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Explaining export diversification through firm innovation decisions: The case of Brazil

Xavier Cirera [a], Anabel Marin [b,*], Ricardo Markwald [c]

[a] Innovation, Technology and Entrepreneurship, Trade & Competitiveness Global Practice, The World Bank Group, 1818H Street, NW, Washington DC 20433, USA
[b] Conicet/Cenit-Untref, Argentina and SPRU, University of Sussex, UK
[c] FUNCEX, Av. Rio Branco, 120, Rio de Janeiro, Brazil

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ABSTRACT

This paper investigates a largely unexplored dimension of export performance, firm level determinants of export diversification. We extend innovation studies and enrich the export literature by analyzing the role of firms' innovation and market strategies in explaining export diversification. To do so, we use a unique dataset that links data on exports, innovation and firms' characteristics at the firm level in Brazil. Our findings show that access to existing resources, as emphasized by existing innovation studies on emerging economies, cannot account for all the heterogeneity observed in firm's export diversification in Brazil. Innovative efforts and the strategic positioning of firms in the domestic market are crucially important in explaining diversification. These results emphasize the importance of distinguishing new from existing exports when investigating the dimensions that affect export performance.

1. Introduction

The importance of product and export diversification for economic growth and development is uncontroversial (see for example Imbs and Wacziarg, 2003; Klinger and Lederman, 2004; Aditya and Acharyya, 2013). A nascent literature concerned with the introduction of new exports at the country level (or "discoveries"), has highlighted the importance of reducing uncertainty, minimizing exchange rate volatility, and encouraging entrepreneurship and human capital development to facilitate export diversification (Hausmann et al., 2007; Agosin et al., 2012). Diversification, however, occurs at the firm level. It is at the firm level that decisions about the commitment of resources to introduce new products (new to the country or to the firm) for export are made. It is also mainly at the firm level that the risks and benefits of new exports, in terms of sales and potential monopoly rents, are taken and appropriated (Wakelin, 1998). This makes the firm the most suitable unit for analyzing the determinants of export diversification.

Existing studies of the firm level determinants of export performance – trade and innovation studies – have highlighted the importance of enhancing productivity and innovation efforts for successful entry to international markets (Cassiman and Golovko, 2011; Becker and Egger, 2007; Wakelin, 1998). One limitation of the existing studies, however, is that typically they do not distinguish between new and existing exports. Export performance is usually evaluated as the propensity to export existing products or to enter new export markets (see Estrada and Heijs, 2006 for a review). The first objective of this paper is to extend existing studies about innovation and trade by researching a rarely explored dimension of export performance: the propensity of firms to introduce new products for export – or export diversification at the firm level. To do so we incorporate insights from the business literature on diversification.

A second limitation of the existing research is the lack of conclusiveness about the role of innovation in supporting exports in firms from less advanced countries. In particular, for firms from these countries, quantitative studies have failed to provide clear evidence supporting the idea that exports follow unique technological assets and product innovations; in contrast with the evidence based on firms from advanced countries (see Cassiman and Golovko, 2011; Wakelin, 1998; Caldera, 2010). The argument is that this is because firms from less advanced countries compete internationally mainly based on the access to existing resources and not so much based on the innovative characteristics of their products (Alvarez, 2007; Özçelik and Taymaz, 2004). Recent evidence from case studies, however, suggests that some firms from emerging markets, are competing internationally based on both access

* Corresponding author.
E-mail addresses: a.i.marin@fund-cenit.org.ar (A. Marin), rmarkwald@funcex.org.br (R. Markwald).

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to resources and unique innovations (Amann and Cantwell, 2012; Marin and Bell, 2012; Amann and Figueriedo, 2012; The Economist, 2010 The Economist, 2010). The second objective of this paper is to improve our understanding of the role that innovation plays in supporting export diversification of firms from less advanced countries.

One of the main distinctive features of our paper is our unique database. The empirical analysis uses a firm level dataset that links production, trade, and innovation data in Brazil. As a result, the paper also contributes to document the process of export diversification in Brazil, an emerging economy in a process a rapid transformation. Despite the fact that Brazil is one of the most diversified economies in Latin America, it still lags behind advanced economies and other emerging economies, such as China and Mexico regarding export diversification (Hummels and Klenow, 2005). Its export basket is heavily concentrated and dependent on natural resources (NRs). Nevertheless, Brazil has developed some highly competitive manufacturing sectors, which makes the country an interesting case study to test our research questions.

Previous research on export performance in Brazil's has documented the role of education, technology, and production scale (Arbache and de Negri, 2003), and cost leadership and differentiation (Aulakh et al., 2000) in explaining export growth and geographical diversification. Our analysis adds to the existing literature on export performance in Brazil in two dimensions; by examining the role of firm's level innovation and market strategies for exporting and product diversification, instead of geographical diversification.

Our analysis shows interesting results. First, we found that a significant share of exporters engages each year in the introduction of new products for export (25% in some years) and that they do so in most industries; including industries conventionally identified as high-tech and also as low-tech. More importantly, regarding the main determinants of firmís level export diversification, our empirical approach allowed identifying the importance of developing unique technological assets to support exports, in the case of firms from less advanced countries, a result that previous research, without distinguishing new from existing exports, failed to identify. It also allowed identifying the importance of the position of firms in the domestic market, as an important dimension in explaining differences in performance regarding export diversification.

These results suggest that existing research about innovation and trade might benefit from distinguishing increases in existing exports from increases in new exports as a measure of exports performance. Our study contributes to existing research about innovation and trade by providing a first step in this direction. We began to evaluate the potential importance of distinguishing new from existing exports, expand existing empirical models within the innovation literature to explore the determinants of new exports incorporating insights from the diversification literature, and explore the proposed exploratory model using a rich dataset from Brazil a developing country in expansion.

The paper is organized as follows. Section 2 surveys the existing literature and discusses our research questions and hypotheses. Section 3 discusses the dataset and methodology used. Section 4 describes some features of the pattern of export diversification in Brazil. Section 5 analyses the main determinants of firm export diversification in Brazil. The last section concludes.

2. The oretical background, objectives, and hypotheses

Our research is about firm level determinants of export diversification. Trade studies have been traditionally concerned with the determinants of export performance. They have, however, only very recently incorporated firm's heterogeneity in models of understanding of trade patterns and performance. In doing so, this literature has emphasized the role of structural characteristics of firms, such as size and productivity, in explaining exportsí performance; both at the intensive margin (same products) and extensive margin (new products) (Melitz, 2003).[1] One limitation of this literature, however, is that it treats productivity as exogenous to the firm; and just like the size of firms, it is considered a structural characteristic of the firm. The question of how firms achieve the productivity threshold that allows them to export tends to be left out of the models (Cassiman and Martinez-Ros, 2007).

Innovation studies have more directly addressed the association between firms' decisions and performance, including export performance (Vernon, 1966; Cassiman and Martinez-Ros, 2007). Vernon (1966) was one of the first authors to directly link innovation to exports, in his product-cycle model. He suggested that exports typically follow firm's product innovations when the domestic market is saturated, in a process which usually starts in advanced countries where markets can pay a premium for innovation. Based on Vernon's product cycle model, numerous studies have theoretically and empirically explored the association between innovation and exports; supporting in general the prediction of the product-cycle model that product innovation is a driving force for the exports of firms from advanced countries (Cassiman and Golovko, 2011; Wakelin, 1998; Caldera, 2010; Lachenmaier and Wößmann, 2006; Bernard and Jensen, 1999; Becker and Egger, 2013; Nassimbeni, 2001).

One important limitation of this literature, however, is that this typically has not distinguished between new exports and existing exports (i.e., export performance is usually evaluated as the propensity to export existing products or to enter new export markets)[2] (Estrada and Heijs, 2006). The first objective of this paper is to extend existing studies about innovation and trade performance by researching the propensity of firms to introduce new products for exports (or export diversification at the firm level). We are interested in understanding the extent to which the same firm level efforts that have been found important in explaining export performance in general, are important also for export diversification. We are also interested in the identification of efforts and behaviors that are particularly significant for export diversification. To explore this second issue we incorporate some insights deriving from the business literature which has addressed issues of firm's diversification.

The more important point made by the business literature in relation to the determinants of diversification, following Penroseí ideas (Penrose, 1959; Teece, 1980, 1982), is similar to the one made by the innovation literature: firms diversify to exploit resources in excess difficult to trade, typically brand name and technological resources. Based on this idea, thus, numerous studies have identified a positive link between diversification and technological resources and marketing' efforts – including patents, product innovations, and efforts in R&D and marketing (Montgomery and Hariha-ran, 1991; Dierickx et al., 1989; Teece et al., 1997; Hargadon and Sutton, 2000; Duarte et al., 2007).[3]

The business literature on diversification, however, has emphasized also two other important dimensions for diversification. First, it has emphasized the importance of the strategic position of firms

[1] Other empirical studies include (Roberts and Tybout, 1997; Isgut, 2001; Cassiman et al., 2010).

[2] Out of 46 studies explored by Estrada and Heijs (2006), none uses the introduction of new to the firm exports as the measure of exports performance.

[3] In both cases, it has been argued that there could be a problem of endogeneity, between innovation and exports and innovation and diversification, however, empirical evidence is rather unanimous in supporting causality going from innovation to exports (see Cassiman and Golovko, 2011, Becker and Egger, 2013 and from innovation to diversification (Rodríguez-Duarte et al., 2007).

in the domestic market as an antecedent for diversification. It has been suggested that the firms that are more likely to diversify are those that have built a reputation and market power in the domestic market (Amsden and Hikino, 1994; Cassiman and Golovko, 2011). Second, this literature has highlighted the importance of the experience in diversification. It has been proposed that firms which are more diversified are more likely to be capable of diversifying, because given their breadth of diversified sector capabilities face a wider array of diversification possibilities in different sectors (Montgomery and Hariha-ran, 1991; Lefebvre and Lefebvre, 2001; Estrada and Heijs, 2006).

All these conclusions, however, from both the innovation and business literature have been based on the experience of firms from advanced countries. In the case of firms from less advanced contexts, indeed, the existing studies have failed to identified the need for unique technology assets and the development of a strategic position in the domestic market for exports and diversification (Alvarez, 2007; Estrada and Heijs, 2006; Özçelik and Taymaz, 2004; Khanna and Yafeh, 2007). Wilmore (1992) and Alvarez (2007), for instance, failed to identify a significant effect for R&D and expenditures in licenses, in the export performance of Brazilian and Chilean firms, respectively. Kumar and Siddharthan (1994) found that R&D had a positive effect in export performance of Indian firms, but only in the case of firms that operate in low-technology sectors. Damijan et al. (2010), with data from Slovenia, found no evidence that either product or process innovations increased the likelihood that a firm will become a first-time exporter. Similarly, Estrada and Heijs (2006) in Mexico found that R&D efforts were important in explaining the probability to export, but the effect of variables representing product innovations (such as high number of new products or a product diversification strategy) was negative. On the contrary, firms that specialize in a single product tended to be more dynamic in the international market. Özçelik and Taymaz (2004) found similar results for Turkish firms, where R&D appeared significant but product innovation was not significant in explaining export probability or propensity.

Similarly, diversification studies, though less numerous suggest that the diversification of firms from less advanced countries is often motivated by the unavailability of inputs and other market imperfections that induce vertical integration and unrelated diversification, than by the need or desire to exploit unique technological resources (Khanna and Yafeh, 2007).

Explanations for these findings are associated in general to the different nature of the innovative process of firms from less advanced countries (see Kumar and Siddharthan, 1994; Estrada and Heijs, 2006; Alvarez, 2007; Özçelik and Taymaz, 2004). Firms from less advanced countries, it is argued, typically reverse the trajectory of technological change observed in advanced country firms (see for instance, Kim, 1999; Bell and Pavitt, 1995; Lall, 1992). They start new activities normally importing existing technologies and, only exceptionally evolve to produce unique technological assets and product innovations which can support processes of exports and diversification (Alvarez, 2007; Estrada and Heijs, 2006; Özçelik and Taymaz, 2004). They are therefore more dependent on foreign links – which facilitate the access to external knowledge inputs and technologies – and, skills and engineering and setting up capabilities – which help them to take advantage of existing technologies – and less dependent on advanced forms of knowledge development such as R&D (which are used to develop unique assets) (see for instance Basile, 2001; Sterlacchini, 1999; Kumar and Siddharthan, 1994; Marin and Bell, 2010; Lefebvre and Lefebvre, 2001; Estrada and Heijs, 2006; Amsden and Hikino, 1994).

Some recent evidence about international distribution of innovations, however, has shown that there has been a transition since the early 1990s and intensifying during the 2000s toward a more geographically dispersed distribution of the more sophisticated kinds of innovative efforts; with the well-known East Asian new entrants being the more significant among the contributors, but with an increasing participation also of countries like India and Brazil (Athreye and Cantwell, 2007; Amann and Cantwell, 2012). Some domestic firms from some emerging economies seem to be using advanced forms of innovation to compete internationally (Amann and Figueiredo, 2012).[4] This new emerging evidence is, however, fragmented and mainly based on case studies. The second objective of this paper is to improve our understanding of the role of innovation in supporting the competitiveness and exports of firms from less advanced countries; focusing empirically on new exports instead of existing exports, as a measure of trade performance, should allow us to better capture the importance of innovation variables.

2.1. Hypotheses

Our main exploratory hypothesis is that in the case of the introduction of new to the firm exports, firms from less advanced countries are required to invest in advanced innovation efforts to create new and unique technology assets and products and to use the domestic market strategically; in the same way that firms from advanced countries have been found to do so, to support their exports and diversification in general. This is because it is very likely that introducing new products for exporting is more demanding on innovative efforts and assets than increasing exports of the same products.

More specifically, based on the discussion above we propose the following hypotheses to be tested empirically.

Based on the evidence from trade studies (Melitz, 2003; Bernard et al., 2007; Wakelin, 1998; Sterlacchini, 1999; Alvarez, 2007 Alvarez, 2007).

1) Size and productivity of firms affect positively our measure of export's diversification of firms.

Based on the evidence of innovation studies about exports of firms from advanced countries (Basile, 2001; Hirsch and Bijaoui, 1985; Estrada and Heijs, 2006; Damijan et al., 2010; Cassiman and Golovko, 2011; Becker and Egger, 2007; Cassiman et al., 2010) and, on the idea that the introduction of new products for exporting is more demanding on innovative efforts and assets than increasing exports of the same products.

2) Creative efforts and outputs of firms, such as R&D expenditures and product and process innovations affect positively our measure of export's diversification of firms.

Based on the evidence from innovation studies about firmsí performance of firms from less advanced countries (Lefebvre and Lefebvre, 2001; Amsden and Hikino, 1994; Basile, 2001; Sterlaccini, 1999; Kumar and Siddharthan, 1994; Beccheti and Rosi, 1998; Lefebvre and Lefebvre, 2001).

3) Efforts to access and implement existing technologies, such as skills and project execution capabilities and; foreign links – measured as foreign capital share, horizontal links with other firms from the same group and vertical links with clients or suppliers – affect positively our measure of exportís diversification of firms.

[4] See Amann and Figueiredo (2012) for a rich description of the technological evolution of Embraer and the very successful firms operating in the pulp and paper sector in Brazil. See also Marin and Bell (2012), Lee and Mathews (2012).

Based on the evidence from business studies about diversification (Montgomery and Hariharan, 1991; Lefebvre and Lefebvre, 2001; Estrada and Heijs, 2006; Amsden and Hikino, 1994; Cassiman and Golovko, 2011; Chang, 1995).

4) Marketing capabilities and the strategic position of firms in the domestic market – measured as the degree of diversification of the domestic production basket, the relative quality of their products or their market power – affect positively our measure of exportís diversification of firms.

These hypothesis and the main variables used in the analysis based on the existing literature are summarized in Table 1. These can be grouped in three sets of variables: structural characteristics of firms, innovative behavior and capabilities, and strategic positioning in the domestic market.

3. Policy context, data, and methodology

3.1. Brazil's policy context

Brazil is a middle income country that has been expanding very rapidly. It is a relatively open economy, which has been historically integrated into world markets, mostly through exports of natural resources (NRs) and industrial commodities based on NRs. Since the mid-1990s and, after the macroeconomic stabilization achieved by the Real Plan, however, the country initiated the reformulation of the legal and institutional framework supporting industrial, innovation and trade policies and, launched a number of policies oriented to improve the country's insertion in world markets. Between 1999 and 2002 new funding mechanisms – "the sectoral funds" – were created with the purpose of financing industrial policies in specific sectors such as oil and gas, biotechnology and aerospace. Later on, between 2003 and 2010, the Bank for Economic and Social Development (BNDES) created new financial mechanisms and seed capital to support innovative projects in selected "high-tech" sectors, and a series of programs and plans of industrial policy were launched, such as the Industrial, Technological, and the Foreign Trade Policy or the Innovation Law, with the purpose of supporting innovation in general. The existing evidence suggest that these policies have had some positive impact on innovation. For example, De Negri and Lemos (2009) find that R&D incentives had a positive impact on inducing investments in R&D in most economic sectors Vieira (2014) also suggest a positive impact, although mainly on high-technology industries Some of these policies to the extent that supported innovation activity, as we will see below, in the manufacturing sectors covered by our data could also could act as an incentive also for export diversification.[1]

Brazil has also used historically export processing zones, since the late 1950s, to attract investments and promote exports in general. As before, to the extent to which these are more common in some specific sectors, and in Brazil they are apparently,[2] these might affect the export's performance of firms in these sectors in general. We do not have information to evaluate this possible effect directly, but the sectoral dummies should capture this possible noise.

3.2. Data sources

We build a unique dataset linking production, trade, and innovation data for Brazilian firms in the extractive and manufacturing sector during the period 2000–2008. This is based on data from three Surveys collected by IBGE and the Trade Office about production, innovation, and trade. For production and firm characteristics we use two modules of the "Pesquisa Industrial Annual" (PIA); PIA "produto", a nationally representative survey that includes production and sales portfolio, and PIA "empresa", which includes firm characteristics. In this survey, all firms with 30 or more employees are included, while smaller firms up to 29 workers are randomly sampled. In total PIA covers more than 40,000 firms. For innovation, we use the "Pesquisa de Inovação Tecnológica" (PINTEC), a CIS-4 type innovation survey that provides detailed information on R&D expenditure and innovation processes for a sample of firms. In this survey, all firms with more than 500 workers are automatically included in the sample, while firms from 5 to 499 workers are sampled randomly. PINTEC is available for the years 2000, 2003, and 2005. Finally, for exports we use a dataset from the Secretaria Comercio Exterior (SECEX) that includes the universe of registered exports at the firm level, by HS-8 product, year and market destination.

For each firm we link information from the four datasets. Although some firms are not surveyed in all surveys, most firms have information regarding production and firms characteristics.[5] More importantly, all exporters from SECEX have been surveyed by PIA or PINTEC, and they represent 17 per cent of the overall sample. This ensures that the risk of sample selection is negligible since all exporters – those that diversify and does that does not diversify – and also a significant amount of non-exporters are included in our dataset. The overall dataset includes around 110,000 observations for more than 10,000 firms during the period 2000–2008. However, for the analysis using innovation variables the dataset is reduced to the three years of data availability in PINTEC, around 38,000 observations.

3.3. Methodology

3.3.1. Identifying new exports

One critical element when analyzing diversification is to correctly identify episodes where new products are introduced for exporting. There are two challenges in doing so. First, we only observe export flows for the period of our sample, so we cannot determine whether a product was introduced before this period. As a result, in our sample we cannot consider a product that was exported in 2000 as a new export, since we do not know whether it was exported in 1999 or earlier. Second, most export flows tend to be short lived (Besedes and Prusa, 2006), and therefore, any meaningful methodology to identify firm export diversification needs to include an element of time sustainability.[6]

To address these issues, we first consider cases of export diversification where a firm introduces a new product not exported in 2000. Then, in order to include time sustainability in our measure, we use three alternative criteria summarized in Table 2.

We differentiate between existing exporters and new exporters and, identify those new exports that are a new for the country (or "discoveries").

3.3.2. Estimating the firm level determinants of diversification

The main objective of this paper is to identify firm level determinants of export diversification. With this objective we estimate Eq. (1).

$$Y = f(S, I, P) \quad (1)$$

[5] Around 73 per cent of firms from PINTEC are matched with PIA data.

[6] In Brazil, only between two and three percent of flows are observed for the entire period. More importantly, once introduced, only 20% of the flows are exported continuously until the end of the period; and a significant share of these flows correspond to those only observed in the last two or three years of the sample period. This suggests a very short duration and intermittence of export flows.

Table 1
Main determinants of diversification, expected direction of influence, and variable definition.

Determinants	Variable label	Variable definition
(i) Structural characteristics of firms		
Size and productivity mostly positive in firms from advanced and less advanced countries (Melitz, 2003; Bernard et al., 2007; Wakelin, 1998; Sterlacchini, 1999; Alvarez, 2007)	Size	Natural log of employment
	Productivity	TFP calculated using the methodology proposed by Levinsohn and Petrin
Foreign links mostly positive in firms from advanced and less advanced countries (Basile, 2001; Sterlacchini, 1999; Kumar and Siddharthan, 1994; Beccheti and Rosi, 1998; Lefebvre and Lefebvre, 2001). We distinguish three types of foreign links:	Foreign share	Dummy with value 1 when firms have a share of foreign capital higher than 10%
i) foreign share, ownership; ii) horizontal links, which captures frequent inter-exchanges of knowledge and information with other companies within the international corporation; and iii) vertical links, which captures interchanges of knowledge and information with clients and suppliers. The importance of this distinction for innovation has been highlighted by the international business literature (Marin and Bell, 2010)		
	Horizontal links	Dummy variable with value 1 if the firm is strongly linked to other firms in their group operating in foreign countries
	Vertical links	Dummy variable with value 1 if the firm is strongly linked with clients operating in foreign countries
(ii) Innovative behavior and capabilities		
R&D expenditures mostly positive in advanced and less advanced countries (Basile, 2001; Hirsch and Bijaoui, 1985; Estrada and Heijs, 2006; Damijan et al., 2010). We expect these variables to have a positive effect in our case in association with new exports	R&D expenditures	Dummy variable that assumes the value of 1 if the firm engages in R&D
Product and process innovations have been identified to have a positive effect on the trade performance of firms from advanced countries (Cassiman and Golovko, 2011; Becker and Egger, 2007; Cassiman et al., 2010), but not in less advanced countries. We expect these variables to have a positive effect in our case in association with new exports	Product and process innovations	Two categorical variables, one assumes the value of 1 if the firm has introduced a product innovation in the last 3 years, the other assumes 1 for process innovation
Skills, project execution capabilities and marketing capabilities have been found to have a positive effect for exports in general, particularly in developing countries (Lefebvre and Lefebvre, 2001; Amsden and Hikino, 1994; Wakelin, 1998; Montgomery and Hariha-ran, 1991). We expect these variables to have a positive effect in our case in association with new exports	Investments in skills	Ratio between firm and sector average wage
	Setting up an engineering efforts	Dummy variable that assumes the value of 1 when the firm engages investments in new machinery, setting up and engineering efforts
	Investments in marketing	Dummy variable that assumes the value of 1 if the firm engages in marketing expenditures
Geographical distance is a proxy for capabilities. This has been identified to have a positive association with trade performance, where it is used as an indicator of the general strength of firms' underlying capabilities to operate in export markets, since firms exporting to more distant markets tend to export higher quality products (Baldwin and Harrigan, 2011)	Geographical distance	The average geographical distance of all export destinations for the firm
(iii) Strategic positioning in the domestic market		
Production baskets which are more diversified and less concentrated in value, are more likely to be capable of diversifying, because given their breadth of diversified sector capabilities face a wider array of diversification possibilities in different sectors (Montgomery and Hariha-ran, 1991; Lefebvre and Lefebvre, 2001; Estrada and Heijs, 2006)	Diversification of the domestic production basket	Distance CNAE (two digits) of the main products produced by the firm
	Concentration in the value of production	Herfindahl index of production
Market power firms with high market power will be in a better position to introduce new products for export (Amsden and Hikino, 1994; Cassiman and Golovko, 2011)	Domestic market power	Firm market share in its main product
Local value: firms with products that have gained higher quality in the domestic market might be better placed to export (see Iacovone and Javorcik, 2010)	Domestic price margin	Ratio between the unit value of the firm's product and the average unit value for that product for all firms[a]

Source: Authors' own elaboration.
[a] When the enterprise is multiproduct, the average unit value ratio for all product is used.

Table 2
Methodologies to identify new products.

Classification	Description
Classification 1	New product not exported in 2000, and once introduced is exported continuously until 2008; if introduced in 2007, also exported in 2008 and 2009
Classification 2	New product not exported in 2000, and once introduced exported for at least 5 years; or exported for three consecutive years at the end of the period (2006–2008 or 2007–2009)
Classification 3	New product not exported before 2002 and exported for at least three years thereafter

Source: Author's own elaboration.

Our dependent variable, export diversification (Y) is measured in two ways: (1) as a dummy variable, that assumes value 1 when the firm has introduced a new export under any of the possibilities included in Table 2 (Classifications 1–3) or, (2) as a count data variable, based on the number of new exports introduced by each firm (diversification intensity). We parametrize Eq. (1) for the decision to introduce a new product for exporting, in a linear form as in Eq. (2).

$$Y_{it} = \alpha_0 + \sum_k \beta_k S_{kit-1} + \sum_l \delta_l I_{kit-1} + \sum_m \gamma_m P_{kit-1} + \sum_{i=1}^{t} T_{t-1} + \sum_{j=1}^{t} Se_j + \sum_{n=1}^{N} R_n + u_{it} \quad (2)$$

As described in Section 2, we classify the firm level determinants of export diversification (Y) in three main types: (i) the structural characteristics of the firms (S); (ii) the innovative behavior of firms (I), and; (iii) the strategic positioning of firms in the domestic market (P). Table 1 summaries the main variables included under each type of determinant, the expected direction of influence and the empirical proxies for these variables.

For structural characteristics of the firm, we include size in terms of employment and TFP productivity; a dummy for foreign ownership, which takes value 1, when foreign share is more than 10% and; dummy variables to identify firms that have strong links with other firms, from the same group or clients.

To capture firms' innovative efforts and outputs we use dummy variables that assume value 1 when firms engage in: R&D, engineering and marketing efforts and, when they have obtained, product i and process innovations. We proxy skills with the ratio between the firm and the sector average wage (which capture the skills premium of the firm). Finally, we use the average geographical distance of the firms export destinations to proxy for the underlying capabilities that allow exporting to more distant destinations.

For differences in the firm's position and strategy in the domestic market, we introduce four variables: domestic market power evaluated as the firm's largest market share in an specific product; domestic price margin, evaluated as the average of the ratio between the firms unit value and the average unit value for each product produced; diversification of the production basket, calculated as the arithmetic difference between CNAE-2 digits sectors (i.e., if the difference is zero all products are within the same sector); and concentration in the value of production, proxied by the Herfindahl index.

We use sector dummies Se at CNAE (Brazilian Industrial Classification) two digits level in order to control for sector specific elements such as trade costs, profitability and changes in foreign demand that are sector specific. We also include year T and regional dummies R to control for year effects and the large correlation between certain regions and exports due to specific policies and firms' clustering.

One important challenge when looking at trading, production and innovation activities is the potential simultaneity or endogeneity of investment and innovation interventions with exporting activities. Firms, as suggested in the literature review, may invest more on innovation activities as a result of trading activities. In order to minimize the risk of simultaneity problems, we use lagged explanatory variables in $t-1$ to explain diversification in t. Since the innovation survey was only available for 3 years, we effectively use production, firm and innovation data for each firm i (vector X_{kt-1}) in 2000, 2003, and 2005 to explain the probability that firm i introduces a new exported product in 2001, 2004, and 2006 (Y_{it}).

In addition, when estimating Eq. (2) we are effectively reducing the sample to exporters, posing a risk of sample selection bias. It is possible that some variables that determine export status also explain firms' export diversification, and by omitting non-exporters from the sample we are likely to bias the estimated coefficients associated to these variables. In order to correct this potential problem, we use a Heckman selection model and the Heckprobit estimator, or two-stage Probit. In the first stage, we use a Probit model to estimate a selection model that models selection into export markets, and calculate the inverse Mills ratio. In the second stage, we add the inverse Mills ratio to correct for the potential sample selection bias.[7]

The second specification focuses on measuring the intensity of diversification using the number of products introduced by a firm when it diversifies. In this case, since the dependent variable is a count of the number of products introduced, zero if the exporter does not diversify, we use a random effects Tobit estimator to deal with the truncation of the dependent variable.

4. Firm's export diversification in Brazil: an overview

Table 3 shows the number of export flows for each classification method and the percentage of total flows where diversification occurs. With Classification 1, which requires sustainability throughout the whole period, the maximum is 4.6% new export flows in the same year.[8] With Classification 3, however, which only requires three years of duration after a flow is introduced, the maximum amount of new flows in a given year, for both existing and new exporters, is around 15.4% of all exports in 2003 (the total flows new and pre-existing). The share of new flows for this classification is decreasing over time, since the closer it is to the end of the sample period the less likely it is to have survived the 3 years. New exports thus are not so rare new exports.

Table 4 shows a similar decomposition but focuses on the number of firms and average number of new products introduced. The table also distinguishes new products by existing exporters, new exporters and discoveries. The main striking fact that emerges from the table is that there is a significant share of firms diversifying each year. In some years, up to 25% of firms introduce at least one new

[7] In order to identify the selection equation for exporting, we need variables that explain selection into new markets but not diversification. As a result, we use the share of national inputs used by the firm, since exporters tend to use better and imported inputs than non-exporters, but this does not necessarily affect the decision of exporters to diversify.

[8] The peak in 2007 under Classification 1 and 2 is due to the fact that we only require products to be exported in 2007–2009 to qualify as a new export.

Table 3
New export product flows from Brazil (2001–2007) – by sustainability classifications.

	Number of new export product flows					
	Classification 1 sustained over the longer term (the whole subsequent period)		Classification 2 sustained over the medium-term (5–3 years)		Classification 3 later introductions sustained over at least 3 years	
Year	Number	% of all exports	Number	% of all exports	Number	% of all exports
2001	2115	3.3%	6876	10.7%	n/a	n/a
2002	2818	4.2%	6609	9.8%	n/a	n/a
2003	3720	4.6%	6831	8.5%	12,366	18.8%
2004	4044	4.4%	5481	6.0%	10,861	14.1%
2005	4136	4.3%	4572	4.8%	8315	9.9%
2006	5192	5.5%	5192	5.5%	6447	8.1%
2007	7034	7.2%	7034	7.2%	6173	6.4%
All years	29,059		42,595		44,162	

Table 4
Number of firms that introduce new products.

		New products			New exporters			Discovery		
Year		Class 1	Class 2	Class 3	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3
2001	Firms	816	1931	0	329	827	0	3	10	0
	% of exporters	7%	17%	0%	3%	7%	0%	0.03%	0.09%	0%
	Average new products	1.92	2.81	.	1.66	1.74	.	1	1	.
	Maximum number	26	74	.	18	25	.	1	1	.
2002	Firms	1074	2053	0	334	680	0	7	19	0
	% of exporters	9%	18%	0%	3%	6%	0%	0.06%	0.17%	0%
	Average new products	2.09	2.61	.	1.71	1.84	.	1	1.16	.
	Maximum number	44	69	.	22	36	.	1	2	.
2003	Firms	1335	2096	3212	501	785	1358	4	10	23
	% of exporters	11%	17%	25%	4%	6%	11%	0.03%	0.08%	0.18%
	Average new products	2.13	2.53	2.98	1.76	1.94	2.06	1	1	1
	Maximum number	37	53	69	45	87	109	1	1	1
2004	Firms	1474	1857	3112	438	544	1000	4	4	9
	% of exporters	11%	13%	22%	3%	4%	7%	0.03%	0.03%	0.06%
	Average new products	2.19	2.41	2.86	1.86	1.83	1.97	1	1	1
	Maximum number	170	188	252	81	88	123	1	1	1
2005	Firms	1649	1777	2757	358	371	593	9	9	13
	% of exporters	12%	13%	21%	3%	3%	4%	0.07%	0.07%	0.10%
	Average new products	2.12	2.19	2.61	1.80	1.83	1.90	1	1	1
	Maximum number	115	117	148	32	34	43	1	1	1
2006	Firms	1901	1901	2218	460	460	524	7	7	7
	% of exporters	15%	15%	17%	4%	4%	4%	0.05%	0.05%	0.05%
	Average new products	2.16	2.16	2.36	2.35	2.35	2.30	1	1	1
	Maximum number	95	95	99	327	327	341	1	1	1
2007	Firms	2692	2692	2692	405	405	0	22	22	22
	% of exporters	21%	21%	21%	3%	3%	0%	0.17%	0.17%	0.17%
	Average new products	2.29	2.29	2.29	2.13	2.13	.	1.05	1.05	1.05
	Maximum number	47	47	47	97	97	.	2	2	2

Source: Author's own elaboration.

product for exporting. This implies that there is substantial export diversification activity.

Indeed, in line with the findings in other countries, exports "discoveries" in Brazil are rare. Table 4 shows the number of new products that were not exported before the sample period and are new to the country. In total across classifications, we identify only 75 new discoveries. More importantly, discoveries are made by existing exporters with significant diversification activity, rather than new entrants to export markets. This suggests that firm level export diversification is a necessary condition for country export diversification.

Table 5 shows the distribution of new product flows per sector during the period. The first three sectors: machinery and electrical, metals and textiles account for half of the new exports. These include both high-tech products such as machinery and mechanical appliances, nuclear reactors and computers and conventionally conceived low-tech sectors, such as iron and steel, and articles of apparel and clothing accessories. It is also interesting to observe that there are no differences across sectors, in relation to the share of new export to total exports, i.e., all of the sectors have a similar propensity to host new exports, which is between 4% and 5% in most cases. The exceptions are vegetable products, food stuff and services which have lower shares between 2% and 3%.

5. Firm level determinants of export diversification

5.1. Determinants of the propensity to diversify exports

In this section, we test empirically the determinants of export diversification. Table 6 shows the Probit estimates with Heckman correction. Even columns show the selection equation for exporting, while odd columns show the estimates for the probability of diversifying. We estimate four specifications. The first specification only uses information on firm characteristics included in the pro-

Table 5
Distribution of new exports flows by sector.

Products	New products flows	Total exports flows	Sector share of new products	Share of new products in total sector export flows
Machinery/electrical	17,523	384,914	27.86%	4.55%
Metals	7918	182,018	12.59%	4.35%
Textiles	6941	152,245	11.04%	4.56%
Plastics and rubber	5856	115,996	9.31%	5.05%
Chemical and allied industries	5044	106,856	8.02%	4.72%
Miscellaneous	5033	121,927	8.00%	4.13%
Wood and wood products	4031	82,562	6.41%	4.88%
Stone and glass	2216	61,086	3.52%	3.63%
Footwear/headgear	1738	31,142	2.76%	5.58%
Transportation	1662	45,784	2.64%	3.63%
Foodstuff	1564	53,913	2.49%	2.90%
Raw hides, skins, leather, and furs	1135	21,451	1.80%	5.29%
Vegetable products	747	37,795	1.19%	1.98%
Animal and animal products	735	18,074	1.17%	4.07%
Mineral products	677	13,678	1.08%	4.95%
Services	72	3809	0.11%	1.89%
Total	62,892	1,433,250	100%	4.39%

Source: Author's own elaboration.

Table 6
Heckprobit estimates determinants of export diversification.

	(1) Diversification	(1) Selection	(2) Diversification	(2) Selection	(3) Diversification	(3) Selection	(4) Diversification	(4) Selection
TFP	0.1117***	0.3168***	0.1046***	0.2809***	0.1161***	0.2367***	0.1143***	0.2356***
	(0.014)	(0.005)	(0.019)	(0.009)	(0.025)	(0.015)	(0.025)	(0.015)
Size	0.1617***	0.3767***	0.1403***	0.3580***	0.1652***	0.3507***	0.1731***	0.3496***
	(0.011)	(0.005)	(0.017)	(0.009)	(0.023)	(0.013)	(0.023)	(0.013)
Domestic value	0.0130**	0.0142***	0.0055	0.0166**	0.0015	0.0106	0.0030	0.0119
	(0.004)	(0.003)	(0.009)	(0.005)	(0.012)	(0.009)	(0.012)	(0.009)
Market power	0.2857***	1.2750***	0.1910*	1.0825***	0.3101**	0.9642***	0.3278***	0.9776***
	(0.051)	(0.037)	(0.075)	(0.061)	(0.095)	(0.088)	(0.095)	(0.088)
Concentration in production	−0.2521***	−0.0553***	−0.2478***	−0.0624**	−0.2673***	−0.0400	−0.2790***	−0.0468
	(0.021)	(0.012)	(0.033)	(0.021)	(0.043)	(0.033)	(0.043)	(0.033)
Diversification of the production basket	0.0071***	0.0172***	0.0070*	0.0143***	0.0056	0.0144***	0.0056	0.0145***
	(0.002)	(0.001)	(0.003)	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)
Geographical distance	−0.0000		−0.0000		−0.0000*		−0.0000**	
	(0.000)		(0.000)		(0.000)		(0.000)	
Product innovation					0.2338***	0.1323***		
					(0.034)	(0.028)		
Process innovation							0.0820*	0.0942**
							(0.035)	(0.030)
R&D			0.1620***	0.1697***				
			(0.030)	(0.027)				
Horizontal links			0.1415*	0.1087	0.0842	0.1095	0.1174*	0.1284
			(0.056)	(0.089)	(0.057)	(0.088)	(0.057)	(0.088)
Vertical links			−0.0754	0.8964***	−0.0443	0.8867***	−0.0273	0.8954***
			(0.069)	(0.119)	(0.072)	(0.119)	(0.072)	(0.120)
Foreign share			0.1293**	0.6465***	0.2184***	0.7612***	0.2024***	0.7595***
			(0.045)	(0.052)	(0.054)	(0.054)	(0.054)	(0.054)
Setting up expenditure					0.0000	0.0000	0.0000*	0.0000
					(0.000)	(0.000)	(0.000)	(0.000)
Marketing					0.0969**	0.1295***	0.1137***	0.1377***
					(0.031)	(0.025)	(0.031)	(0.025)
Skills					1.7245**	−0.0525	2.3988***	−0.0467
					(0.648)	(0.077)	(0.636)	(0.072)
Constant	−3.1118***	−6.3201***	−2.9797***	−6.0423***	−3.3875***	−5.7455***	−3.4787***	−5.7676***
	(0.563)	(0.205)	(0.804)	(0.353)	(0.857)	(0.399)	(0.865)	(0.400)
Observations	37.686	107.199	16.065	36.923	9.101	15.716	9.101	15.716
log-likelihood	−19882	−53331	−8038	−18330	−4780	−7610	−4801	−7617
Pseudo R^2	0.104	0.269	0.124	0.275	0.140	0.288	0.137	0.288

Notes: All the estimations include year, region and sector dummies. *, **, *** Significance at 10%, 5% and 1% level, respectively.

duction and export data. This specification maximizes the number of observations since this data is available for all the years of the sample. All the other specifications use innovation data, restricted to the years that the Innovation Survey was collected: 2000, 2003, and 2005, so the number of observations is reduced. The second specification includes information on R&D, and the third and fourth include information about structural characteristics of the firm (foreign ownership, and links with the global group and clients), and learning efforts (related to skills, marketing, other innovative efforts and links with universities). The third specification includes product innovation and, the fourth, process innovation.

The Pseudo R^2 ranges between 0.10 and 0.28, and the Chi test for the overall non significance of the model is rejected. More importantly, the coefficient on the IMR is not statistically significant for

Table 7
Random effects Tobit estimates of number of new products for exporting.

	(1)	(2)	(3)	(4)	(5)
TFP	−0.109*	−0.17*	−0.184**	−0.175*	−0.198**
	(0.0534)	(0.0702)	(0.0702)	(0.0703)	(0.0707)
Size	1.072**	1.238**	1.188**	1.237**	1.276**
	(0.0772)	(0.1056)	(0.1052)	(0.1069)	(0.1072)
Domestic value	0.143**	0.149*	0.151*	0.156*	0.16*
	(0.0514)	(0.0741)	(0.0737)	(0.0739)	(0.0737)
Market power	3.379**	2.77**	2.786**	2.845**	3.09**
	(0.4076)	(0.5379)	(0.5347)	(0.5398)	(0.5374)
Concentration in production	−1.755**	−1.76**	−1.756**	−1.844**	−1.89**
	−0.1992	−0.2733	−0.2722	−0.2740	−0.2739
Diversification of the production	0.002	−0.015	−0.011	−0.015	−0.008
basket	−0.0200	0.0254	−0.0244	0.0250	−0.0258
Geographical distance	0.000**	0.000**	0.000**	0.000**	0.000**
	0.0000	0.0000	0.0000	0.0000	0.0000
Product innovation	1.669**	1.847**	0.334	0.564**	
		0.2344	0.2066	0.2012	0.2104
RD	1.03**	0.427		1.249**	
	0.1746	(0.2454)		(0.2180)	
Horizontal links	0.764*	0.587	0.581	0.831*	0.863**
	(0.3056)	(0.3298)	(0.3282)	(0.3298)	(0.3294)
Vertical links	−0.341	−0.469	−0.398	−0.377	−0.219
	(0.3789)	(0.4043)	(0.4061)	(0.4054)	(0.4056)
Foreign share	1.427**	2.297**	2.288**	2.293**	2.309**
	(0.2452)	(0.2771)	(0.2760)	(0.2779)	(0.2782)
Setting up expenditures	0.000*		0.000**		0.000**
	(0.0000)		(0.0000)		(0.0000)
Marketing	0.476**		0.621**		
			(0.0000)		(0.0000)
Skills	12.322**	12.393**	13.265**	17.832**	
		(3.8267)	(3.7328)	(3.8338)	(3.6767)
Constant	−10.568**	−12.102**	−11.73**	−11.656**	−11.716**
	(0.7145)	(0.9713)	(0.0000)	(0.0000)	(0.0000)
Observations	16069	9103	9103	9103	9103
Number of firms	9014	5406	5406	5406	5406

Notes: All the estimations include year, region and sector dummies. *, **, *** Significance at 10%, 5% and 1% level, respectively.

most of the specifications, which implies that given our identification strategy we cannot accept the hypothesis of sample selection bias.

The results of the selection equation into exporting (even columns) show that larger and more productive firms are more likely to become exporters. Also, the coefficient for the identification variable, the share of national inputs used by the firm, is, as expected, negative. Exporters tend to have lower shares of national inputs, since they are more likely to import their inputs internationally.

Comparison across specifications reveals that the three types of determinants identified in the literature – the firm's structural characteristics, the innovation efforts and the position in the domestic market – are relevant in explaining a firm's export diversification.

Looking more specifically at every group of determinants, we find three main sets of results. First, the three dimensions introduced to account for differences in the structural characteristics of firms are highly significant in association with export diversification. Larger, more productive firms and firms with greater foreign share participation are more likely to diversify. The impact of firms' international links is ambiguous. Vertical links appear to have some relevance in three of the six specifications included; however, horizontal links do not tend to be statistically significant. This might be reflecting the fact that foreign share already captures some of the links and support to export from foreign firms within the same group.

Second, innovation efforts are also important, particularly related to R&D, product innovation and marketing, which appear strongly statistically significant in all the specifications included. This indicates that innovative efforts in the frontier are critical for export diversification. Skills and process innovations are also significant but not as strongly as the previous two: process innovation is still significant but at lower significance levels and skills appear significant in two of the four specifications included. Setting up expenditures and geographical distance are less significant.

Third, the position of firms in the domestic market is also important, mainly in relation to domestic market power. This result suggests that in preparation for export diversification, the position of firms in the domestic market, as reflected by domestic shares, makes a positive contribution to the likelihood of introducing and sustaining new exports. Sector diversification of the production base of the firm has a positive effect on firm selection to exporting and export diversification. This reflects the importance of diverse production and technological capabilities for new exports. Firms with capabilities that span along different types of products are more likely to introduce new products. The introduction of new exports is less probable in firms with a basket of production which is highly concentrated in value. This is explained by the fact that these firms might opt to expand exports of existing products, their core business, rather than the type of products exported. Finally, the effect of increasing quality, proxied by the unit value, does not appear statistically significant in all specifications. It is possible that firms focus on improving quality on existing products rather than on introducing new products.

In association with the hypotheses proposed, these results provide evidence in support of (H1), (H2), and (H4), but less evidence in support of (H3), which summarises the main determinants of exports performance – measured as increases of exports in gen-

Table 8
Heckprobit estimates conservative classification.

	(1)	(2)	(3)	(4)
TFP	0.0991***	0.1157***	0.0989***	0.0976***
	(0.015)	(0.022)	(0.027)	(0.027)
Log employment	0.1540***	0.1336***	0.1629***	0.1733***
	(0.012)	(0.018)	(0.024)	(0.024)
Ratio unit value to product average	0.0117*	0.0034	−0.0090	90.0065
	(0.005)	(0.009)	(0.014)	(0.014)
Firm market share by product	0.2750***	0.2129*	0.3225**	0.3461***
	(0.055)	(0.083)	(0.103)	(0.103)
Herfindahl concentration	−0.2219***	−0.2254***	−0.2507***	−0.2640***
production	(0.023)	(0.036)	(0.048)	(0.048)
Distance CNAE 2 digits divisions	0.0058**	0.0101**	0.0077	0.0079
	(0.002)	(0.003)	(0.004)	(0.004)
Geographical distance	−0.0000	−0.0000	−0.0000**	−0.0000***
	(0.000)	(0.000)	(0.000)	(0.000)
Dummy for product innovation			0.2621***	
			(0.038)	
Dummy for process innovation				0.0743
				(0.039)
RD dummy		0.1648***		
		(0.033)		
Group dependency		0.1244*	0.0825	0.1186*
		(0.059)	(0.060)	(0.060)
Client dependency		−0.0513	−0.0201	0.0042
		(0.076)	(0.079)	(0.079)
Foreign capital		0.0933	0.1866**	0.1672**
		(0.048)	(0.058)	(0.058)
Other Innovation expenditure			0.0000	0.0000
			(0.000)	(0.000)
Marketing			0.0900**	0.1099**
			(0.034)	(0.034)
Number of high skill technical staff			0.5725	1.3441
			(0.724)	(0.694)
Constant	−8.8910***	−8.3322	−8.1709	−8.3159
	(0.401)	(0.000)	(0.000)	(0.000)
Observations	37,686	16,019	9071	9071
Log-likelihood	−16083	−6269	−3788	−3811
Pseudo R^2	0.101	0.117	0.135	0.130

Notes: All the estimations include year, region and sector dummies. *, **, *** Significance at 10%, 5% and 1% level, respectively.

eral – identified by previous studies in the case of firms from less advanced countries.

5.2. Determinants of diversification intensity

We estimate Eq. (1) using the number of products introduced for diversification as dependent variable; diversification intensity. Table 7 shows the Tobit random effects estimates.[9] The Chi test for the overall non significance of the model is rejected, and the random effects model explains 35% of the variance and, therefore, should be preferred to the pooled estimator. The results for diversification intensity are similar to those in Table 6 but the coefficients appear less statistically significant.

Size, foreign ownership, lack of business concentration, geographical distance of exports, R&D, product innovations, and skills are all significant in explaining the number of new exports introduced. However, there are three main differences from previous results in Table 6. For diversification intensity, productivity has a negative effect on export diversification, weak, but negative. The diversification of the production basket that was previously significant, now appears to be not significant, and the effect of setting up investments, geographical distance and domestic value, all of which were not strongly significant in the previous estimation, now appear to be more statistically significant. This suggests that more productive firms may concentrate diversification in less products and that investments are critical for those firms with large diversification portfolios.

5.3. Robustness checks

The results shown in Table 7 are based on the most flexible methodology to identify new exports. As a robustness check, we re-estimate the same models using the most conservative methodology, which requires that once the new product is introduced, it is exported until 2008.

Table 8 shows the results of the estimates for the Heckprobit second stage, the probability of diversification, with very similar results to the ones in Table 8, both in size and sign of the coefficients. This suggests that the previous results are not sensitive to the methodology used to characterize new exports.

A final robustness check is related to the sample choice. One implication of using some criteria of sustainability when identifying diversification is the possibility of distorting the sample. Specifically, the main risk is the fact that if firm turnover is large we may be biasing our estimates since some of the factors affecting firm exit would influence the estimates of the firm dynamics and strategies of exporters.

In order to test whether exit factors may be affecting our results, we restrict our sample to only those firms that are in the dataset for the entire period of the sample (our survivor sample) and re-

[9] We first try to estimate Eq. (1) with a Poisson fixed effects estimator. However, two main problems arose when trying to implement this estimator. Firstly, estimates do not converge when using sector dummies. As a result it is possible that some of the coefficients are capturing sector wide effects. Secondly, and more importantly, the FE Poisson estimator eliminates groups (firms) with only one observation or where there are only zero outcomes. This implies that is mainly estimating the sample of diversification firms.

estimate Eq. (1). Estimates are available in Cirera et al. (2012). The loss of number of firms and observations is moderate, indicating that firm exit is a small part of the sample. More importantly, the results are very similar to the ones in Tables 6 and 7, suggesting that the main estimates are robust to potential firm non-survival biases.

6. Conclusions

This paper explores firm level determinants of exports diversification using a rich firm-level data set from Brazil. Our approach builds on and extends existing research on innovation and trade performance by incorporating insights from the diversification literature. We also enrich the export literature by analyzing the role of firms' innovation and market strategies in explaining export diversification.

Our empirical results confirm the potential importance of the framework proposed. We identified that new exports are explained by both: innovation variables – as the ones traditionally explored within innovation studies about trade and, variables capturing firms' efforts to develop a strategic position in the domestic market. More specifically, we identified that firms that are successful at introducing new exports are the ones that have invested before in in innovation and in the development of a dominant position in the domestic market – a dimension emphasized by the business literature about diversification.

These findings suggest that access to existing resources (natural and technological) it is not the only determinant of the export performance of firms from less advanced countries, as suggested by previous studies. By focusing in new exports, we identified that efforts to develop new and unique technological have also an important role to play in the export performance of these firms.

The findings of the paper have important implications for theory. First, they emphasize the importance of shifting the focus of research on export performance toward product diversification. Second, they highlight the need to enrich the trade literature on firm export performance using existing frameworks from innovation studies and the business diversification literature.

The findings have also important policy implications. First, our empirical analysis contradicts some of the previous research which has failed to identify a prominent role for innovation in supporting exports of firms from less advanced countries. We found that at least for the case of Brazil export diversification does not occur in the absence of significant knowledge-creating components of innovative activity and distinctive technological assets, as previous studies on innovation and trade would suggest. Instead, two other possible activities might be supporting this process – although more research and evidence is necessary to understand which of these is taking place: (i) Diversification type product innovation that is still behind the frontier, but requires more than just project execution capability inputs – including significant knowledge-creation activities based on R&D investments, or (ii) Diversification type product innovation that pushes out the international frontier in some direction or other. As a result, policy instruments that are successful in incentivizing investments in innovation, such as R&D incentives implemented in Brazil, are also likely to have a positive impact on firm export diversification. Innovation policy is, therefore, also a tool for export diversification.

Second, the results also suggest however, that policies targeted to improve exports in general via providing market information or finance or export zones, are not necessarily effective in supporting the expansion of new exports. This requires a strategy that aligns trade, innovation, industrial, and competition policy, something that Brazil has started to implement, but might need further alignment.

It is important to stress that our results are constrained to the Brazilian context and, therefore, more research is needed to better understand the process of export diversification at the firm level in other developing and emerging countries, and the extent to which firms in these countries invest in innovation efforts to diversify exports.

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