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Brazilian exporters and the rise of Global Value Chains: an empirical assessment[1]

Caio Torres Mazzi[2]

Abstract

This paper studies how production fragmentation has affected the performance of Brazilian exporters in the manufacturing sector. We begin by combining existing classifications of internationally traded products to identify four different categories of goods, of which one ('customised intermediates') we associate more closely with fragmented trade. We then proceed to compare the productivity premium of international traders for these different categories. Our results confirm exporting customised intermediates is associated with a superior performance in comparison to other intermediates; but also highlights a strong influence of sector specificities. We also investigate the existence of learning-by-exporting effects and find no evidence for firms that produce customised intermediates exclusively. However, exports of customised products in general – i.e. both final and intermediate goods – are associated with learning. This result suggests trade in customised intermediates might be associated with learning when firms manage to upgrade their products to other customised goods.

JEL Classification: F14; F12; O33; O31

Keywords: *exports; productivity; fragmentation; Global Value Chains.*

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1. Introduction

One prominent aspect of globalisation has been the emergence of Global Value Chains (GVCs). The term and its variations[3] refer to the remarkable increase in fragmentation of production chains across international borders in recent times. Baldwin (2012) refers to this process as the second 'unbundling' of globalisation, in which production stages previously performed in close proximity or within the same facility are being dispersed across international borders. This phenomenon has received considerable attention in several fields of academic discussion and in the business community but measuring its exact size and importance has proven challenging for scholars involved in the debate.

The use of trade data to compute international flows of `parts and components' or intermediary products – a method pioneered by Yeats (1999) and later followed and improved by others (Jones et al., 2005; Lall et al., 2004; Ng & Yeats, 2001; Sturgeon & Memedovic, 2010; among others) – was likely the first approach that tried to quantify GVCs. The picture that emerges from these studies points to important changes in the nature of cross border flows of goods and services. Trade in `parts and components', a subset of intermediates mainly associated to machinery products, are found to represent a growing share of international trade (Athukorala, 2010; Jones et al., 2005; Schmidt & Ferrantino, 2018; Yeats, 1999); with electronics being responsible for most of this growth. Developing countries have also been shown to be quickly gaining participation in overall trade and this process has been even more intense in 'parts and components' and `customised' intermediary products – a group of more complex intermediates that characterises supplier-buyer relationships in GVCs (Sturgeon & Memedovic, 2010).

The objective of this paper is to study the effect of these trends on the performance of exporters in the context of developing countries. We follow the firm-level international trade literature and analyse both the productivity premia and the learning-by-exporting hypothesis associated with trading in the context of fragmented trade. The international firm-level trade literature has grown dramatically since the pioneering work of Bernard & Jensen (1999), establishing several empirical regularities regarding exporters and importers. Studies almost unanimously find that international traders outperform firms that are restricted to local markets. Recently, the literature has begun to look deeper into heterogeneities between exporters; and into the factors explaining these differences, changing its focus to the extensive margins of trade, the number of traded products and country destinations, and the role of distance, among other issues (Wagner, 2016). Our approach contributes to this literature by identifying heterogeneous effects of trade on the performance of firms according to specific product characteristics associated with production fragmentation.

We follow the GVC literature and concentrate on 'customised' intermediates and 'parts and components' as the product types most closely associated with fragmented trade. This allows us to compare the productivity of firms that trade these products with firms that trade other types of products; and with firms that do not trade at all. We look at domestic firms in Brazil, a large and diversified developing economy. The recent period of rapid expansion of GVCs has mainly impacted Brazil by increasing demand for primary products and resource-based manufactures in which the country has historically enjoyed

[3] "Global production networks", "fragmentation", "vertical specialization", among others, have been used to refer to the same or closely related phenomena (Hummels et al., 2001).

comparative advantage. However, exports of industrial products have also expanded vigorously, and a large number of manufacturing sectors and firms continue to thrive in international markets. Our sample covers the period 1997-2007, which is the most recent allowed by our dataset but conveniently includes both the period before and during the intensification in international trade associated with the 'commodity boom' that strongly impacted the Brazilian economy, which began around 2001.

Our results confirm that exporters perform significantly better than non-exporters before and after entering in export markets; and that exporting customised intermediates is associated with higher performance levels compared to exporters of other types of intermediates. However, unlike previous evidence for Brazil, we find limited evidence of learning-by-exporting for overall exporters; and no such evidence is found for firms that export exclusively customised intermediates. Instead, we observe that exporting customised products in general – i.e. both final and intermediate goods – relates to continuous, significant *ex-post* gains in terms of performance. This suggests fragmentation, by promoting trade in customised intermediates, might be associated with learning when firms manage to successfully upgrade their portfolio to other customised products.

The remainder of this paper is organised as follows. In section two, we present the related literature, while in section three our product classification schemes are presented. Section four presents the dataset and section five explains the empirical methodology and results for the regression analysis. Conclusions follow in section six.

2. Related Literature

The firm-level international trade literature has become impressively abundant since the pioneering work of Bernard & Jensen (1999). Its most significant result continues to be that exporters are (almost always) better performing than non-exporters and that this difference is mainly due to self-selection, i.e. the fact that only the most productive firms are able to enter foreign markets. Melitz (2003) demonstrated in a general equilibrium framework how higher fixed costs of entry in foreign markets creates a hierarchy among heterogeneous firms in each industry, where only the most productive ones can export. The competing but not excluding idea that the export premia of exporters also arises after entry in export markets – the learning-by-exporting hypothesis – has not reached a similar status, as results continue to vary frequently depending on econometric methods employed and the characteristics of countries and firms under analysis (Wagner, 2007, 2012). In general, confirmatory evidence appears to be more frequent for developing countries, whose firms tend to be farther away from the technological frontier or use older vintages of capital goods; and can benefit more from knowledge transfers from more advanced economies (Foster-McGregor et al, 2014). In the case of Brazil, for example, available studies indicate the presence of significant performance gains after entry in foreign markets, especially for firms that continue to export after starting (Araújo, 2016; Araújo & Hiratuka, 2006; Kannebley Jr, 2011; Kannebley et al., 2005).

A parallel microlevel research agenda has been conducted in the context of the GVC approach (Gereffi et al., 2005; Giuliani et al., 2005; Humphrey & Schmitz, 2002). Despite still being in its infancy, available evidence appears to support a positive correlation between supplying in GVCs and firms' performance. Giovannetti & Marvasi (2016) show that firms in Tuscany that participate in hierarchical global (as opposed to local) value chains are the best performing group, especially midstream producers (buyers and suppliers of intermediates). This result is confirmed by evidence indicating positive and significant premia for exporters of intermediate goods (Accetturo & Giunta, 2017; Veugelers, 2013), while Agostino et al. (2015) present evidence that the export premia of suppliers that innovate is as high as that of exporters of final goods. Brancati et al. (2017) shows how participation in specific types of GVCs has a positive impact on innovation, R&D and productivity for Italian firms, but their study does not differentiate between suppliers of intermediates and producers of final goods.

These studies have not been as successful in disentangling learning and self-selection in the same way as done by the international trade literature. In general, there is more emphasis on learning and upgrading, but the empirical evidence at the firm-level is mostly correlational, with only the studies of Brancati et al. (2017) and Agostino et al. (2015) offering evidence that relates GVC participation with ex post performance gains by suppliers. In general, authors in this literature tend to consider that GVC participation favors learning because the firms that lead value chains may promote – explicitly or tacitly – knowledge transfers and upgrading opportunities for their suppliers, especially in value chains where coordination is stronger and engagement by leaders higher (Giuliani et al., 2005). A similar idea has been well-known in the international trade literature since Blalock & Gertler (2004) advocated for the existence of learning-by-exporting in the case of firms in developing countries involved in supply relationships with higher degrees of customisation or 'extended coordination'.

Nonetheless, there are good reasons to assume that learning is not the only relevant factor in the context of fragmented trade. First, trade in GVCs is characterised by higher transactional complexity, which entails higher relationship-specific investments, for example, in the development and adaptation of products and plants to the specific needs of buyers (Antràs & Chor, 2013). Second, because these relationships involve higher quality standards and specification requirements, international buyers will tend to `cherry pick' the most capable suppliers to avoid production line delays and quality debasements caused by problems in the supply base. Third, some studies indicate that transactional frictions related to distance - such as transportation and communication costs, trade barriers, language and cultural differences - can be more intense for trade in intermediates, parts and components (Jones et al., 2005; Kimura et al., 2007; Kowalski et al., 2015; Sturgeon et al., 2017; UNIDO, 2018), which directly relates to the costs of entry firms must face to enter international markets.

Alternatively, non-GVC goods may be related to higher export premia. Standardised markets are highly competitive, forcing firms to develop their own capabilities in order to enter and maintain market-shares, which could positively affect learning (Hu & Tan, 2016). Indeed, one of the main insights of the GVC approach is to demonstrate that value chain governance influences upgrading and GVCs may 'lock-in' suppliers to trajectories of low value-added when lead firms do not sustain the development of core capabilities by local firms; which tends to be the case in hierarchical value chains (Pietrobelli et al., 2011). Even when governance does not hinder upgrading by suppliers, successful learning will frequently depend on firms' own internal innovation efforts: firms need to "invest in learning and building technological capabilities to innovate effectively" in value chains (Morrison et al., 2008, p.51).

In this paper, we take a step forward to characterise performance and learning in the context of fragmented trade. We are not able to study the effect of GVCs across other dimensions that are important in the GVC approach - e.g. governance and firms' innovative efforts - since the data available provides little information on those areas. Nevertheless, in accordance with the evidence reviewed in this section, we still expect to find significant heterogeneities in the relationship between trade and firms' performance related to participation in fragmented trade.

3. Product Classification

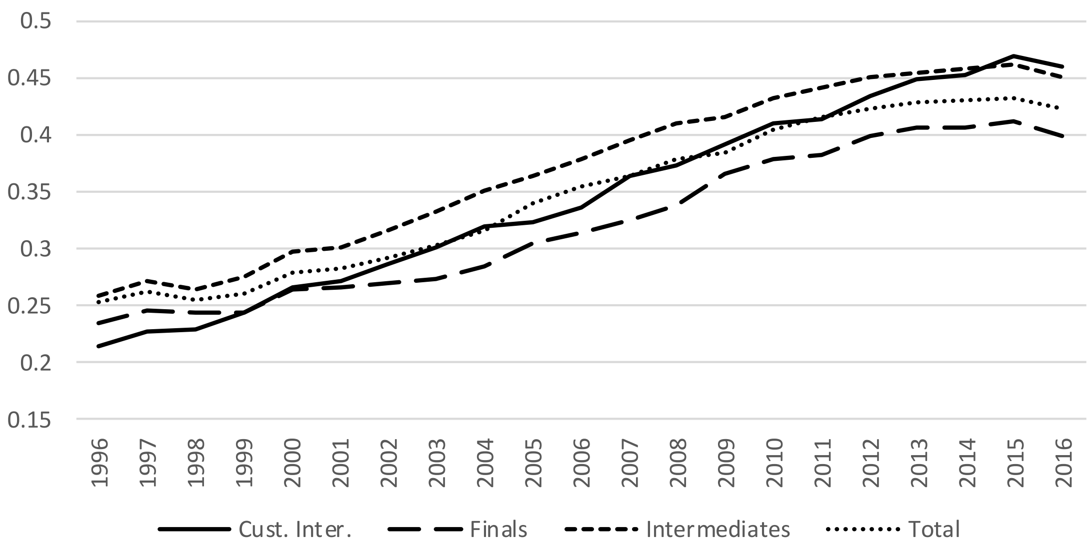
Our first step is to divide products into three categories according to their end-use using the United Nations Broad Economic Categories classification (BEC): industrial intermediates, primary intermediates (foods and beverages, fuels and primary industrial supplies) and final products (capital and consumption goods). Industrial intermediates, however, will still not reflect fragmented trade because the group is too aggregated and includes standardised products traded trough arms-length relationships. We are interested in complex intermediates that are either part of intrafirm trade or exchanged in networks, involving higher degrees of customisation and coordination between firms, since these are the relationships that characterise GVCs. There is no easy way to observe this type of trade directly in the data, so we create classifications based on *ad hoc* taxonomies of internationally traded goods, dividing intermediates in (GVC-related) customised and non-customised products.

We employ the conservative version of Rauch (1999)'s classification of differentiated products, which has become quite popular in the literature as a measure of complexity or 'contract-intensity' of products (Andersson & Weiss, 2012; Antràs & Chor, 2013; Del Prete & Rungi, 2015). His methodology consists of dividing products in three categories: traded in organised exchanges, reference priced in trade publications, and all others. The first two categories indicate homogeneous products traded in dense markets, while the residual identifies differentiated products more likely to be traded on the basis of networks. We call this list the `RCON' classification.

A second classification we produce involves merging the lists of Athukorala (2010) and Sturgeon & Memedovic (2010), which we call the 'ASM' classification. This list is more precise in identifying GVC-related products, since the latter is based on careful product-by-product inspections of items. However, the ASM taxonomy has the downside of being concentrated in traditional GVC sectors (apparel, textiles, footwear and machinery products), while the RCON taxonomy is based on a general methodology, designed to cover all sectors where trade in complex intermediates exists. Therefore, we use the latter as the main classification to be able to include in the analysis manufacturing firms and sectors where fragmentation remains limited but is playing an increasingly important role.

Both procedures result in four categories of products plus a small residual group of not-classified products[4]: customised industrial intermediates, non-customised industrial intermediates, primary intermediates (foods and beverages, fuels and primary industrial supplies) and final products (capital and consumption goods). This subdivision is applied to Brazil's exports and imports. The Brazilian trade registry is obtained in different HS editions, depending on the year so we use correspondence tables to adapt our taxonomy and classify products in all HS editions. In the HS 2002 edition, which is the most used in our sample, the RCON classification results in 1,549 customised intermediates in a total of 5,222 listed products, while the ASM has only 789 products of the same class, with 92% of these being in apparel, textiles, footwear and machinery. The lists are divided according to the sections of the HS 2002 and are provided in Appendix I, along with detailed procedures for their construction.

Figure 1: Non-OECD countries participation in total global exports in current values according with product categories



Own elaboration from COMTRADE export data. Export flows are in current values. The series exclude countries whose data is not available for the entire period in the Harmonised System, however including these countries does not affect results. Products divided according to the RCON classification.

Figure 1 displays the share of non-OECD countries' in total world exports and in the different categories of exports participation.[5] It illustrates and confirms results from the literature describing the growing importance of international trade in customised intermediates for developing countries: it is apparent that there is a long-term trend for developing countries to gain participation in these products. In 1996, developing countries accounted for 21% of international exports in customised intermediates, below their overall average. This numbers grows steadily and reaches 46% in 2016, above the

[4] The residual represents less than 1% of products and a little more than 1% in traded value. We ignore it throughout this work, although we maintain controls for these products in all regressions.

[5] OECD countries are the early participants of the organization plus South Korea: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.

overall average of 42%. Indeed, throughout the total period this is the category of products where non-OECD countries present the highest average annual growth rate (9.23%) and OECD countries present the lowest (3.29%). This trend is most extreme for China and Southeast Asia, but when these countries are subtracted from the series non-OECD countries still gain participation relatively faster in this category. In Appendix I we depict this trend and show that Brazil has not benefited from it, stagnating in international participation in customised intermediates.

4. Data

Data for this paper comes from three sources: the Brazilian Annual Industrial Survey (PIA), the Annual Registry of Social Information (RAIS) and the registry of foreign trade of the Secretary of Foreign Trade (Secex). PIA annually collects detailed business information (revenues, expenses, personnel, wages, investments, etc.) on Brazilian firms in manufacturing and extractive industries. All firms with more than 30 employees or revenues above R$ 13.6 million in the previous year are surveyed, while firms below these thresholds are sampled. These firms usually appear in the sample for only one period and are exclude from our sample since our analysis is focused on firms that are observed for at least five consecutive years. We also exclude firms from extractive industries to concentrate on manufacturing. This sample is merged with information on firm age, the number of employees and their average years of study taken from RAIS, which collects employment information from all active Brazilian firms. Finally, the resulting sample is merged with the registry of foreign trade (Secex), which contains information for all exporting and importing firms (value, product, quantity and destination). We concentrate on the eleven-year period between 1997-2007, which results in an unbalanced panel containing 61,879 firms in total that are responsible for approximately 77% of Brazilian accumulated exports during the period. All data were accessed at the Brazilian Statistical Office (IBGE) safe room and confidentiality procedures were followed.

Our main performance measure is total factor productivity (TFP) estimated according to Levinsohn & Petrin (2003). This method, as well as other semiparametric approaches that have become widespread in the literature (Ackerberg et al., 2006; Olley & Pakes, 1996), attempt to correct for the bias caused by the endogeneity between variable inputs and unobserved firm productivity. Revenues are deflated by 3-digit sector level price indexes (IPA-OG) and the cost of industrial operations by the intermediate products price index (IPA-EP). Production functions for firms' value-added - defined as the difference between revenues and the cost of industrial operations - is then estimated for each 2-digit sector. We also used TFP estimated with firm fixed-effects as an alternative, but given the qualitatively similar results do not report the results in this paper. Both TFP estimations were used in Araújo (2016) and Messa (2014).

Table 1 presents averages and medians for the variables used in the models for all firm-year observations. As expected, exporters are superior in performance, size, age and human capital. Exporters of final goods and customised intermediates are very similar and constitute the most common groups, but exporters of non-customised and primary goods are significantly larger, older, possess more higher human capital (schooling) in the case of non-customised intermediates and are slightly more productive. The TFP hierarchy indicates exporters of GVC-related intermediates perform less well than exporters of other types of intermediates. In the following sections we will see this picture changes once we control for firm-level characteristics in the regression analysis, including the sector and region in which they operate, as well as differences in the size and age of firms.

Table 1: Summary Statistics by type of exported product (Means and Medians)

	Freq	TFP-LP	Po_Med	Age	Schooling
Total	292,425	13.08 (12.99)	72 (56)	19.26 (16.17)	7.72 (7.79)
Finals	45,296	14.11 (14.02)	162 (133)	25.55 (24.17)	8.56 (8.50)
Cust. Inter	51,306	14.11 (14.05)	153 (128)	25.96 (24.99)	8.56 (8.59)
Non-Cust. Inter.	23,705	14.86 (14.83)	226 (192)	28.40 (27.74)	8.82 (8.93)
Primary Inter.	8,485	15.41 (15.37)	321 (279)	30.27 (29.99)	8.47 (8.53)
Other	738	14.31 (14.09)	247 (176)	30.97 (31.52)	9.30 (9.25)

Means and medians (between parentheses). TFP estimated according to the Levinsohn & Petrin (2003) methodology. Values are calculated over the total number of observations between 1997-2007 and categories are not exclusive.

5. Empirical Methodology

Our analysis proceeds in two steps. First, we evaluate the export premia for firms according to the four categories of products described above. In this step, we are interested in comparing productivity differentials associated to different categories of products, focusing especially on customised intermediates. Next, we evaluate export premia for starters in the same categories of products before, during and after entry in international markets. In this case, we will be testing if productivity differentials were built after entry in international markets – which we consider supportive of learning-by-export – or prior to entry – which points to self-selection of firms into export markets.

5.1.1. Are Brazilian exporters of customised intermediates more productive?

We follow the methodology developed by Bernard & Jensen (1999) and later adaptations created to estimate the export premia for different categories of firms classified according to their export destinations (Pisu, 2008; Serti & Tomasi, 2009), although are focus is on product types. It is important to also include the effect of importing the same product categories. Most studies indicate importing is associated with a higher productivity impact than exporting, although two-way traders are usually the best performing group in studies that compare these groups (Foster-McGregor et al., 2014). In fragmented trade, importing intermediates is crucial as a “ticket” to participate in international value chains that depend on obtaining specific items from different locations; and as a source of a greater variety and higher quality inputs and advanced technology that impact firms productivity (Bas & Strauss-Kahn, 2014; Pierola et al., 2018).

The productivity premium is defined here as the difference in productivity between firms that export (import) a positive value of a given type of product and those that do not export (import) the same product type, conditional on firm-level controls that include other export and import behaviors. Therefore, different trade behaviors are not mutually exclusive: firms can – and frequently do – export and import more than one product category. We adopt the following semi-logarithmic equation:

$$LnTFP_{it} = \alpha_0 + \boldsymbol{\beta X_{it}} + \boldsymbol{\delta M_{it}} + \boldsymbol{\Phi Z_{it}} + \alpha_t + \varepsilon_{it} \qquad (1)$$

where TFP_{it} indicates total factor productivity, $\boldsymbol{X_{it}}$ designates the vector of five dummies indicating if firm *i* exports one of the four product categories or the residual unclassified group[6] at time t, $\boldsymbol{M_{it}}$ designates the corresponding vector of dummies for each import category, $\boldsymbol{Z_{it}}$ indicates the vector of controls and α_t are year fixed-effects. Controls include 3-digit sector (CNAE - National Classification of Economic Activities) and state dummies, size (log of number of employees), firm age, firm age squared and human capital (years of study of employees). We include firm-fixed effects in some estimations and depict these equations in the results section. Despite allowing us to control for unobserved firm characteristics, firm fixed-effects have the drawback of subsuming all time invariant firm characteristics, including the presence in export markets of firms that always export during the sample period, which is important to include at this stage. Nonetheless, we will see estimated effects are, as expected, smaller but consistent with other formulations.

Table 3 presents results of the estimation of equation (1). Column (1) estimates our preferred model for the 11-year complete sample using the RCON classification. All export premia are positive and significant, as expected. The significant coefficients on firm age and its squared term indicate slightly decreasing returns to firm age. Coefficients on the remaining control variables take positive and significant values, consistent with most results found in the literature. There is a productivity hierarchy between exporters: exporters of final goods have the highest coefficient, followed by customised intermediates, primary intermediates and non-customised intermediates. F-tests (not depicted) indicate the differences between all coefficients are significant at 5%, except between basic and non-customised intermediates. Exporting final goods is associated with a 26% productivity premium, exporting customised intermediates adds 20% to firms' performance, while the effect of other intermediates is around 16%[7]. Importing the same product categories also has very different effects, but this time customised intermediates have the higher impact, with non-customised and final goods showing similar coefficients and basic intermediates having the smallest coefficient. As expected, all coefficients for imports are above their counterparts for exports.

In the following columns of Table 3 we estimate several variations of (1). In column (2), we exclude multi plant firms and observe that the estimated export and import premia increase but the hierarchy between categories is unaffected. In columns (3) and (4) we

[6] We maintain the residual group in the regressions for control. For brevity, however, these are omitted in the depiction of results, although naturally available upon request.

[7] We transform estimates in column (1) by the equation $100 \times (e^{\beta} - 1)$ to arrive at those numbers.

add controls for the numbers of exported varieties (product-country pairs), multinational firms and intensity of scientific and technical personnel, which is a proxy for firms' innovativeness[8]. The only notable difference is in the effect of exporting customised and primary intermediates, which are no longer significantly different in column (3). In column (5) we include firm fixed-effects as cited previously. Besides the magnitude of effects, the main difference is on the import side, where primary intermediates now have an effect similar to non-customised intermediates and above final goods. In column (6) we limit the sample to its most recent period, which is marked by intense growth in international trade and fragmentation; nonetheless results remain qualitatively similar.

We would like to know if these results are homogenous throughout all sectors or conditional on the dynamics of each industry. Our main interest lies in the sectors of early GVC development, i.e. apparel, textiles, footwear and machinery products. Therefore, we subdivide the sample in three groups of sectors according to firms CNAE classification: apparel/textile/footwear (sectors 17-19), machinery (sectors 29-35)[9] and other manufacturing (sectors 15-16, 20-28, 36-37). We estimate regression models with controls for multinationals and scientific and technical personnel for each sector.[10] Results are depicted in Table 4. There are significant sectoral heterogeneities that qualify results from Table 3. First, only in the case of apparel/textiles/footwear do we see the same hierarchy between customised intermediates and final goods; for machinery and other sectors the order is reversed, with the premium for customised intermediates being above that for all other exports. Second, although exporters of customised intermediates always perform better than exporters of both non-customised and primary intermediates, direct comparison of coefficients indicates the absolute difference is bigger in GVC-related sectors compared to results in columns (5) and (6).

Tables 3 and 4 confirm the existence of positive and significant productivity premia for exporters of products associated with fragmented trade. It also supports results of the empirical literature indicating that exporting intermediates related to GVCs is associated with a better performance compared to suppliers of other types of intermediates. Regarding the hierarchy with producers of final goods, we find an indication that results heavily depend on sector specificities. On the import side, we see that the effect of customised intermediates is above all other imports for the GVC-related sectors, confirming known results from the international trade literature that indicate higher quality inputs have a stronger effect on firms' performance (Bas, 2012; Bas & Strauss-Kahn, 2014; Feng et al, 2016). Exploring the role of imports however is beyond the scope of this work and we concentrate exclusively on exports in the following section

[8] This variable was developed by Araújo et al (2009), who demonstrated it is highly correlated with firms' internal R&D expenditures as declared in innovation surveys. It is based on the identification of specific functions performed by employees within the firm that are likely related to advanced technical and scientific activities. These include employees classified as researchers, engineers, R&D managers, IT personnel, physicists, chemists and other science-related activities.

[9] These sectors comprise machinery and equipment (29), office machinery (30), electric machinery (31), electronic and telecommunication machinery (32), medical, precision and optical machinery (33), vehicles (34) and transport equipment (35).

[10] Controlling for exported varieties or altering the period yields qualitatively similar results in these regressions.

Table 3: Regression Results (Full Sample)

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	Ln TFP-LP					
	1997-2007	Single Plant	1997-2007	2000-2007	1997-2007	2001-07
Export Cust. Inter.	0.181	0.233	0.115	0.189	0.077	0.199
	(0.005)***	(0.0070)***	(0.006)***	(0.0062)***	(0.005)***	(0.006)***
Export Non-Cust. Inter.	0.146	0.205	0.091	0.128	0.053	0.136
	(0.006)***	(0.0106)***	(0.007)***	(0.0080)***	(0.006)***	(0.008)***
Export Finals	0.229	0.276	0.157	0.250	0.088	0.259
	(0.005)***	(0.0070)***	(0.006)***	(0.0061)***	(0.006)***	(0.006)***
Export Primary Inter.	0.154	0.208	0.117	0.150	0.054	0.158
	(0.011)***	(0.0222)***	(0.011)***	(0.0131)***	(0.011)***	(0.014)***
Import Cust. Inter.	0.325	0.331	0.323	0.336	0.083	0.350
	(0.005)***	(0.0075)***	(0.005)***	(0.0069)***	(0.005)***	(0.007)***
Import Non-Cust. Inter.	0.266	0.297	0.261	0.269	0.070	0.276
	(0.005)***	(0.0082)***	(0.005)***	(0.0072)***	(0.005)***	(0.007)***
Import Finals	0.258	0.276	0.255	0.246	0.053	0.263
	(0.005)***	(0.0077)***	(0.005)***	(0.0068)***	(0.004)***	(0.007)***
Import Primary Inter.	0.180	0.223	0.172	0.162	0.067	0.184
	(0.007)***	(0.0135)***	(0.007)***	(0.0097)***	(0.008)***	(0.010)***
Ln Personnel	0.428	0.391	0.424	0.421	0.311	0.417
	(0.002)***	(0.0038)***	(0.002)***	(0.0031)***	(0.006)***	(0.003)***
Schooling	0.111	0.090	0.110	0.110	0.034	0.119
	(0.001)***	(0.0015)***	(0.001)***	(0.0015)***	(0.002)***	(0.001)***
Age	0.022	0.023	0.022	0.025	0.003	0.027
	(0.000)***	(0.0006)***	(0.000)***	(0.0005)***	(0.0014)**	(0.000)***
Age^2	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)***	(0.0000)***	(0.000)***	(0.0000)***	(0.0000)*	(0.000)***
Exp Variety			0.074			
			(0.004)***			
Multinational				0.068		
				(0.0099)***		
Tech personnel				2.838		
				(0.1410)***		
Observations	292,425	200,556	292,425	226,085	292,425	202,720
R-squared	0.67	0.57	0.67	0.65	0.15	0.65
F-Statistic	4433	1904	4400	3305	.	3001
State FE	YES	YES	YES	YES	NO	YES
Year FE	YES	YES	YES	YES	YES	YES
Sector FE	YES	YES	YES	YES	NO	YES
Firm FE	NO	NO	NO	NO	YES	NO

*** p<0.01, ** p<0.05, * p<0. Robust standard errors in parentheses. Export/import residual category omitted. All estimations with RCON classification. All estimations for the TFP (Levinsohn & Petrin (2003) methodology.

Table 4: Regression Results (Divided Sample)

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	Ln TFP-LP					
	A/T/F		Machinery		Others	
Export Cust. Inter.	0.306	0.298	0.214	0.222	0.218	0.232
	(0.014)***	(0.017)***	(0.010)***	(0.011)***	(0.006)***	(0.007)***
Export Non-Cust. Inter.	0.051	0.008	0.126	0.087	0.173	0.158
	(0.018)***	(0.022223)	(0.013)***	(0.015)***	(0.008)***	(0.009)***
Export Finals	0.558	0.606	0.132	0.125	0.132	0.140
	(0.010)***	(0.012)***	(0.010)***	(0.011)***	(0.007)***	(0.008)***
Export Primary Inter.	0.185	0.248	0.055	-0.003	0.148	0.143
	(0.039)***	(0.050)***	(0.024)**	(0.026)	(0.012)***	(0.014)***
Import Cust. Inter.	0.420	0.439	0.333	0.350	0.265	0.267
	(0.013)***	(0.016)***	(0.011)***	(0.013)***	(0.007)***	(0.009)***
Import Non-Cust. Inter.	0.343	0.362	0.207	0.170	0.272	0.271
	(0.013)***	(0.017)***	(0.011)***	(0.013)***	(0.007)***	(0.009)***
Import Finals	0.308	0.313	0.269	0.241	0.251	0.239
	(0.013)***	(0.016)***	(0.011)***	(0.013)***	(0.007)***	(0.008)***
Import Primary Inter.	-0.003	-0.057	0.134	0.076	0.236	0.212
	(0.020206)	(0.0266)**	(0.016)***	(0.019)***	(0.009)***	(0.011)***
Ln Personnel	0.319	0.303	0.273	0.262	0.507	0.504
	(0.005)***	(0.006)***	(0.005)***	(0.006)***	(0.003)***	(0.004)***
Schooling	0.083	0.086	0.119	0.097	0.115	0.114
	(0.002)***	(0.003)***	(0.003)***	(0.003)***	(0.001)***	(0.001)***
Age	0.046	0.048	0.012	0.014	0.015	0.018
	(0.000)***	(0.001)***	(0.001)***	(0.001)***	(0.000)***	(0.000)***
Age^2	-0.001	-0.001	0.000	0.000	0.000	0.000
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Multinational		0.282		0.267		0.091
		(0.0383)***		(0.0156)***		(0.0132)***
Tech personnel		8.176		2.252		4.053
		(0.873)***		(0.186)***		(0.262)***
Observations	65,278	51,943	47,353	36,601	179,794	137,541
R-squared	0.55	0.54	0.66	0.65	0.67	0.66
F-Statistic	1768	1393	1124	870.7	4385	3291
State FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Sector FE	YES	YES	YES	YES	YES	YES

*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. Export/import residual category omitted. All estimations with RCON classification. A/T/F is the Apparel/Textiles/Footwear subdivision. All estimations for the TFP (Levinsohn & Petrin (2003) methodology.

In the sectors of early GVC growth we can also employ the ASM classification mentioned previously to track GVC-related trade. Table 5 presents estimation results for apparel/textiles/footwear and machinery in columns (1) and (2) respectively. Results for machinery are very similar and confirm previous findings, but coefficients for customised intermediates in apparel/textiles/footwear become considerably smaller and F-tests indicate they are statistically indistinguishable from non-customised and primary intermediates in the case of exports[11]. This result confirms previous findings that exporters of final goods are the best performing category, but is at odds with findings in Tables 3 and 4.

It seams using different classifications affects the relative magnitude of estimations for this sector. A detailed look at these classifications revels very small differences in machinery sectors. However, among textile products items considered of low customisation in the RCON typology are systematically promoted to GVC-related in the ASM classification[12]. For instance, various categories of cotton yarns and woven fabrics are considered non-customised by Rauch (1999), but included as GVC intermediates by Sturgeon & Memedovic (2010). The latter taxonomy therefore indicates that many textiles integrated into GVCs are of low relative complexity, suggesting that GVCs are not limited to items of higher complexity in some sectors.

Table 5 therefore might also suggest that customisation is a factor directly related to the performance of traders. Customisation is also a feature of final goods, especially capital goods, or consumption goods produced under specific requirements of large retailers, for instance. This point is reinforced by the results we found for final goods, whose premia is frequently the highest: most finals (85%) are classified by Rauch (1999) as “customised”. When we ignore the intermediate and final goods distinction and estimate the export premia for Rauch (1999)’s categories – customised, reference priced and traded in organised markets, the latter two previously defined as non-customised products – in columns (3)-(6) we observe that customised products carry a significantly higher premium in all cases, including the division by subsectors in columns (3) to (5).

The export premia estimations appear to also be related to the level of customisation of the products. Fragmentation is more strongly related to productivity when customised intermediates are involved, possibly by encouraging local firms to produce more complex intermediates or by incentivising capable local producers to become exporters. In cases where intermediates of lower relative complexity are involved, fragmentation might have a smaller impact on the relative performance of exporters, eventually indiscernible from traditional forms of arms-length based trade. It is therefore important to know more about the mechanisms that drive the performance differentials we observed in this section. In the following section we look at this in more detail by exploring the possibility of learning-by-exporting for exporters of different product types.

[11] F-tests indicate estimations for exports are statistically equal between customized and non-customized intermediates in all regressions and for imports in the Levinsohn & Petrin (2003) estimation.

[12] In total, the ASM classification indicates 368 HS 2002 codes as customized intermediates in sections XI (textiles and apparel) and XII (footwear, umbrellas, headgear, others), while the RCON classification selects only 278 items in the same sections as customized.

Table 5: Regression Results (Divided Sample – Alternative classifications)

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	Ln TFP-LP					
	A/T/F	Machinery	A/T/F	Machinery	Others	All
Export Cust. Inter.	0.183	0.211				
	(0.016)***	(0.010)***				
Export Non-Cust. Inter.	0.227	0.069				
	(0.016)***	(0.011)***				
Export Finals	0.563	0.136				
	(0.011)***	(0.010)***				
Export Primary Inter.	0.180	0.086				
	(0.040)***	(0.023)***				
Export Cust.			0.643	0.299	0.280	0.351
			(0.010)***	(0.009)***	(0.006)***	(0.004)***
Export Ref.			0.074	0.181	0.207	0.182
			(0.017)***	(0.012)***	(0.008)***	(0.006)***
Export Traded			0.085	0.069	0.199	0.194
			(0.0343)**	(0.026)***	(0.014)***	(0.012)***
Import Primary Inter.	0.359	0.270				
	(0.014)***	(0.012)***				
Import Cust. Inter.	0.354	0.227				
	(0.014)***	(0.011)***				
Import Non-Cust. Inter.	0.312	0.255				
	(0.013)***	(0.011)***				
Import Finals	0.008	0.167				
	(0.02)	(0.015)***				
Import Cust.			0.569	0.482	0.420	0.472
			(0.011)***	(0.010)***	(0.006)***	(0.005)***
Import Ref.			0.346	0.251	0.299	0.288
			(0.013)***	(0.011)***	(0.007)***	(0.005)***
Import Traded			0.072	0.197	0.258	0.192
			(0.020)***	(0.016)***	(0.011)***	(0.008)***
Observations	65,278	47,353	65,278	47,353	179,794	292,425
R-squared	0.5433	0.6567	0.5517	0.6565	0.6750	0.6693
F-Statistic	1732	1114	1981	1129	4604	4486
State FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Sector FE	YES	YES	YES	YES	YES	YES

*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. Export/import residual category omitted. All estimations with ASM classification. A/T/F is the Apparel/Textiles/Footwear subdivision. All estimations for the TFP (Levinsohn & Petrin (2003) methodology.

5.1.2. Are there different learning effects for exporters of customised intermediates?

We use a leads-and-lags approach to evaluate the export premia of firms in our sample. This method is designed to explore two main aspects in the relatively long (eleven-year) panel available: first, it permits us to estimate a long-term "learning curve" for firms, tracking their productivity premium trajectory many years before and after entry, which provides a picture of longer trends; second, it also maximises the number of observations for export entries in each export category due to the fact we can keep starts from different years in the sample. We drop all firms that start exporting in their first two years in the sample to avoid capturing export starters with intermittent behaviors. We also chose to drop all firms that appear less than five consecutive years in the sample to increase the probability of observing exporters learning curve for a longer time period.

Table 6 depicts frequency, mean and medians for the main variables in the remaining sample according to the type of export category. The sample now presents significantly lower levels for all variables in all categories compared to the complete sample in Table 2. This is not surprising considering we have dropped firms that always export, which is the best performing group along these different dimensions. However, the same unconditional productivity hierarchy between different types of exporters is preserved, with exporters of non-customised and primary products still taking the lead.

Table 6: Summary Statistics for different types of export starters (Means and Medians)

	Freq	LnTFP	Po_Med	Age	Schooling
Sample	135,665	12.9 (12.8)	102 (57)	19.5 (16.7)	7.5 (7.5)
Finals	19,293	13.6 (13.5)	172 (83)	21.7 (19.0)	8.0 (8.0)
Cust. Inter	17,767	13.6 (13.6)	155 (83)	22.1 (19.8)	7.9 (8.0)
Non-Cust. Inter.	7,490	14.3 (14.3)	220 (98)	22.8 (20.3)	7.9 (8.0)
Primary Inter.	2,568	15.0 (15.1)	337 (137)	24.7 (23.6)	7.8 (7.8)

Means and medians (between parentheses). TFP estimated according to the (Levinsohn & Petrin (2003) methodology. Sample containing only non-exporters and starters. Residual category omitted.

We start with results for exporters without differentiating product types. The estimated equation is as follows:

$$LnTFP_{it} = \alpha_0 + \sum_{s=-8}^{8} \beta_s X_{is} + \delta M_{it} + \boldsymbol{\Phi Z_{it}} + \alpha_t + \varepsilon_{it} \qquad (2)$$

where X_{is} and M_{it} indicate if firm *i* is an exporter or importer in time *t*; but in this case the elements of X_{is} take the value one if, and only if, $s = t - K_i$, where K_i indicates the year firm *i* started exporting. Therefore, the elements of $\sum_{s=-8}^{8} X_{is}$ indicate how many years time *t* is before or after firm *i* started to export. For example, if firm *i* started exporting in 2001 and stays in the sample for the entire eleven-years period, the dummies ranging from X_{i-4} to X_{i+6} will take value one in the corresponding years (1997 for dummy X_{i-4}, 1998 for dummy X_{i-3} and so on until 2007 for dummy X_{i+6}). In all other cases X_{is} will be zero. The estimates $\sum_{s=-8}^{8} \beta_s$ correspond to the learning curves for exporters, ranging from eight years before to eight years after entry[13]. We concentrate on the eleven-year period before and after entry [β_{-5}, β_{-4}, …, β_5] because the number of observations for starters reduces as we move away from the year of entry, rendering estimates increasingly imprecise. The vector $\boldsymbol{Z_{it}}$ again includes controls for 3-digit sector and state dummies, size (log of number of employees), firm age, firm age squared, human capital (years of study of employees), and time fixed-effects. We depict results in graphical form, but Appendix II provides tables with the coefficients for all figures. In all cases we use the Levinsohn & Petrin (2003) productivity estimation method.[14]

We test for differences between coefficients two years after entry (β_{+2}) with estimations for two (β_{-2}) and one year (β_{-1}) before to have a first indication of learning-by-exporting – the latter test providing stronger evidence because it directly compares performance before and after entry. If there is learning, productivity gains should happen upon entry and after and remain significant for a minimum period, reducing the chance we are capturing transitory increases related, for example, to higher capacity utilisation. We would also like to know if productivity gains are dependent on firms continuous exporting activity, for which we compare trajectories of firms with different minimum permanence periods in exporting. Simultaneously, exporters could be more productive than non-exporters already before entry, indicating self-selection into export markets. We test this possibility by looking at the significance of the export premia coefficients of starters in the years before entry. Finally, the learning curves also serve as an indication of 'conscious' self-selection (Alvarez & López, 2005), i.e. firms purposively making investments and increasing their performance on their way to access foreign markets; we note however that there is no way of stablishing a causal effect from the choice of exporting to firms' decision to become more productive.

Figure 2.1 depicts results for the estimation of equation (3). Each line indicates results for firms that start exporting at s=0 and export continuously for *at least* zero to three years, i.e. until years s=0, s=1, s=2 and s=3, respectively. For example, curve T=0 contains all starters, curve T=1 excludes starters that stop exporting in s=1 (droppers), curve T=2 excludes droppers that stopped exporting in s=1 or s=2, and so on. The curves are estimated separately keeping the same group of non-exporters as baseline in each regression. All coefficients are significant at 5% or better. Complete results are available in Appendix II.

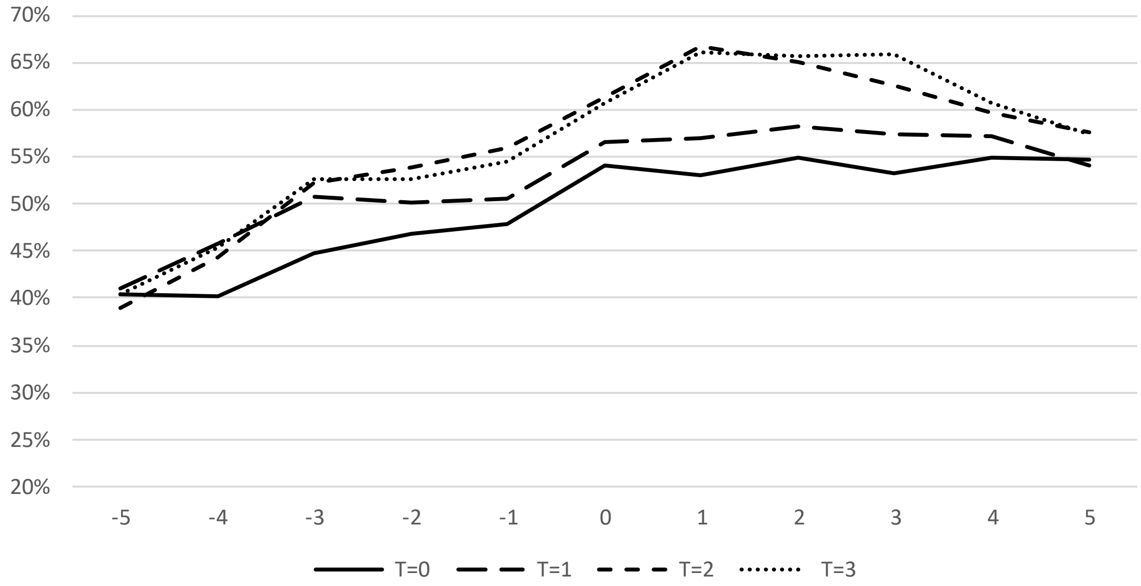
There are several insights about the long-term performance trajectory of exporters. First, they confirm that exporters are significantly more productive long before entering export markets, offering strong support to the idea of self-selection: five years before entering foreign markets, future exporters are about 40% more productive than similar non-exporting firms. Second, the productivity differential of exporters increases almost continuously on their trajectory to enter foreign markets, which offers support to the idea of conscious self-selection: in the year before entry (s=-1), future exporters are already

[13] Eight years is the maximum number of years firms can export *after entry* in an eleven-year sample in which we only allow valid entries from the third year.

[14] Results for the TFP version estimated with firm fixed-effects do not alter results and are available upon request.

48%-56% percent more productive than non-exporters. Third, the probability of continuing to export after entry is correlated with productivity levels immediately before entry and with growth in the period before entry. All groups depart from the same productivity premia five years before entry and progressively start to diverge.

Figure 2.1: Productivity premia (%) for starters compared to non-exporters



Coefficients (β) estimated according to equation (3) and transformed according to equation $100 \times (e^{\beta} - 1)$, using the same control variables as in equation (2). Each line indicates results for firms that start exporting at s=0 and export continuously for zero to three years, i.e. respectively until s=0, s=1, s=2, s=3. For example, at s=2, all exporters included in curves T=2 and T=3 are still exporting (continuers), while firms in curves T=0 and T=1 includes continuers and droppers. The curves are estimated separately keeping the same group of non-exporters as baseline in each regression. All coefficients are significant at 5% or less. Complete results are available in Appendix II.

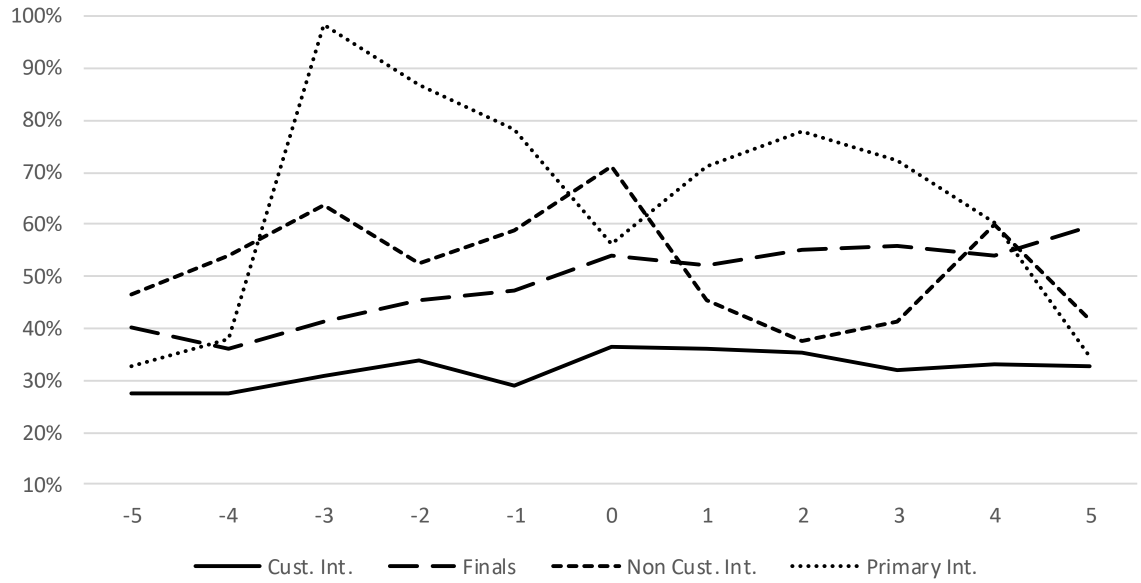
Finally, there are significant productivity gains in the year of entry and one year after entry for two and three-years continuers. In all curves the F-tests confirm β_{+2} is significantly higher compared to β_{-2} at the 5%, level and at the 10% significance level when compared to β_{-1}[15]. This provides some evidence in favor of learning-by-export in line with previous work done for Brazil (Araújo, 2016; Kannebley Jr et al, 2009). Nonetheless, the long-term approach allows us to observe that there is no indication that productivity gains continue after entry – they are restricted to the year of entry and to the following year for the group of two and three-year continuers, after which there is a relative stability compared to non-exporters even for firms that continue to export for four consecutive years. Becoming an exporter does not appear to be related to additional *ex-post* learning opportunities for firms.

We now turn to the behavior of exporters split according to the product groups we defined previously. We would like to know if exporters of customised intermediates

[15] In the case of β_{-2}, the p-values are 2.16%, 5.57%, 7.14% and 5,31% for T=0, T=1, T=2 and T=3, respectively; which are considerably closer to the 5% threshold than the 10% level.

benefit from learning-by-exporting and if the effect is different from exporters of other types of products. We exclude firms that export more than one product type to avoid `second' (or more) starts in the case of firms that start exporting in one category but already exported in another – which would likely be less costly due to complementarities and economies of scope, for example, in transportation, distribution and marketing networks in foreign market. We also perform estimations separately and keep the same baseline comparison group of non-exporters we used in Figure 2.1. Joint estimation of the different effects gives very similar results, and so we choose not to report them here[16]. Although the sample is large, entry is a relatively rare phenomenon, which motivates us to concentrate only on estimations for the RCON classification that allows maintaining the complete sample of firms. Still, we are left with far fewer cases of entry in primary intermediates, which makes the estimations noisier for this group.

Figure 2.2: Productivity premia (%) for starters in each product category (T=0)



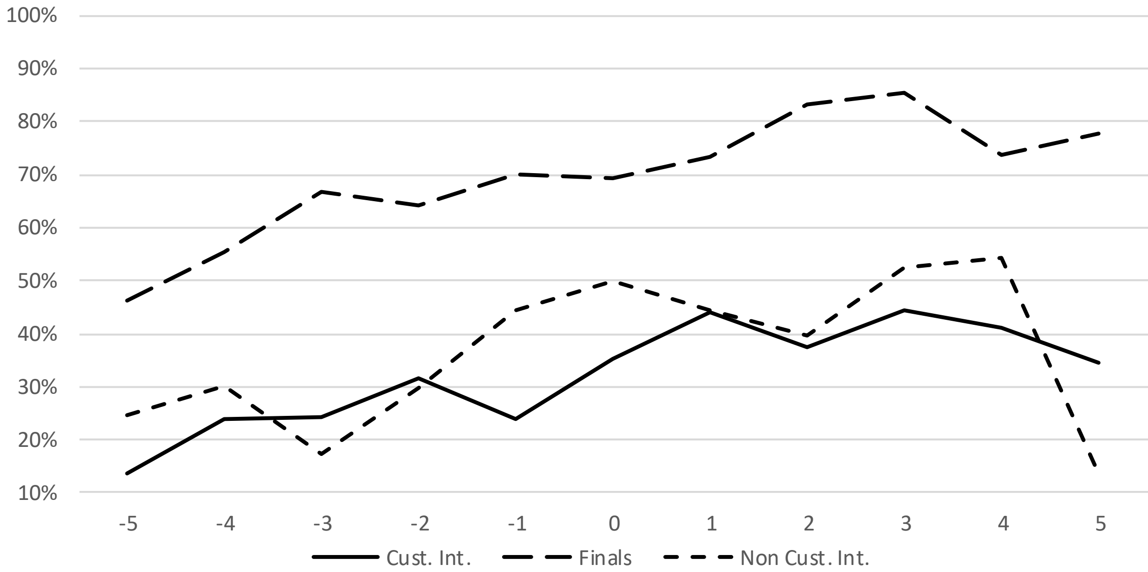
Coefficients (β) estimated according to equation (4) and transformed according to equation $100 \times (e^{\beta} - 1)$, using the same control variables as in equation (2). Each line indicates results for firms a category that start exporting at s=0 and are not constrained to export for more than one year (T=0). The curves are estimated separately keeping the same group of non-exporters as baseline in each regression. All coefficients are significant at 5% or less. Complete results are available in Appendix II.

Figures 2.2 and 2.3 show learning curves for starters in each category, imposing zero and three year continuity periods, respectively. In Figure 2.3 we exclude the curve of primary intermediates to avoid distorting the graph, but the behavior is similar to that in Figure 2.2, although at a higher level. Complete estimations are available in Appendix II. Overall, all categories are more productive than non-exporters long before entry and – except for exporters of primary intermediates, whose performance peaks three years before entry – present a growth trend before entry and on the year of entry. After entry, trends are less clear. Exporters of final goods appear to follow an upward trend, exporters of customised

[16] This results are of course available upon request.

intermediates appear stable while exporters of non-customised intermediates either lose performance or remain stable, and present an irregular behavior in periods 4 and 5. F-tests indicate that β_{+2} is higher than β_{-2} for exporters of final goods at 7.5%, while β_{+2} is significantly smaller than β_{-1} for exporters of non-customised intermediates by 9.5% in the regression of Figure 2.2. No other test is significant at standard levels, indicating post-entry trends are not robust enough to be characterised with precision. Results for the TFP fixed-effects estimation and for two-years and four-years continuers, although not depicted, do not change this picture: there is no robust evidence of productivity gains for separate subgroups after entry, with only a limited indication regarding exporters of final goods.

Figure 2.3: Productivity premia (%) for starters in each product category (T=3)



Coefficients estimated according to equation (4) and transformed according to equation $100 \times (e^{\beta} - 1)$, using the same control variables as in equation (2). Each line indicates results for firms a category that start exporting at s=0 and continue to do so for at least two more years (T=2). The curves are estimated separately keeping the same group of non-exporters as baseline in each regression. Complete results are available in Appendix II.

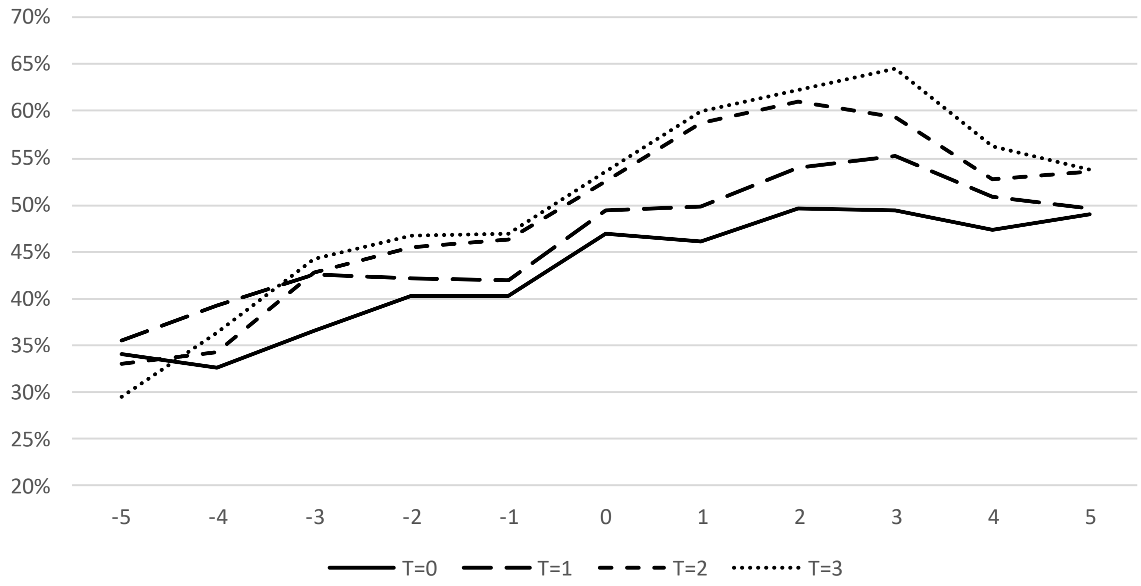
We saw in the previous section that customised products, both intermediates and finals, present higher export premia. In Figure 2.4 we depict learning curves for exporters of customised products according to their time of permanence in export markets, in a similar manner to that we did for all exporters in Figure 2.1. Exporters of customised intermediates will often also export final goods and vice-versa[17]; and a shortcoming of the previous approach is that we do not allow firms to move from one category to another when upgrading their products. The results are considerably different in this case, as we observe firms' learning curves continue to grow after entry until the second year for all starters. When we observe behavior until s=3, productivity continues to grow for curves containing only export continuers; and falls or stabilises only when droppers are included.

[17] 50% of exporters of customized intermediates also export final goods, while 56% of exporters of final goods also export customized intermediates.

F-tests confirm β_{+2} is significantly higher than β_{-1} and β_{-2} at the 5% significance level in almost all cases[18]. After period s=4 these gains are reduced but not completely lost in relation to pre-entry levels.

Therefore, in the category of customised products we find evidence of learning-by-exporting, especially for export continuers. The fact we do not find learning for exporters of customised intermediates or final goods separately and the high incidence of exporters of both categories confirms moving between customised products in these categories is important for the most successful exporters, i.e. those that export continuously and continue to gain performance throughout the trajectory.

Figure 2.4: Productivity premia (%) for exporters of customised products (finals and intermediates)



Coefficients estimated according to equation (3) and transformed according to equation $100 \times (e^{\beta} - 1)$, using the same control variables as in equation (2). Each line indicates results for firms that start exporting at s=0 and export continuously for zero to three years, i.e. respectively until s=0, s=1, s=2, s=3. For example, at s=2, all exporters included in curves T=2 and T=3 are still exporting (continuers), while firms in curves T=0 and T=1 includes continuers and droppers. The curves are estimated separately keeping the same group of non-exporters as baseline in each regression. All coefficients are significant at 5% or less. Complete results are available in Appendix II.

6. Conclusion and Discussion

The objective of this paper was to unveil heterogeneous effects of trade on the performance of trading firms according to their involvement in production fragmentation. We estimated the productivity premia associated with various types of exported products in order to check if there are differences in performance between firms that traded products associated with production fragmentation ('customised' intermediates) and those that trade other types of products. Next, we used the same taxonomy of products

[18] In one case the p-value is 5.2%, slightly missing the 5% threshold.

in a second group of estimations designed to verify if learning and self-selection differ among Brazilian trading firms.

We were motivated by the growth of international fragmentation in industrial organisation. These trends, according to part of the international trade literature, have the potential to offer increased learning avenues for firms in developing countries. Trends in international trade in the past twenty years suggest that the participation of developing countries has been growing more intensively in customised intermediates, a fact associated with production fragmentation. This result is sensitive to fluctuations in subperiods and short-term cycles but appears to be robust for the complete period. China and Southeast Asia have been leading this trend, but it can also be observed in other developing countries. Brazil, on the other hand, has been a laggard regarding participation in international trade of customised intermediary products for the period.

Our results partially confirm evidence from the empirical literature indicating that exporting intermediates related to GVCs is associated with a better performance compared to non-exporters or suppliers of other types of intermediates, although we observe in apparel/textiles/footwear that the differences cease to be significant once less complex products are considered GVC-related. Regarding the hierarchy with producers of final goods, we also find results that vary across sectors. In general, we find evidence suggesting that the impact of fragmentation is related to the level of customisation of the products: exporting is associated with better performance when customised intermediates are involved, but not when lower complexity goods are sold.

Like previous work for Brazil, we find some evidence of learning-by-exporting in our sample. We observe significant and growing productivity premia long before entry in foreign markets, at least five years prior to start, which we interpret as a clear indication of self-selection of more productive firms into foreign markets. We also observe that exporters' productivity premia increase steadily in the years before entry, which can offer support to the idea of "conscious self-selection" by exporters. There is an indication of productivity gains after entry, but they are mostly limited to the year of entry or immediately after, suggesting that foreign markets are not a source of continuous learning for overall exporters.

Exclusive exporters of customised intermediates do not benefit from learning-by-exporting, i.e. our results do not confirm fragmentation in intermediates *per se* is a source of learning for firms in Brazil. We observe, however, that customised products are associated with learning in set-ups where firms are allowed to export both final goods and intermediates. This indicates fragmentation, by promoting trade in customised intermediates, might still be associated with learning when firms manage to upgrade their products. As we observed previously, this fact is well known in the GVC literature, which indicates that both the governance structure of the value chain (Pietrobelli et al., 2011) and firms' internal innovation efforts and capabilities will influence successful upgrading (Morrison et al., 2008). Unfortunately, we are not able to explore these dimensions more profoundly in this study, which remains one of the its main limitations, and a promising area for future research in this topic.

Appendix I

Rauch (1999)'s classification of differentiated products divided products in three categories: traded in organised exchanges, reference priced in trade publications, and all others. The first two categories indicate homogeneous products traded in dense markets, while the residual identifies differentiated products more likely to be traded on the basis of networks. We call this list the `RCON' classification. Sturgeon and Memedovic (2010) created a list of customised intermediates for the group of most GVC intensive sectors - textiles, apparel, footwear, automotive and electronics; Athukorala (2010)'s taxonomy tracks 'parts and components' for the entire spectrum of traded products using the Harmonised System, but the method of defining 'parts and components' as GVC products is highly biased towards the machinery sectors.

All our classifications are produced for all versions of the Harmonised System (HS). We use correspondence tables taken from UNSTATS.[19] Our first step is to classify products as final, industrial intermediates or primary intermediates. We consider fuels and lubricants as primary intermediates, separating them from the overall industrial sector. We use the Fourth Revision of the United Nations Broad Economic Categories (BEC) classification and adopt the following criteria:

- Codes for final goods (capital and consumption): 41, 521, 112, 122, 522, 61, 62, 63
- Codes for industrial intermediates: 22, 42, 53
- Codes for primary intermediates: 21, 111, 121, 31, 322, 321

The BEC classification is mostly precise, however we follow Athukorala (2010) and Sturgeon and Memedovic (2010) and correct the 75 products classified as finals that are mostly intermediates according to either of the two classifications.

The next step is to produce the subdivision of customised and non-customised industrial intermediates, which differentiates the RCON and the ASM classifications. For the RCON classification we use Rauch's (1999) list of customised products. This classification was originally created using the second revision of the SITC system. We use correspondence tables to directly convert this classification to all HS system versions, therefore obtaining our RCON list. For the ASM classification, we first obtained the Sturgeon and Memedovic (2010) updated classification for all HS versions directly from the authors. The Athukorala list was originally done for version 1 of the HS system, so conversion for other versions of HS system is done using correspondence tables.

Table I.1 depicts the number of products in each chapter of the HS 2002 system that results from the procedure described above. The ASM classification is mostly focused in Apparel/Textiles/Footwear (chapters 11-12) and Machinery (chapters 16-18). In machinery classifications mostly coincide, but differences for Apparel/Textiles/Footwear are quite large: the ASM classification indicates much more customised intermediates than the RCON classification.

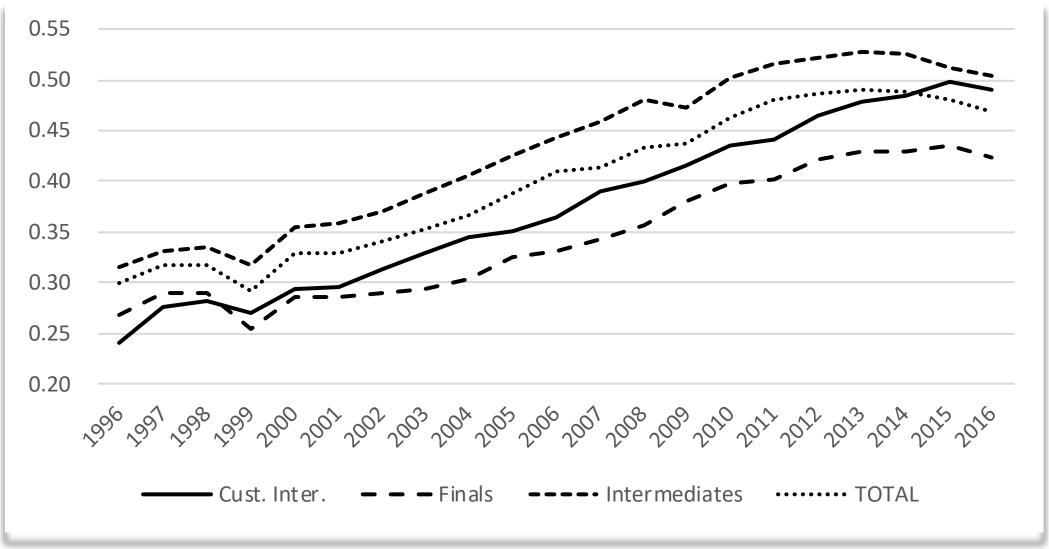
Table I.1: Division of HS 2002 codes according to classification RCON and ASM

[19] https://unstats.un.org/unsd/trade/classifications/correspondence-tables.asp

Sections	Finals	Cust Inter.		Non-Cust Inter.		Prim. Inter.	NA
	BOTH	RCON	ASM	RCON	ASM	BOTH	BOTH
01-10	592	420	26	783	1177	419	0
11	317	262	355	232	139	37	0
12	39	16	13	0	3	0	0
13-15	104	361	39	271	593	38	3
16	471	327	324	0	3	1	0
17	84	42	42	0	0	1	7
18	158	81	63	0	18	0	0
19-21	107	40	17	0	23	0	11
99	0	0	0	0	0	0	2
Total	**1872**	**1549**	**879**	**1286**	**1956**	**496**	**23**

Figure I.1 below shows trends for export participation by product type are not affected by the inclusion of all countries in the COMTRADE export database. Figures I.2 reproduces the same analysis excluding China and Southeast Asia, while and figure I.3 shows trends for export participation by product type for Brazilian exports only. As described previously, the overall results remain the same in Figure I.2, with exports of intermediates by developing countries growing 8.41%, above the average of 7.50%, although remaining at much lower levels and more influenced by the fall after 2014 in exports of primary intermediates. In Figure I.3, we observe how this is not the case for Brazil, where relative participation in exports of customised intermediates slightly reduces throughout the period.

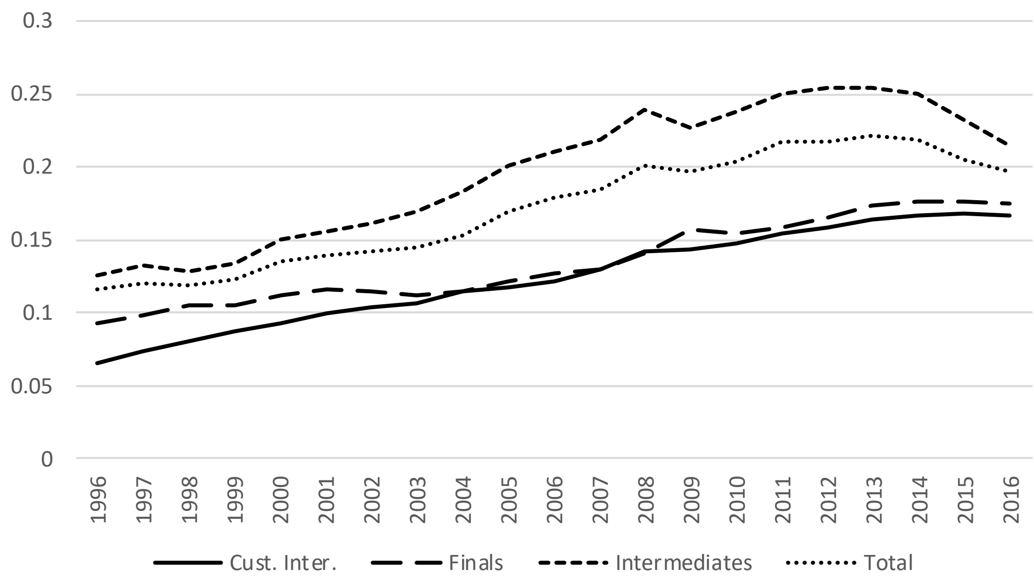
Figure I.1: Non-OECD countries participation in total global exports in current values according with product categories, including all countries



Own

Own elaboration from COMTRADE export data. Export flows are in current values. The series exclude countries whose data is not available for the entire period in the Harmonised System. Products divided according to the RCON classification.

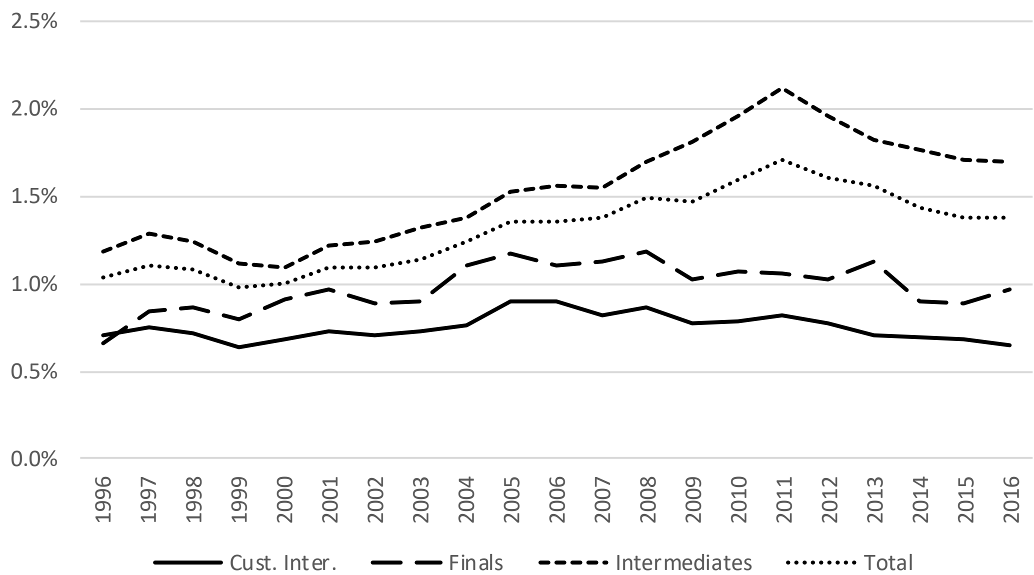
Figure I.2: Non-OECD countries participation in total global exports in current values according with product categories, excluding China and Southeast Asia exports



Own

Own elaboration from COMTRADE export data. Export flows are in current values. The series exclude countries whose data is not available for the entire period in the Harmonised System. Products divided according to the RCON classification.

Figure I.3: Brazil's participation in total global exports in current values according with product categories



Own

Own elaboration from COMTRADE export data. Export flows are in current values. The series exclude countries whose data is not available for the entire period in the Harmonised System. Products divided according to the RCON classification.

Appendix II

Table II.1: Productivity premia for starters compared to non-exporters

	(1)	(2)	(3)	(4)
Dependent Variable	TFP-LP			
	T=0	T=1	T=2	T=3
β(-8)	0.3199	0.2544	0.1833	
	(0.0375)***	(0.0588)***	(0.0984)*	
β(-7)	0.3122	0.3017	0.3026	0.4049
	(0.0302)***	(0.0427)***	(0.0604)***	(0.0856)***
β(-6)	0.3204	0.3082	0.3003	0.3158
	(0.0234)***	(0.0325)***	(0.0433)***	(0.0521)***
β(-5)	0.3399	0.3435	0.3292	0.3388
	(0.0209)***	(0.0287)***	(0.0369)***	(0.0451)***
β(-4)	0.3382	0.3763	0.3667	0.3735
	(0.0175)***	(0.0231)***	(0.0301)***	(0.0339)***
β(-3)	0.3693	0.4110	0.4204	0.4233
	(0.0152)***	(0.0194)***	(0.0244)***	(0.0282)***
β(-2)	0.3841	0.4069	0.4308	0.4227
	(0.0135)***	(0.0176)***	(0.0212)***	(0.0247)***
β(-1)	0.3905	0.4087	0.4443	0.4354
	(0.0136)***	(0.0179)***	(0.0225)***	(0.0250)***
β(0)	0.4317	0.4486	0.4779	0.4746
	(0.0140)***	(0.0179)***	(0.0219)***	(0.0250)***
β(+1)	0.4255	0.4509	0.5106	0.5073
	(0.0149)***	(0.0189)***	(0.0233)***	(0.0271)***
β(+2)	0.4371	0.4588	0.5013	0.5049
	(0.0161)***	(0.0201)***	(0.0232)***	(0.0268)***
β(+3)	0.4275	0.4533	0.4854	0.5067
	(0.0173)***	(0.0219)***	(0.0251)***	(0.0271)***
β(+4)	0.4381	0.4526	0.4681	0.4743
	(0.0188)***	(0.0241)***	(0.0282)***	(0.0304)***
β(+5)	0.4360	0.4318	0.4549	0.4530
	(0.0222)***	(0.0285)***	(0.0330)***	(0.0366)***
β(+6)	0.3994	0.4001	0.4093	0.4329
	(0.0253)***	(0.0337)***	(0.0396)***	(0.0428)***
β(+7)	0.3730	0.3419	0.3702	0.3646
	(0.0307)***	(0.0394)***	(0.0467)***	(0.0526)***
β(+8)	0.3588	0.3438	0.3558	0.3285
	(0.0409)***	(0.0495)***	(0.0577)***	(0.0665)***
pimp	0.5621	0.5849	0.6045	0.6128
	(0.0068)***	(0.0075)***	(0.0080)***	(0.0082)***
Observations	135,665	122,613	116,818	113,631
R-squared	0.6482	0.6373	0.6326	0.6268
$\beta_{-2}=\beta_2$	0.94%	4.69%	2.23%	2.19%
$\beta_{-1}=\beta_2$	2.16%	5.57%	7.14%	5.31%

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table II.2: Productivity premia for starters in each product category (T=0)

	(1)	(2)	(3)	(4)
Dependent Variable	TFP-LP			
	Finals	Cust.	Non-Cust.	Primary
β(-8)	0.2828	0.2789	0.5865	0.2758
	(0.0627)***	(0.0664)***	(0.1086)***	(0.1841)
β(-7)	0.2601	0.2360	0.3631	0.4205
	(0.0506)***	(0.0562)***	(0.1266)***	(0.1221)***
β(-6)	0.2773	0.2620	0.3244	0.2381
	(0.0393)***	(0.0441)***	(0.1009)***	(0.1594)
β(-5)	0.3366	0.2438	0.3816	0.2822
	(0.0371)***	(0.0408)***	(0.0892)***	(0.1142)**
β(-4)	0.3085	0.2426	0.4325	0.3224
	(0.0295)***	(0.0342)***	(0.0766)***	(0.1308)**
β(-3)	0.3446	0.2682	0.4923	0.6854
	(0.0256)***	(0.0315)***	(0.0651)***	(0.1224)***
β(-2)	0.3741	0.2915	0.4213	0.6257
	(0.0232)***	(0.0275)***	(0.0675)***	(0.1218)***
β(-1)	0.3878	0.2541	0.4634	0.5777
	(0.0248)***	(0.0266)***	(0.0559)***	(0.1128)***
β(0)	0.4320	0.3099	0.5370	0.4467
	(0.0250)***	(0.0274)***	(0.0652)***	(0.1436)***
β(+1)	0.4202	0.3072	0.3750	0.5376
	(0.0270)***	(0.0301)***	(0.0664)***	(0.1426)***
β(+2)	0.4401	0.3019	0.3194	0.5769
	(0.0295)***	(0.0359)***	(0.0667)***	(0.1556)***
β(+3)	0.4433	0.2773	0.3453	0.5432
	(0.0320)***	(0.0359)***	(0.0812)***	(0.1634)***
β(+4)	0.4325	0.2872	0.4706	0.4731
	(0.0344)***	(0.0416)***	(0.0929)***	(0.1564)***
β(+5)	0.4667	0.2828	0.3488	0.2964
	(0.0431)***	(0.0545)***	(0.1082)***	(0.1783)*
β(+6)	0.4702	0.2403	0.4007	0.3516
	(0.0532)***	(0.0554)***	(0.0952)***	(0.1770)**
β(+7)	0.3986	0.2595	0.3266	0.3111
	(0.0625)***	(0.0651)***	(0.1097)***	(0.3144)
β(+8)	0.3235	0.2520	0.2552	0.3042
	(0.1001)***	(0.0827)***	(0.1143)**	(0.5484)
pimp	0.6249	0.6325	0.6695	0.6780
	(0.0083)***	(0.0083)***	(0.0089)***	(0.0091)***
Observations	114,175	111,802	106,672	105,482
R-squared	0.6078	0.6033	0.6083	0.6078
$\beta_{-2}=\beta_2$	7.49%	81.65%	28.02%	80.39%
$\beta_{-1}=\beta_2$	16.86%	27.90%	9.52%	99.65%

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table II.3: Productivity premia for starters in each product category (T=3)

Dependent Variable	(1) TFP-LP Finals	(2) Cust.	(3) Non-Cust.	(4) Primary
β(-8)	0.2100	0.1591	-0.1912	0.2132
	(0.1826)	(0.1770)	(0.4383)	(0.1534)
β(-7)	0.3235	0.1410	0.1652	0.4220
	(0.0997)***	(0.0947)	(0.1700)	(0.2920)
β(-6)	0.3793	0.1279	0.2205	0.1600
	(0.0917)***	(0.0965)	(0.1528)	(0.3373)
β(-5)	0.4399	0.2150	0.2624	0.3291
	(0.0713)***	(0.0902)**	(0.1704)	(0.2564)
β(-4)	0.5116	0.2174	0.1583	1.0271
	(0.0582)***	(0.0690)***	(0.1867)	(0.4382)**
β(-3)	0.4955	0.2746	0.2593	0.8850
	(0.0595)***	(0.0632)***	(0.1115)**	(0.4288)**
β(-2)	0.5309	0.2151	0.3677	0.9269
	(0.0582)***	(0.0628)***	(0.1164)***	(0.4091)**
β(-1)	0.5270	0.3013	0.4046	0.9690
	(0.0591)***	(0.0563)***	(0.1599)**	(0.4312)**
β(0)	0.5506	0.3656	0.3678	0.8902
	(0.0641)***	(0.0603)***	(0.1705)**	(0.4307)**
β(+1)	0.6061	0.3175	0.3336	0.8291
	(0.0663)***	(0.0637)***	(0.1543)**	(0.4541)*
β(+2)	0.6180	0.3666	0.4214	0.8017
	(0.0651)***	(0.0672)***	(0.1495)***	(0.4444)*
β(+3)	0.5532	0.3450	0.4341	0.5958
	(0.0676)***	(0.0791)***	(0.1705)**	(0.4228)
β(+4)	0.5757	0.2972	0.1264	0.2075
	(0.0861)***	(0.0950)***	(0.2542)	(0.5538)
β(+5)	0.5808	0.2671	0.7530	0.6155
	(0.0999)***	(0.1143)**	(0.1981)***	(0.0395)***
β(+6)	0.5503	0.1994	0.5506	0.2585
	(0.1129)***	(0.1334)	(0.1836)***	(0.0395)***
β(+7)	0.3204	0.2077	0.3139	
	(0.1757)*	(0.1427)	(0.1659)*	
β(+8)				
pimp	0.6636	0.6670	0.6715	0.6785
	(0.0089)***	(0.0090)***	(0.0091)***	(0.0091)***
Observations	106,424	106,265	105,319	105,081
R-squared	0.6025	0.5990	0.6005	0.6013
$\beta_{-2}=\beta_2$	21.27%	63.16%	69.56%	92.77%
$\beta_{-1}=\beta_2$	39.19%	25.02%	85.95%	87.10%

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table II.4: Productivity premia for exporters of customised intermediates

	(1)	(2)	(3)	(4)
Dependent Variable	TFP-LP			
	T=0	T=1	T=2	T=3
	(0.0445)***	(0.0754)***	(0.1315)	
β(-8)	0.2587	0.2471	0.1761	0.1674
	(0.0360)***	(0.0529)***	(0.0741)**	(0.1101)
β(-7)	0.2862	0.2987	0.2517	0.2488
	(0.0273)***	(0.0405)***	(0.0582)***	(0.0743)***
β(-6)	0.2930	0.3045	0.2862	0.2589
	(0.0249)***	(0.0361)***	(0.0490)***	(0.0644)***
β(-5)	0.2825	0.3315	0.2955	0.3094
	(0.0206)***	(0.0285)***	(0.0387)***	(0.0473)***
β(-4)	0.3122	0.3544	0.3566	0.3663
	(0.0178)***	(0.0238)***	(0.0312)***	(0.0363)***
β(-3)	0.3384	0.3515	0.3748	0.3832
	(0.0160)***	(0.0225)***	(0.0279)***	(0.0344)***
β(-2)	0.3380	0.3508	0.3805	0.3850
	(0.0163)***	(0.0229)***	(0.0306)***	(0.0345)***
β(-1)	0.3848	0.4011	0.4218	0.4293
	(0.0168)***	(0.0228)***	(0.0289)***	(0.0346)***
β(0)	0.3795	0.4042	0.4621	0.4705
	(0.0178)***	(0.0237)***	(0.0305)***	(0.0370)***
β(+1)	0.4031	0.4320	0.4765	0.4835
	(0.0199)***	(0.0261)***	(0.0317)***	(0.0378)***
β(+2)	0.4015	0.4403	0.4658	0.4983
	(0.0213)***	(0.0283)***	(0.0344)***	(0.0383)***
β(+3)	0.3878	0.4111	0.4229	0.4458
	(0.0232)***	(0.0316)***	(0.0383)***	(0.0422)***
β(+4)	0.3992	0.4033	0.4286	0.4298
	(0.0279)***	(0.0369)***	(0.0434)***	(0.0488)***
β(+5)	0.3677	0.3693	0.3720	0.3978
	(0.0307)***	(0.0423)***	(0.0509)***	(0.0590)***
β(+6)	0.3314	0.3009	0.3186	0.3289
	(0.0370)***	(0.0493)***	(0.0604)***	(0.0715)***
β(+7)	0.3291	0.3221	0.3179	0.2614
	(0.0517)***	(0.0606)***	(0.0759)***	(0.0937)***
β(+8)				
pimp	0.5771	0.6093	0.6298	0.6379
	(0.0073)***	(0.0080)***	(0.0084)***	(0.0086)***
Observations	125,688	115,769	111,617	109,569
R-squared	0.6032	0.6002	0.6000	0.6004
$\beta_{-2}=\beta_2$	0.98%	1.79%	1.48%	4.77%
$\beta_{-1}=\beta_2$	0.95%	1.75%	2.74%	5.18%

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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