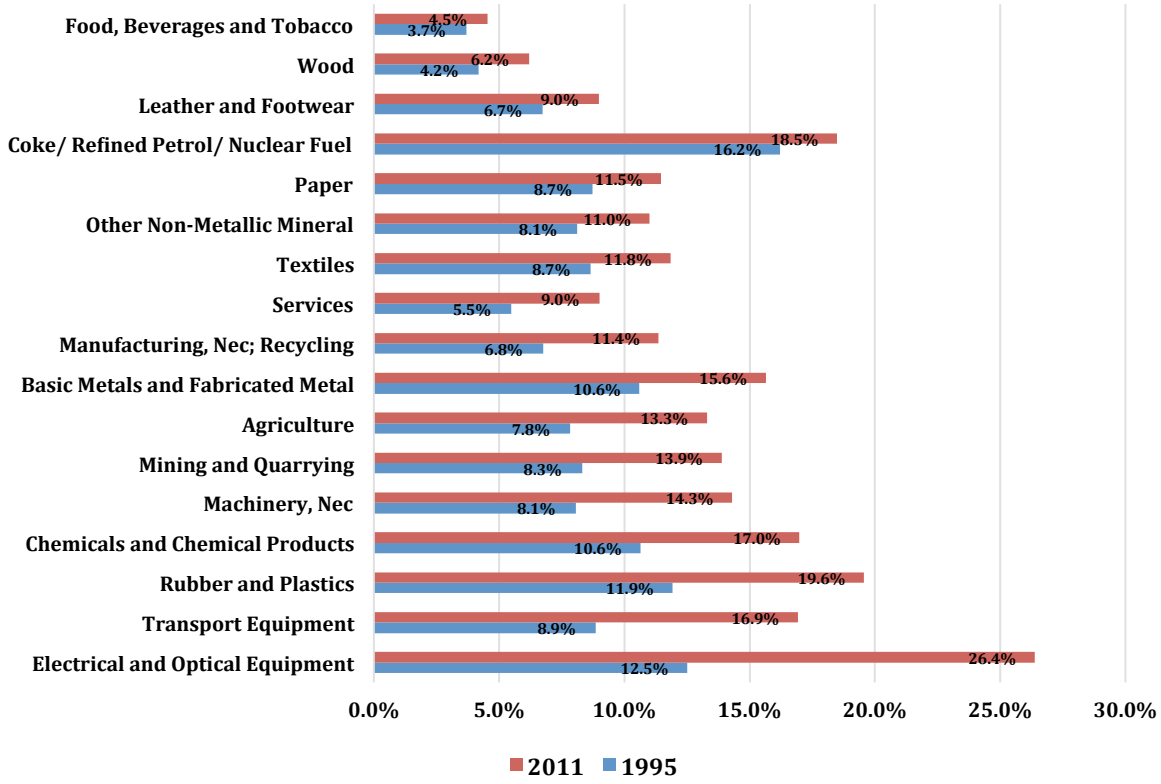
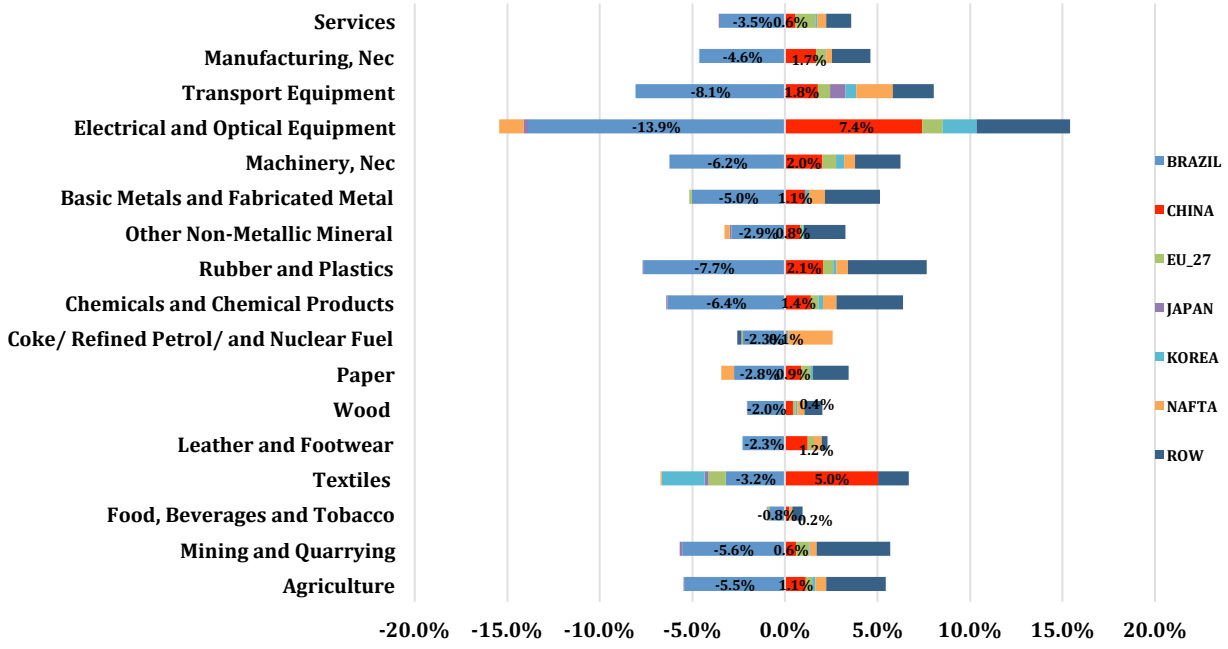


Figure 8. Evolution as a source of intermediates by sector in Brazil (1995 to 2011).



4. Estimating the Ad valorem equivalents of Non-Tariff Barriers (NTBs): The impact of Technical Barriers to Trade (TBTs) as well as Sanitary and Phitosanitary measures (SPSs) on bilateral trade flows.

World average import tariffs have significantly declined over the last decades as a result of several trade negotiating rounds at the WTO. More recently, countries notifications of technical barriers to trade (TBTs) as well as sanitary and phitosanitary measures (SPSs) started to proliferate, raising serious concerns of protectionist behavior and possibly threatening global efforts towards a world of free trade. Regardless of the real objectives of the imposition of non tariff barriers such as TBTs and SPSs, several empirical studies have pointed out their likely negative effects on trade flows (Leamer, 1990; Moenius, 2004; Disdier et al, 2008; Kee et al, 2009;).

Most of the studies on the effects of NTBs on bilateral trade flows are based on gravity models. However, the existence misspecifications in several of theses studies called the attention to a group of trade theorists starting by the influential work of Anderson and Wincoop (2003), where the issue of "remoteness" in gravity equations was first modeled and addressed. The work by Silva and Tenreyro (2005) points out to another possible misspecification problem in gravity regressions, suggesting that under heteroskedasticity, the parameters of log-linearized gravity models estimated by OLS may lead to biased estimates of the true elasticities. More recently, another influential article by Helpman et al (2008) raised the issue on the existence of firm heterogeneity and also on the correct treatment of zero bilateral trade flows in traditional gravity estimations, prompting a new generation of empirical studies addressing specification concerns such as the existence of sample selection bias and the influence of heterogeneous firms in gravity equations. Among the new generation of empirical studies controlling for the existence of sample selection bias in gravity models are Disdier and Marette (2010) and Crivelli and Groschl (2012).

According to the work by Helpman et al (2008) if the probability to become an exporter is correlated to the decision on how much to export, the estimated impact of NTBs on trade flows using standard gravity OLS regressions are likely to be downward biased. Regarding firm heterogeneity, the authors point out that standard gravity equations "confound the effects of trade barriers on firm-level trade with their effects on the proportion of exporting firms". Accordingly, if firm heterogeneity is not somehow included as a explanatory variable in the standard gravity equation, its absence may induce an upward bias on the estimated effects of NTBs on trade flows.

The issue of sample selection bias in gravity models can be properly addressed through the Heckman's selection model (Heckman, 1979). In this work, we use Heckman's model in its two-stage version. The first stage specifies a Probit model which (*ceteris paribus*) estimates the impact of a NTB on the probability of a firm to become an exporter. The first stage also estimates the inverse Mills ratio (the so called Heckman's lambda) that must be added as a additional explanatory variable in the (second stage) standard gravity equation. Its worthy note that the second stage equation estimates the impact of a NTB on bilateral trade flows, conditional on the fact that firms are already exporters.

The issue of firm heterogeneity can be also addressed in the second stage gravity equation through the fraction of exporting firms in each sector. Based on the seminal model of

heterogeneous firms by Melitz (2003), it is possible to show that the fraction of exporting firms in each exporting sector and bilateral trade flow can be estimated based on the inverse of the cdf of the unit-normal distribution applied to the estimated first stage probabilities of a firm to become an exporter. The estimated fraction of exporting firms in each sector for each bilateral trade flow can then be added as a regressor in the second stage standard gravity equation.

The general equilibrium effects of NTBs can be estimated through the calculation of their ad valorem equivalents and then through their implementation in CGE models (Gasiorek et al, 1992; Harrison et al, 1994; Andriamananjara et al, 2003, 2004; Francois et al, 2005). However, as already signaled by Baldwin (2000), the notification of TBTs and SPSs by importing countries are likely to generate extra fixed as well as variable costs for exporting firms. Therefore, when working in conjunction with those notifications, CGE models should somehow accommodate an imperfect competition market structure able to represent export-specific fixed costs due to the existence of NTBs. The first attempt to represent those fixed costs can be found in Zhai (2008) and more recently in Akgul et al (2014).

This article uses the GTAP model on its dynamic version under a perfect competition market structure. Therefore, calculated ad valorem equivalents of TBTs and SPSs must represent estimations of pure extra variable costs and shall not be influenced by any kind of fixed costs. The Heckman selection model seems to be suitable for this task as long as fixed costs are not expect to exert any sort of influence on its second stage gravity equation. This must be true since fixed costs must only influence entrepreneur's decision to become an exporter (Heckman's first stage equation representing the effects of NTBs on the extensive margin of trade) but not his decision of how much to export, given that he is already an exporter (Heckman's second stage equation representing the effects of NTBs on the intensive margin of trade). This reasoning is fully backed by the theoretical foundations found in Melitz' seminal model of heterogeneous firms (Melitz, 2003).

4.1. The Gravity Equation

The gravity specification used to estimate the impacts of NTBs on bilateral trade flows is described by equation (1):

$$y_{ijst} = \alpha_p d_p + \gamma_s NTB_{ist} v_s + v_s^p d_p v_s + \gamma_s^p NTB_{ist} v_s d_p + X_{ijst}\beta + \alpha_i + \psi_j + v_s + \eta_t + \varepsilon_{ijst} \quad (1)$$

Where i stands for the importer country (China and Mercosur countries: Brazil, Argentina, Uruguay, Paraguay and Venezuela), j for the exporter country, s for sector and t for the time period. Therefore, y_{ijst} denotes the (CIF) value of country i's imports from country j, in sector s and time period t. Dummy variables α_i, ψ_j, v_s and η_t control for the fixed effects of importers, exporters, sectors and time, respectively. The vector X_{ijst} represents standard gravity control variables, such as: GDP (both for importer and exporter), bilateral distance, common language, border sharing and colonization. The variable d_s is a sectorial dummy variable, which is equal to 1 if country pair trade flows belongs to sector *s* and zero otherwise. The vector dummy variable d_p controls for specific bilateral trade flows and includes the

following relations: imports among Mercosur members, imports by Mercosur countries from China and vice-versa. The dummy variable NTB_{ist} controls for sector-specific NTBs imposed by importer *i* in sector *s*, which is still active in year *t*. It is defined as follows:

$$NTB_{ist} = \begin{cases} 1, & se\ t \geq t_{is}^{*} \\ 0, & otherwise \end{cases}$$

where t is the current year and t_{ij}^{*} is the first year which country i imposed the first TBT and/or SPS notification on a product included in sector s.

We are interested in the likely effects of NTBs within each sector for each possible bilateral combination of trade flows among Mercosur countries and China.

4.2. Database

Bilateral flows of imports (in current dollars) as well as import tariff data were obtained from the World Integrated Trade Solutions (WITS) of the World Bank. The data are annual from 2006 to 2013, according to the four-digit classification of the Harmonized System (HS04). We could have used data at the HS06 disaggregated level, but the measures are defined mostly in four digits or less. Tariff data used in this work are sectorial simple averages. The advantage of using simple averages - rather than the weighted averages by trade flows - is to circumvent possible endogeneity in the estimation procedure. GDP data were obtained from the World Bank. The work uses GDP data in current dollars since the HS code data were only available in current dollars as well. Additional control variables, such as bilateral distance, common language and border sharing as well as colonization were obtained from the French think tank CEPII. The number of documents necessary to import was used as the excluded variable (instrument) in the first stage of the Heckman selection model. This variable was sourced from the site "Trading across borders" of the Doing Business (World Bank).

Most of the TBT and SPS measures imposed by Mercosur countries and China were sourced from the site of the World Trade Organization (WTO). However, a significant amount of notifications reported to the WTO does not necessarily report the product codes affected by such notifications. Therefore, the database used in this work had to be complemented by additional information available from other sources such as the Brazilian National Institute of Metrology, Quality and Technology (Inmetro) and the Centre for WTO Studies (CWS). While Inmetro provided us product codes for additional TBT notifications, the CWS provided the codes for the additional SPS notifications. Product codes were available at the HS04 disaggregated level.

Last, we used a correspondence between the GTAP sectorial classification and the HS04 code, assigning the GTAP sectorial classification to bilateral trade flows in the Heckman selection model.

4.3. Results

The time frame covered in this work corresponded to 2006 till 2013. Over this period, a sample of 82.405 observations on positive import flows for Mercosur countries and China are available. When zero import flows are added to the sample, the number of observations raises to 330.234. Over the years, nearly 74% of the observations corresponded to zero import flows, suggesting a high potential for sample selection bias in standard gravity estimations when only positive trade flows are considered.

The third column in Table 1 reports standard (pooled) OLS estimates of a gravity model. The estimated coefficients have the expected signs and are mostly significant at the 1% level, exception made for the estimates on the impact of the exporting country's GDP, which is not statistically different from zero. The second column in Table 1 reports the estimations of a Probit model with basically the same set of explanatory variables as the model in column two and corresponds to the first stage of the Heckman selection model. The Probit model estimates the impacts of traditional gravity variables on the probability to become an exporter. The significance of the estimated coefficients suggests a likely correlation between the decisions on how much to export (import) and the probability to become and exporter. This is the second piece of evidence on the existence of sample selection bias in traditional OLS gravity estimates. For identification reasons related to the second stage estimations of the Heckman selection model, the variable "import documents" was added to the Probit model. This variable reports the number of documents needed to import a given good into Mercosur countries and China from the rest of the world. Heckman correction imposes that this variable must help explaining the probability to export, but it should be orthogonal when it comes to explaining the decision on how much to export. According to Melitz (2003), sectorial extensive margin of trade is deeply influenced by existing heterogeneity on the productivities of domestic firms. Accordingly, sectors facing higher fixed costs to export are likely to sell lower volumes abroad, since only a few most productive firms may be able to earn positive profits in the exporting activity. As long as "the number of documents to import" in the destination country constitutes an additional fixed cost to exporting firms in source countries, it should exert a negative and statistically significant effect on the probability of a firm to become an exporter, as it is shown in the first column of Table 1. As a fixed cost, however, it should have no influence on the marginal decision on how much to export, given that a firm is already exporting, as it seems to be the case according to estimations reported in the second column of Table 1[8].

The Mills ratio estimated in the first stage (second column) is then used as an additional explanatory variable in the second stage (column 4) of the Heckman selection model. Estimations reported in column three reveal two important facts. First, the highly significance of the Mills ratio corroborates the existence of sample selection bias and the importance of taking zero trade flows into consideration when working with gravity models. Secondly, not controlling for the existence of sample selection bias in traditional gravity estimations (third column) may lead to downward biased estimates.

[8] This is probably a more suitable instrument than the" regulatory costs to start operating a business" as used in the work by Helpman et al (2008), as long as "the number of documents to import" seems to be less general and more trade specific.

Table 1. Two-stage Heckman selection model (2006-2013).

Dependent variable: y_{ijst}

	Probit	OLS	Heckman Selection	Firm Heterogeneity
GDP importer	0.398***	0.461**	0.972***	0.539***
	(0.0594)	(0.178)	(0.170)	(0.196)
GDP exporter	-0.0503	0.0604	-0.0838	0.0425
	(0.0339)	(0.0993)	(0.103)	(0.1000)
Distance	-0.400***	-0.704***	-1.125***	-0.811***
	(0.0296)	(0.0963)	(0.0963)	(0.106)
Colonial Ties	0.361***	0.312	0.981***	0.410*
	(0.115)	(0.210)	(0.250)	(0.235)
Language	0.354***	0.628***	1.045***	0.725***
	(0.0491)	(0.124)	(0.119)	(0.123)
Land border	0.247***	0.443***	0.646***	0.501***
	(0.0708)	(0.136)	(0.150)	(0.155)
Import Documents	-0.402***	0.411*		
	(0.0877)	(0.219)		
Inverse Mills ratio			3.579***	
			(0.294)	
Firm heterogeneity				-0.272
				(0.225)
Observations	323015	83635	83635	83635
Adjusted R^2	0.580	0.501	0.535	0.501

Note: * Significant at 10%; **Significant at 5%; ***Significant at 1%. The simulations in each column also control for the interactions between a existing measure (dummy variable) and each of the 42 GTAP sectors (sectorial dummy variables).

From the inverse of the cdf of the unit-normal distribution applied to the first stage estimated probabilities in the Probit model, it is possible to build a proxy to the sectorial share of existing exporting firms in each sectorial flow of exports absorbed in Mercosur countries and China. This proxy variable is then added to the second stage gravity equation in column 5, suggesting that the impact of firm heterogeneity is not statistically different from zero. The insignificance of firm heterogeneity may be explained, at least in part, due to low number of exporting firms in Brazil, where only a few multinationals firms with higher than average productivity levels are responsible for most of exports in the country[9].

[9] Helpman et al (2008) worked with bilateral trade data at the national level. They obtained that the effect of firm heterogeneity is usually stronger than the effect of sample selection bias in gravity equations. We guess that their results can be sensitive to the level of data aggregation.

The two-stage Heckman selection model provides valuable information both for the extensive margin of trade (first stage Probit model) as well as for the intensive margin of trade (second stage pooled OLS model). Results reported in Figures 10, 11 and 12 show the sectorial impacts of existing measures (TBT/SPS) on bilateral trade flows among Mercosur countries, on Mercosur countries' bilateral imports from China and on China's imports from Mercosur countries, respectively. All the estimations were derived from the first stage Probit model and therefore measure the likely impacts of existing notifications on the probability of a firm to become an exporter at each GTAP sector level, in each source country.

Figure 10. Sectorial impacts of NTBs on the probability to become an exporter: Mercosur-Mercosur

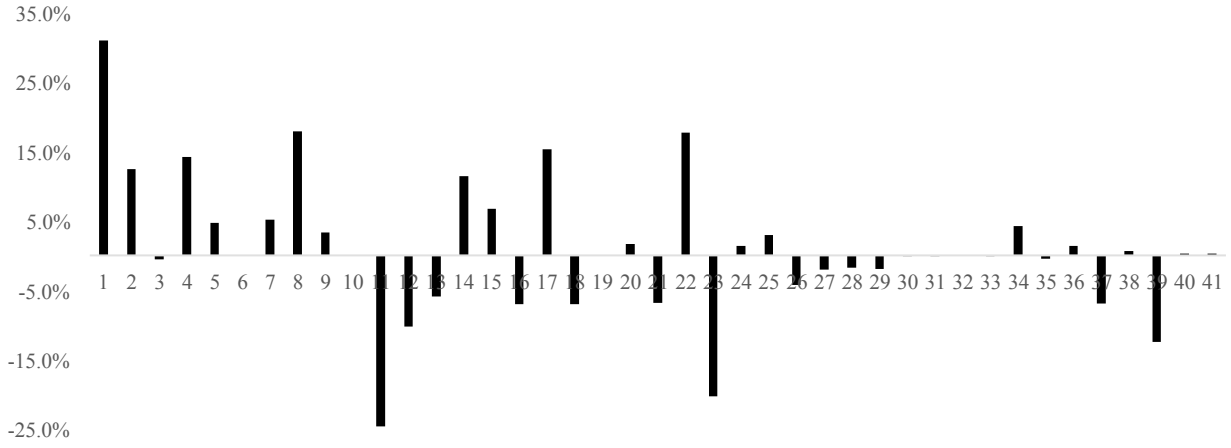


Figure 11. Sectorial impacts of NTBs on the probability to become an exporter: Mercosur-China

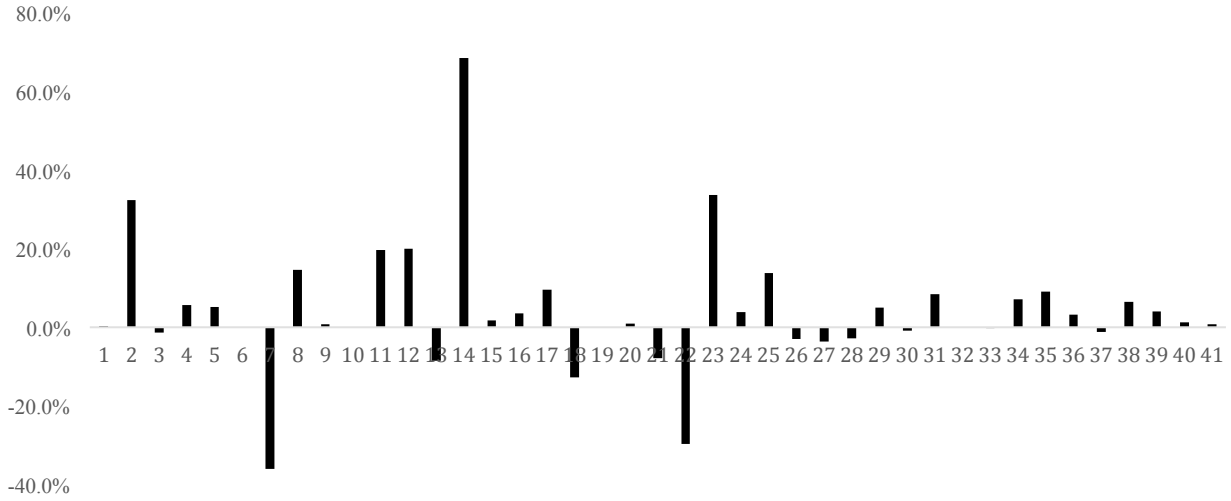
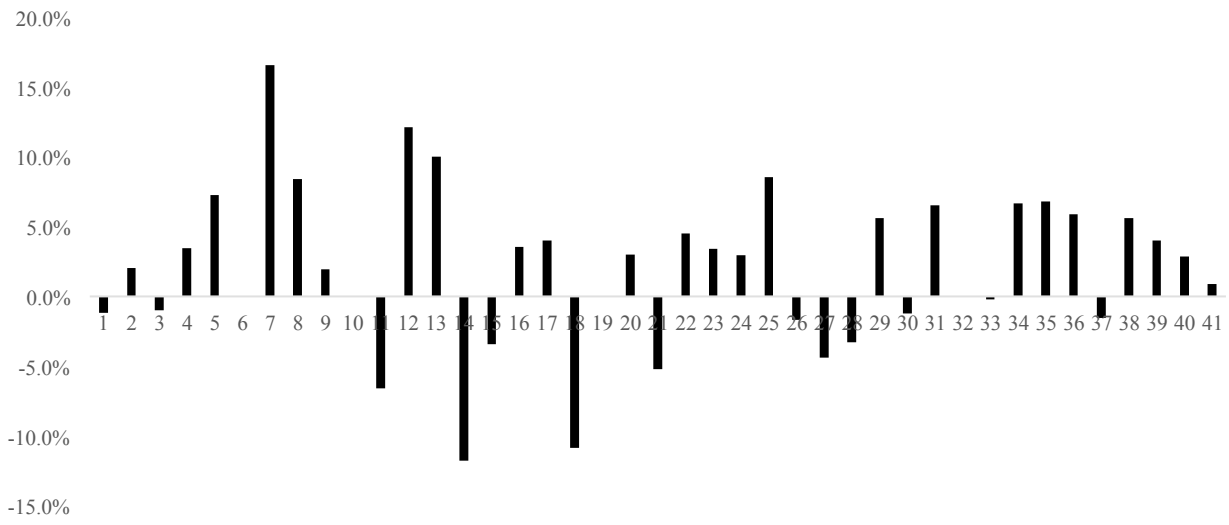


Figure 12. Sectorial impacts of NTBs on the probability to become an exporter: China-Mercosur



According to Figures 10, 11 and 12, the imposition of a NTB by an importing country may have contrasting sectorial effects on the exporting country. For instance, Figure 11 shows that when a typical country from Mercosur imports from China, pre-existing TBT/SPS in GTAP sector 7 decreases the sectorial probability of a Chinese firm to become an exporter to Mercosur by over 30%. In contrast, the imposition of non-trade barriers in GTAP sector 23 increase the sectorial probability of a Chinese firm to become an exporter to countries in Mercosur by more than 30%. These two apparently conflicting results may be reconciled when a more careful look is given to the expected firm level effects of a TBT/SPS. Accordingly, the imposition of a given measure by an importing country may exert simultaneous and conflicting effects on the exporting firm's demand, marginal costs and fixed costs. This is the reason behind the apparent ambiguity when the net effects of measures on firm's behavior are evaluated. For instance, when the fixed cost effect of a measure is dominant, it will affect negatively the extensive margin of trade, meaning that the probability of a firm to become an exporter will decrease. On the other hand, when the demand effect of a given measure is dominant[10], it will increase the probability of a firm to become an exporter. It is worthy noting that when it comes to the intensive margin of trade (second stage equation), variations in fixed effects due to the imposition of a given measure play no role in the decision of a firm on how much to export.

Results in Tables 2 to 4 show the estimated tariff equivalents of existing TBT/SPS per each GTAP sectorial trade flow among countries in Mercosur and China. These tariff equivalents are calculated from the marginal effects of sectorial measures and tariffs on bilateral imports estimated from the second stage equation (column 5) in the Heckman selection model. For the non-reported tariff equivalents in the Tables, it means either that its calculated impact on bilateral trade flows was positive or not statistically different from zero.

[10] For instance, a firm may decide to become an exporter if the positive demand shock resulting from adopting the new standard notified in the importing country pays for the higher total costs it will be obliged to bear.

Table 2. Ad valorem equivalents (%) of NTBs: Agriculture

Sectors	Mercosur-Mercosur	Mercosur-China	China-Mercosur
Paddy rice	-	7.25	-
Wheat	1.83	-	-
Cereal grains nec.	4.32	2.84	2.88
Vegetables, fruits	8.40	10.60	-
Oil seeds	2.49	10.49	-
Plant based fibers	-	12.52	-
Crops nec.	8.88	6.58	-
Bovine cattle, sheep/goats/horses	11.16	10.36	10.30
Wool/silk	12.56	-	9.22

Table 3. Ad valorem equivalents (%) of NTBs: Extractive

Sectors	Mercosur-Mercosur	Mercosur-China	China-Mercosur
Fishing	0.71	-	-
Coal	-	-	-
Oil	1.45	1.20	0.29
Gas	1.46	-	-

Table 4. Ad valorem equivalents (%) of NTBs: Agribusiness

Sectors	Mercosur-Mercosur	Mercosur-China	China-Mercosur
Bovine meat products	20.87	17.71	17.71
Vegetables, Oils and fats	10.18		
Dairy products	17.90	18.90	19.18
Processed rice	-	19.57	18.23
Sugar	20.56	-	9.36
Food prod. nec.	9.58	8.87	4.68
Beverage/Tobacco	-	4.96	5.39

In general, results in Table 2 to 4 suggest that the protectionist effects of existing TBT/SPS are more relevant for bilateral imports among Mercosur countries as well as for Mercosur's imports from China than for China's bilateral imports from Mercosur countries. While the protectionist effects of existing TBT/SPS on Mercosur's imports from China seem to be evenly spread among sectors, the same effects for China's imports from Mercosur seem to be concentrated in the Agribusiness sector. Due to its very nature, this is a sector with a higher incidence of SPS than TBT.

Due to the asymmetric distribution of tariff equivalents among sectors in Tables 2 to 4, any uniform reduction of existing NTB for bilateral trade flows among Mercosur countries and China, resulting from a hypothetical FTA, would be probably more beneficial for China's exports to Mercosur than for Mercosur's exports to China. By the same token, bilateral import volumes are expected to grow faster for Mercosur countries than it would grow for China.

Table 5. Ad valorem equivalents (%) of NTBs: Manufacturing

Sectors	Mercosur-Mercosur	Mercosur-China	China-Mercosur
Textiles	-	8.29	-
Wearing apparel	-	9.95	1.69
Leather products	-	8.92	-
Wood products	3.63	7.80	-
Paper products	6.28	-	-
Petroleum/coal prod.	-	7.25	-
Mineral products nec	3.39	-	-
Metals nec	-	8.35	-
Metal products	1.93	-	-
Motor vehicles/parts	-	11.41	2.27
Transport equipment	-	9.46	-
Electronic equipment	-	-	0.86
Manufactures nec.	4.96	-	-

5. The Impacts of a PTA between Mercosur and China on Brazil's economy: tracing out potential incentives to production sharing

This section presents the impacts of a hypothetical free trade agreement between Mercosur and China on the economy of Brazil. Beyond the traditional impact analysis based on gross bilateral trade, the results will be evaluated according to the trade in value added logic, a more precise representation of the likely impacts of PTAs in a global economy where trade in intermediates represent currently more than 63% of global trade in goods and services. The analysis links the traditional CGE approach to PTAs to an input-output model based on the recent work by Johnson and Noguera (2012) that allows comparisons of trade in value added as well as the share of reprocessing of imported intermediates at pre and post simulation equilibriums.

5.1. Model and Database

The Dynamic GTAP[11] computable general equilibrium model (GDyn) was used in order to evaluate the potential effects of a free trade agreement between Mercosur and China on the economy of Brazil.

GDyn is a recursively dynamic AGE model of the global economy. The model identifies 57 sectors in 113 regions of the world. Its system of equations is based on microeconomic foundations providing a detailed specification of household and perfect competitive firm behavior within individual regions and trade linkages between regions. The model extends the static version of GTAP model (Hertel, 1997) to include international capital mobility, capital accumulation, and an adaptive expectations theory of investment.

at[11] For a description of the standard GTAP model see Hertel (1997).

According to Ianchovichina et al (2012), the GDyn model is able to provide a better treatment of the long run within the GTAP framework. In contrast with the standard version of GTAP, in the GDyn model capital can move not only between industries within a region but also between regions. The ability to accommodate international capital mobility allows the analysis of policy shocks that affect economic incentives to invest overseas, such as the ones related to the outsourcing of production. In this sense, the GDyn model seems particularly suitable to the purpose of evaluating the likely effects of PTAs on the formation of GVCs as long as foreign capital ownership can be taken into account and GVC income flows can be better traced out.

5.2. Simulation results:

5.2.1. The big picture: standard macro results

Table 6 shows the likely impacts of a comprehensive FTA involving Brazil and China only, considering full reduction of bilateral import tariffs as well as a 50% reduction in bilateral TBT/SPS barriers. By 2030, additional GDP growth in Brazil is expected to reach 0.56% per year, reflecting additional investments of 2.50% per year and greater participation in global trade. The rest of the countries in Mercosur are expected to be worse off with the agreement, due to the lost in market-share in their largest trade partner in Mercosur. Given the much larger size of China's economy, trade gains in the long term are expected to be less impressive in comparison to the ones obtained by Brazil.

Table 6. Macroeconomic Effects of a FTA between Brazil and China (in %, 2030)

	Brazil	Argentina	Venezuela	Paraguay	Uruguay	China
GDP	0.56	-0.07	0.02	-0.16	-0.13	0.09
Exports	5.40	-0.24	0.00	-0.13	-0.16	0.24
Imports	6.86	-0.18	0.20	-0.30	-0.30	0.47
Investment	2.50	-0.04	0.13	-0.45	-0.27	0.21

Results reported in Table 7 show the macro results for a similar FTA, but now including the other economies in Mercosur. While the long term results for Brazil remain basically unchanged, reflecting its larger size and the fact that bilateral tariffs among Mercosur countries are already quite close to zero, the rest of Mercosur is clearly better off. In the case of Argentina, the second largest economy in Mercosur, additional GDP gains per year are expected to reach 1.04% by 2030. China is expected to be slightly better off in this second scenario, with additional GDP gains of 0.15% per year in the long term.

Table 7. Macroeconomic Effects of a FTA between Mercosur and China (in %, 2030)

	Brazil	Argentina	Venezuela	Paraguay	Uruguay	China
GDP	0.56	1.04	0.49	0.53	3.23	0.15
Exports	5.47	4.19	3.72	3.64	7.11	0.39
Imports	7.01	6.63	5.76	3.29	11.17	0.76
Investment	2.50	3.46	1.24	1.89	8.68	0.36

5.2.2. Export Flows: standard and value added approaches

The last section reported traditional macro results usually described in standard CGE analysis. Since nowadays over 70% of global exports correspond to trade in parts and components, it seems important to report and compare long term growth in gross trade flows as well as in value added.

Table 8 reports the long term impacts on Brazilian bilateral exports of a comprehensive FTA involving Mercosur and China (Table 7). By 2030, the economy of Brazil is expected to increase its per year gross exports (column 2) to its main trade partners (China, USA and EU), with the exception of Argentina, a destination to where the Brazilian economy is expected to be exporting less (-8.15%, per year), as a consequence of the agreement. When the growth in value added generated by exports is taken into consideration (column 3), figures are generally lower (column 4), suggesting that standard CGE analysis focused on gross trade figures may overestimate income gains generate by the agreement. In particular, while Brazil's gross exports to Uruguay is expected to be 11% higher by 2030, domestic value added per year generated by these exports is expected to decrease by -3.69%. In the case of Argentina, the loss in domestic value added is greater than the loss in gross exports.

Table 8. Impacts on Brazilian exports by destination (in %, 2030)

Destination	Gross Exports	V.A. Exports	Difference Gross-V.A.
USA	3.46	3.14	0.32
EU	2.62	2.51	0.11
Argentina	-8.15	-10.17	2.02
China	7.69	7.51	0.18
Row	2.95	2.78	0.17
Venezuela	55.23	52.54	2.69
Paraguay	-6.90	-8.59	1.69
Uruguay	11.02	-3.69	14.71
Total	4.56	4.07	0.49

It is noteworthy that the difference between gross exports and value added exports reported in Table 8 may be clearly interpreted as an economic signaling that the foreign content embedded in Brazilian exports has increased as a consequence of the agreement, reflecting a higher prevalence of trade in intermediates among Brazil and some of its main trade partners, such as

USA, EU, China and Argentina, despite the prediction of lower export volumes to its main trade partner in Mercosur. The higher foreign content embedded in Brazil's export is expected to improve the competitiveness of its goods abroad, increasing its penetration in larger and more competitive markets in the USA, EU and the rest of the world.

5.2.3. Import Flows: standard and value added approaches

When it comes to bilateral imports, the difference between gross import flows and value added imported by the Brazilian economy is positive for all the countries involved in the FTA. This is also suggestive of a greater prevalence of trade in intermediates among countries in Mercosur and China, probably reflecting a higher foreign content embedded in goods and services imported by the Brazilian economy from its FTA partners. Results in Table 9 are also suggestive that the significant increase in Brazilian imports from China is made at the expense of imports from the USA and EU. To the extent that imports from China may replace more efficient suppliers in those regions, this may result in trade diversion, partially reducing potential gains from trade in Brazil.

Table 9. Impacts on Brazilian imports by origin (in %, 2030)

	Gross Imports	V.A. Imports	Difference Gross-V.A.
USA	-13.46	-12.08	-1.38
EU	-11.46	-9.73	-1.73
Argentina	-0.80	-1.85	1.05
China	69.02	57.61	11.41
Row	-7.26	-0.83	-6.43
Venezuela	4.57	3.15	1.42
Paraguay	2.17	1.19	0.98
Uruguay	-3.25	-3.55	0.30
Total	5.34	4.85	0.49

5.2.4. Bilateral trade flows at the sector level: standard and value added approaches

Results in Tables 10 and 11 report the likely impacts of the Mercosur-China FTA on bilateral trade between Brazil and China at several GTAP sector levels. As suggested by the numbers described in the Tables, differences between gross trade and trade in value added are even more impressive when comparisons are made at a more disaggregated sectorial level. In particular, "mercantilist" type analyses focused on gross trade imbalances may prove to be misguided when it comes to the sectorial evaluation of net income generated by exports. Again, the differences reported in Table 10 may reflect a higher prominence of trade in intermediates involving Brazil and China as well as third countries, with likely consequences to the way goods and services are produced in both regions.

Table 10. Impact on Brazil's bilateral trade with China (in %, 2030)

	Gross Exports	V.A Exports	Gross Imports	V.A. Imports	Gross Trade B.	V.A. Trade B.
Agriculture						
Paddy rice	8.9	21.1	32.1	67.4	32.7	68.0
Wheat	4.7	32.1	-5.5	72.3	-5.6	86.0
Cereal grains nec	3.4	31.6	11.6	64.3	12.4	130.8
Vegetables, fruit, nuts	61.7	29.9	55.5	63.1	55.1	64.0
Oil seeds	4.5	4.9	52.3	50.9	4.5	4.4
Sugar cane, sugar beet	-	14.3	-1.7	56.0	-1.7	11.4
Plant-based fibers	15.2	11.4	5.3	83.2	15.2	-279.7
Crops nec	45.0	37.5	67.8	49.8	44.9	36.8
Bovine cattle, sheep,goats, horses	17.7	33.2	14.6	74.8	29.1	96.2
Animal products nec	53.0	41.2	19.5	76.3	13.6	93.7
Wool, silk-worm cocoons	49.4	1531.5	4.4	80.7	50.2	46.0
Extractive						
Forestry	20.5	11.0	35.2	54.7	17.3	73.4
Fishing	-0.3	27.2	14.9	55.5	15.4	56.4
Coal	36.9	8.4	-0.6	42.8	-0.6	43.1
Oil	-0.3	2.5	6.5	34.8	-0.3	-64.4
Gas	-	5.5	-	46.1	-	-52.4
Minerals nec	0.5	1.2	5.0	60.2	0.5	-5.3

For instance, results for Brazilian agricultural sectors in Table 10 suggest that annual growth in sectorial value added generated by exports are expected to be systematically higher when compared to gross export growth by 2030. Therefore, gross trade figures reported for those sectors may now quite well underestimate the expected sectorial net income growth due to the agreement. This is mainly the consequence of three effects that reflects the very nature of trade in agricultural goods. First, the foreign content embedded in natural resource intensive goods such as agricultures is usually low. Second, agricultural intermediates may also be indirectly exported to China embedded in other sectors' exports of final goods in Brazil. Third, Brazil's exports of agricultural intermediates to other countries may be later reprocessed and redirected to China, following the logic of GVC. The last two kinds of indirect exports do not show up as

gross exports to China in traditional national input-output tables. The same is obviously true from the point of view of Brazilian imports and may help to explain why Brazil's imported value added in agricultural goods is systematically higher then gross imports.

Table 11. Impact on Brazil's bilateral trade with China (in %, 2030)

	Gross Exp	V.A. Exp	Gross Imp	V.A. Imp	Gross T.B.	V.A. T.B.
Manufacturing						
Bovine meat products	358.3	35.6	107.6	103.4	23.8	-1.7
Meat products nec	52.0	42.3	223.9	103.2	51.2	35.8
Vegetable oils and fats	3.3	5.2	69.3	52.9	3.2	-3.5
Dairy products	331.8	20.2	276.5	91.7	266.6	-60.6
Processed rice	50.6	12.6	170.2	61.1	14969.5	80.0
Sugar	25.1	11.4	88.4	53.8	23.5	8.1
Food products nec	68.3	32.9	51.7	57.9	85.5	17.3
Beverages and tobacco products	96.6	11.9	36.4	57.4	-3.8	73.2
Textiles	121.9	8.1	99.3	82.5	98.9	98.4
Wearing apparel	238.7	30.7	125.2	98.9	124.7	102.5
Leather products	76.5	70.1	178.7	137.9	-110.9	-63.6
Wood products	9.0	8.4	142.7	62.9	-121.7	432.2
Paper products, publishing	7.8	7.9	81.1	57.0	-8.3	-64.9
Petroleum, coal products	34.3	6.7	11.1	34.9	10.9	48.8
Chemical, rubber, plastic products	68.6	13.3	45.7	48.0	42.0	120.6
Mineral products nec	106.4	11.3	60.2	52.6	58.9	63.5
Ferrous metals	25.4	13.7	52.8	63.8	1033.6	103.5
Metals nec	53.7	15.8	115.4	65.2	177.9	73.2
Metal products	122.2	7.2	107.0	68.5	106.7	249.5
Motor vehicles and parts	81.4	33.0	171.0	95.0	238.3	155.4
Transport equipment nec	50.5	23.3	226.2	162.3	232.6	180.2
Electronic equipment	37.9	5.6	49.2	42.2	49.3	43.9
Machinery and equipment nec	102.9	21.3	87.4	72.2	86.9	79.3
Manufactures nec	252.1	13.9	75.9	65.2	75.5	67.1
Services	81.0	11.8	-2.3	49.9	-105.8	-53.0

When it comes to bilateral trade in manufacturing, results in Table 11 suggest a different trade logic in comparison to the one described for agricultures as well as for goods from the extractive industry. First, the production and exporting of manufactures are, in general, not constrained by the existence of domestic natural resources. This helps to explain the ongoing predominance of international supply chains in manufacturing sectors and the higher foreign content embedded in the exports of manufactured goods in comparison to other goods such as agricultures (backward linkages). Second, manufactured intermediates are usually inputs for the production of final goods in manufacturing sectors, which weakens the creation of value added through indirect (domestic) exports. Last, indirect exports through third countries are clearly a possibility for the exports of manufactured goods (forward linkages). Results in Table 11 suggest, however, that Brazilian gross exports are expected to growth faster than the domestic value added they create by 2030. This is a sign that Brazil's manufactured exports to

China are expected to carry a higher foreign content of intermediates in the long term as a consequence of the agreement. Moreover, given the numbers reported, this effect certainly predominates over the two possible kinds of indirect exports described above.
Regarding Brazil's imports of manufactured goods from China, gross imports are expected to grow faster than value added imported by 2030, suggesting that China's manufactured exports to Brazil are also expected to employ a higher foreign content of intermediates in the long term.
Results in Table 10 and 11 are therefore suggestive that long term changes in relative prices are expected to be associated with structural changes when it comes to bilateral trade between Brazil and China. This issue will deserve a more comprehensive and detailed analysis in the following section.

5.2.5. Connecting to Global Value Chains: Are there signs of integration?

Results in Table 12 show the macro sectorial "vax ratio"[12] for exporting sectors in Brazil. It turns out that the qualitative behavior is basically the same as the one described for the sectorial bilateral trade between Brazil and China. While Brazil is expected to add a greater share of foreign inputs within its total exports of manufactured and service goods by 2030, meaning less domestic value added will be created at the margin, domestic indirect exports will distort the vax ratio for agricultures and extractive goods, meaning more domestic value added will be created at the margin. Since Table 12 reports Brazil's total exports, indirect exports through third countries do not play a role as a possible mechanism in the determination of the "vax ratio" for the macro sectors represented.

Table 12. Sectorial Vax Ratio

Sector	Vax Ratio		
	Baseline	**Policy**	**Impact (%)**
Agriculture	0.999	1.010	1.12
Extractive	0.794	0.803	1.12
Manufacture	0.489	0.482	-1.56
Services	3.165	3.086	-2.49

In order to trace out clearer long term signs of integration according to the value chain logic, Tables 13 to 15 decompose bilateral trade among the largest economies in the agreement, taking into consideration its absorption in the primary destination country, its reflection back to the primary exporting country and its redirection to third regions such as the USA and EU. For instance, when it comes to Brazil's export to China, Table 13 shows that absorption is expected to increase by 0.52% by 2030, meaning a greater share of Brazil's export will attend final demand in China. At the same time, redirection of Brazil's exports to Argentina (embedded in Chinese exports) is expected to increase by 57% (in relative terms) and reflection to Brazil will increase by 58% (implicit "go and back" logic of Brazil's exports of intermediates to China).

[12] This follows the definition found in Johson and Noguera (2012) and means value added exported over gross exports.

Since redirection of Brazil's export to relevant trade partners such as the USA and EU is expected to decrease, trade in intermediates among Brazil, China and Argentina is expected to be reinforced as a result of the agreement. By the same token, when China exports to Brazil, Table 13 shows that absorption of Chinese exports is expected to decrease by -0.30% (meaning more reprocessing of China's intermediates in Brazil), while reflection to China grows by 3.40% and redirection of China's export to Argentina (embedded in Brazil's exports) decreases by -17%. On the other hand, redirection of China's export to significant Brazilian trade partners (embedded in Brazil's export) such as the USA and EU is expected to increase. Therefore, international supply chains involving China, Brazil, the USA and EU are expected to be created/reinforced by the agreement.

Table 13. Trade decomposition: Absorption, reflection and redirection (in %)

Brazil exports to China				**China exports to Brazil**			
	Baseline	Policy	Impact		Baseline	Policy	Impact
USA	6.84	6.70	-2.05	USA	1.55	1.66	7.10
Brazil	0.46	0.73	58.70	Brazil	89.89	89.62	-0.30
EU	7.41	7.25	-2.16	EU	1.74	1.77	1.72
Argentina	0.14	0.22	57.14	Argentina	0.88	0.73	-17.05
China	65.88	66.22	0.52	China	1.47	1.52	3.40

When it comes to bilateral trade between Brazil and Argentina, there are clear signs that the agreement is expected to lead to a lower concentration of trade relations between the two most industrialized economies in Mercosur. For instance, when Brazil exports to Argentina, absorption is expected to decrease by -2.21% in the long term, meaning a greater share of Brazilian intermediates being reprocessed in Argentina and redirected to third countries. However, redirection is expected to increase for China (17.86%), EU (6.51%) and the USA (8.09%) at the expense of reflection to Brazil (-1.33%). The same behavior is expected for Argentina's exports to Brazil: a greater share of reprocessing in Brazil and redirection to third countries at the expense of reflection to Argentina. Since trade in manufactured goods represents more than 80% of bilateral trade between Brazil and Argentina, results in Table 14 are suggestive that a FTA between Mercosur and China may favor the integration of existing regional value chains in Mercosur to the ones in third regions such as China, the USA and EU, as already suggested in section 5.2.4.

Table 14. Trade decomposition: Absorption, reflection and redirection (in %)

Brazil exports to Argentina				**Argentina exports to Brazil**			
	Baseline	Policy	Impact		Baseline	Policy	Impact
USA	1.73	1.87	8.09	USA	2.17	2.26	4.15
Brazil	6.00	5.92	-1.33	Brazil	84.99	84.07	-1.08
EU	2.61	2.78	6.51	EU	2.50	2.59	3.60
Argentina	77.41	75.70	-2.21	Argentina	1.81	1.70	-6.08
China	1.96	2.31	17.86	China	1.55	1.75	12.90

Table 15 reports the long-term expected behavior for bilateral trade relations between China and Argentina. As in the case of China and Brazil (Table 13), (potential) existing value chains between China and Argentina are expected to be (created) reinforced with the agreement, given the growth in reflection not only when China exports to Argentina, but also when Argentina exports to China. Moreover, when China exports to Argentina, a higher share of China's intermediates is expected to be redirected to other regions (embedded in Argentina's exports) at the expense of Brazil. On the other hand, when Argentina exports to China, the agreement is expected to lead to a higher share of reprocessing in China (lower absorption) and higher redirection to other countries/regions such as Brazil, the USA and EU.

Table 15. Trade decomposition: Absorption, reflection and redirection (in %)

China exports to Argentina				**Argentina exports to China**			
	Baseline	Policy	Impact		Baseline	Policy	Impact
USA	1.35	1.43	5.93	USA	5.28	5.36	1.52
Brazil	3.93	3.71	-5.60	Brazil	0.37	0.60	62.16
EU	2.16	2.25	4.17	EU	5.91	6.05	2.37
Argentina	82.42	81.67	-0.91	Argentina	0.11	0.17	54.55
China	2.03	2.38	17.24	China	72.62	71.81	-1.12

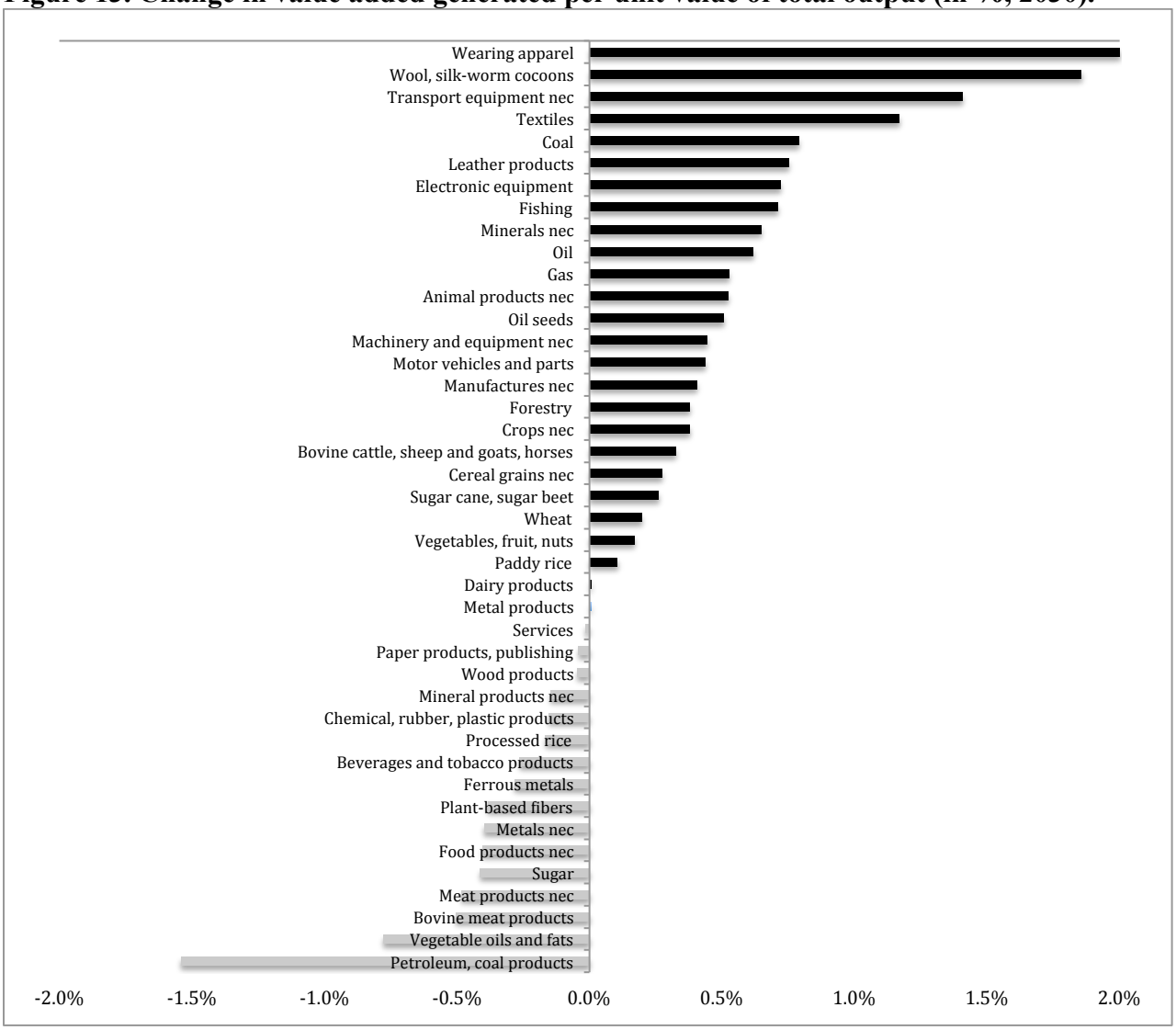
5.2.6. Connecting to GVC: moving up or down the ladder?

So far, the analysis in section 5 suggests that a comprehensive FTA between Mercosur and China is expected to lead to structural changes in the way the largest economies in the block trade with each other. In this regard, results in Tables 13 to 15 show that bilateral trade between Brazil and Argentina is expected to become less concentrated in the south-cone region, expanding to other countries such as China, and up to a lower extent to the USA and EU, following the value chain logic.

The higher prominence of trade in intermediates will induce specialization in sector specific tasks for the economies involved in the agreement, according to their local comparative advantages. Therefore, it seems relevant to tackle the issue of how production sectors in Brazil are expected to adjust in the long term as a consequence of the agreement. In this regard, the change in value added generated by unit value of total output produced may work as a useful proxy variable in order to figure out whether a sector is expected to specialize in more or less sophisticated tasks, once it starts participating in international supply chains (Baldwin et al, 2013).

Figure 13 shows the expected change in the ratio of value added generated over total value of output produced for a set of sectors in the economy of Brazil, by 2030, as a result of the agreement. Positive changes are expected to be associated with specialization in higher value added tasks, whereas negative variations suggest specialization in less sophisticated tasks.

Figure 13. Change in value added generated per unit value of total output (in %, 2030).



6. Final Remarks

The last few decades have witnessed significant changes in the way countries do trade. The global fragmentation of production induced by the reduction in international freight costs and advances in communication technology has contributed to accelerate the pace of industrialization in several developing countries in Asia and Eastern Europe, with significant impacts on labor markets. As a general global pattern, workers in developed countries have been progressively specializing in high value added service tasks, while simple manufacturing activities have been increasingly offshored to lower cost developing nations.

The economy of Brazil, specially its manufacturing sector, seems to be still stuck in the old paradigm of vertical production where most of the supply chains involved in the manufacturing of final goods are predominantly domestic. Therefore, while foreign goods are nowadays made in the world, Brazilian goods are still made in Brazil. This relative isolation to trade in tasks

may help to explain the loss of competitiveness of Brazil's manufacturing industry over the last decades.

This article suggests that the formalization of preferential trade agreements with natural trade partners may pave the way for the Brazilian industry to integrate into international supply chains. In the case of a free trade agreement between Mercosur and China, simulation results show a tendency of decentralization when it comes to the bilateral trade between Brazil and Argentina, the two most industrialized nations in Mercosur. In particular, bilateral trade between Brazil and China is expected to intensify in the long run and a greater share of reprocessing of intermediates and redirection to other nations is also expected to occur in both countries. In this regard, Brazilian exports of intermediates to the USA, EU and Argentina are expected to increase, now embedded in China's exports of final goods to those destinations.

When it comes to non-tariff barriers to trade, this article proposes a more reliable way to estimate the tariff equivalents of TBT/SPS measures, highlighting the importance to take into consideration its effects on both the extensive as well as intensive margins of trade. In particular, since only the intensive margin equation is considered in the estimation of tariff equivalents, they are fully compatible with a perfect competition market structure as the one assumed in the standard GTAP dynamic model.

7. References

Antràs, P., Garicano, L., Rossi-Hansberg, E. 2006. *Offshoring in a Knowledge Economy. Quarterly Journal of Economics* 121, no. 1: 31-77

Backer, K. De, Miroudot, S. 2013. *Mapping Global Value Chains*. *OECD Trade Policy Papers*, No. 159. Disponível em: http://www.oecd-ilibrary.org/trade/oecd-trade-policy-working-papers_18166873.

Baldwin, R. (2000). Regulatory protectionism, developing nations and a two-tier world trading system. In: Collins S and Rodrik D, eds., Brookings Trade Forum. Washington, DC, Brookings Institution. Republished in: Maskus K and Wilson JS, eds. (2001). *Quantifying the Impact of Technical Barriers to Trade: Can it be done?* Ann Harbor, Michigan, Michigan University Press, Ann Harbor.

Baldwin, R.E., Lopez Gonzalez, J. 2013. *Supply-Chain Trade: A Portrait of Global Patterns and Several Testable Hypotheses*. NBER Working Paper 18957.

Banco Mundial. 2014. *Conecting to Compete: Trade Logistics in the Global Economy*. Disponível em: http://www.worldbank.org/content/dam/Worldbank/document/Trade/LPI2014.pdf

Blyde, J, A Graziano, C Volpe Martincus. 2013. *Economic Integration Agreements and Production Fragmentation: Evidence on the Extensive Margin*. Inter-American Development Bank, unpublished document. Washington, DC.

Daudin, G., Rifflart, C., Schweisguth, D.. 2011. *Who Produces for Whom in the World Economy?* Canadian Journal of Economics. 44 (4): 1403–37.

Djankov, S., Qian, Y., Roland, G., Zhuravskaya, E. 2006. *Entrepreneurship in China and Russia Compared*. *Journal of the European Economic Association*, MIT Press, vol. 4(2-3), pages 352-365, 04-05.

Ferraz, L. P. C. 2012. *Os Brics sob a Ótica da Teoria dos Acordos Regionais de Comércio*. Texto para discussão IPEA.

Ferraz, L.P.C.; Gutierre, L.; Cabral, R. 2014a. *Connecting to Global Value Chains*. *Work in progress*, CCGI-FGV.

Ferraz, L.P.C; Curado, T. 2014b. *Os Gargalos Portuários e as Cadeias Globais de Valor*. Work in progress, CCGI-FGV.

Francois JF, van Mel H and van Tongeren F (2005). Trade liberalization in the Doha development round. *Economic Policy*, 20 (42), 349–391.

Hayakawa, K., Yamashita, N. 2011. *The Role of Preferential Trade Agreements (PTAs) in Facilitating Global Production Networks*. IDE Discussion paper No. 280.

Hummels, D. L., Schaur, G. 2013. *Time as a Trade Barrier*. *American Economic Review*, 103(7): 2935-59.

Hummels, D., Ishii, J., Yi, K.. 2001. *The nature and growth of vertical specialization in world trade*. *Journal of International Economics*. 54, 75–96

Johnson, R. C., Noguera, G. 2012. *Fragmentation and Trade in Value Added Over Four Decades*. NBER Working Paper No. 18186.

Johnson, R. C., Noguera, G. 2012a. *Accounting for Intermediates: Production Sharing and Trade in Value Added*. Journal of International Economics, 86, 224–236.

Kohler, W. 2004. *International outsourcing and factor prices with multistage production*. *Economic Journal*, Royal Economic Society, vol. 114(494), pages C166-C185, 03.

Koopman, R., Powers, W., Wang, Z., Wei, S. 2010. *Give Credit Where Credit Is Due: Tracing Value Added in Global Production Chains*. NBER Working Paper No. 16426.

Koopman, R., Wang, Z., Wei, S.J. 2014. *Tracing Value-Added and Double Counting in Gross Exports*. *American Economic Review*, 104(2): 459-94.

Krugman, P. R. 1991. *Target zones and exchange rate dynamics*. *Quarterly Jounal of Economics*, 106, 669-682.

Los, B., Timmer, M.P., Vries, G.J. de. 2014. *How Global are Global Value Chains? A New Approach to Measure International Fragmentation*. *Journal of Regional Science*, (forthcoming).

New Economic Geography: Effects and Policy Implications. Jackson Hole Conference Volume, Federal Reserve of Kansas City, August, pp. 59-102.

Working Paper ERSD-2004-04.

OECD-WTO. 2012. *Trade in Value-Added: Concepts, Methodologies and Challenges*. Joint OECD-WTO Note. Disponível em: http://www.oecd.org/sti/ind/49894138.pdf .

Orefice, G., Rocha, N. 2011. *Deep Integration and Production Networks: an Empirical Analysis*. WTO, Staff Working Paper ERSD-2011-11.

Stehrer, R. 2012. *Trade in Value Added and the Value Added in Trade*. WIOD Working Paper Nr. 8.

Timmer, M.P., Los, B., Stehrer, R. and Vries, G.J. de. 2013. *Fragmentation, Incomes and Jobs*. An analysis of European competitiveness. *Economic Policy*, 28, 613-661.

Venables, A. J. 2003. *Winners and losers from regional integration agreements*. *Economic Journal*, Royal Economic Society, vol. 113(490), pages 747-761, October.

Wonnacott, P., Lutz, M. 1989. *Is There a Case for Free Trade Areas?* Free Trade Areas and U.S. Trade Policy, ed. J.J. Schott, Washington, D.C.: Institute for International Economics. 59-84.

Zhai, F. (2008): "Armington Meets Melitz: Introducing Firm Heterogeneity in a Global CGE Model of Trade," Journal of Economic Integration, 23, 575–604.