Export financial support of Brazilian manufactured products: a microeconometric analysis

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Abstract

The renewed interest in the role of export credit agencies (ECAs) in providing credit to international trade under conditions of scarcity of liquidity also stimulated the investigation about their role in promoting the development of countries´ exports. In this paper we investigate the impact of Brazilian public financing to exports – Drawback, Exim and Proex – on the performance of firms in foreign trade between 1998 and 2007. We focus on the (i) risk of abandonment of export activity; (ii) the number of destinations; and (iii) export value. Through a quasi-experiment with a unique dataset of Brazilian firms entering foreign markets, we find a positive relationship between export programs and the intensive and extensive export margins, as well as with persistence in international trade. On average, supported firms had their chance to keep exporting augmented between 2,3% and 13,5%, increasing their number of destinations by up to 43% and the export value between 74% and 90%, although not all three programs are effective. The results suggest that financial constraints may limit the export potential of firms and highlight the importance of the government's export credit agencies.

Keywords:
International trade
Export performance
Financial constraints
Treatment effect models

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Introduction

The international financial crisis in the late 2000s renewed interest in the role of export credit agencies (ECAs) in providing credit to international trade under conditions of scarcity of liquidity. Chauffour and Farole (2009) emphasize the importance of financing mechanisms for international trade to support risk mitigation and liquidity provision. In addition, ECAs alter the real sector of the economy by increasing exports. However, there is little evidence of the importance of these agencies in the development of countries' exports due to the scarce availability of information. Such evidence is more scarce in developing countries where imperfections in credit markets are more noticeable. The public nature of the resource and the subsidized nature of the financing (due to the existence of significant differences between the domestic interest rates and the foreign interest rate present in the contracts) increases the relevance in evaluating the effectiveness of these instruments for emerging countries.

Manova (2013) highlights that exporting also involves variable trade costs, such as transport, warehousing, cargo insurance and fees, which are usually incurred prior to shipping, although the external revenue has deadline for receipt superior to domestic sales. The combination of sunk costs and variable trade costs exacerbates exporters' need for financial capital, and thus financial constraints can be an obstruction to trade. This type of argument is incorporated into models of heterogeneous firms in international trade – in line with Melitz (2003) – to demonstrate that credit constraints must reduce the number of firms that would otherwise be able to export (Chaney, 2016; Manova, 2013). All of the above theoretical models recommend public policy that improves access to financial markets (and market operations).

Several studies have produced evidence using credit restriction measures from the private credit market. Such measures of credit restriction were related to the financial health of exporting and non-exporting firms, the likelihood of export and the intensive and extensive export margins, which corroborated Chaney (2016) and Manova (2013) among others. Examples of this literature with measures of credit restriction are the works of Greenaway et al. (2007), Minetti and Zhu (2011), Berman and Héricourt (2010), Muûls (2015) - many of which are reviewed in Wagner (2014) - which present as general

conclusion that heterogeneity in the access to external finance impacts export behavior [2] [3].

Developing countries have credit restrictions as an important market failure. The provision of public credit for export financing through export credit agencies has alleviated the financial constraints of exporting firms. Brazil has some forms of official credit for exports carried out by public banks that play an important role, as well as some mechanisms for financing short-term private exports. Bank of Brazil (public bank) and Brazilian National Bank for Economic and Social Development (BNDES) are financial institutions that act in the form of ECA's.

We evaluate two export credit lines offered by the main Brazilian public banks: Proex (Bank of Brazil) and Exim (BNDES), and another programme that is a compensatory subsidy: the Drawback regime. This is a special customs regime that provides advantages related to taxes and fees on raw materials purchased to produce goods that are subsequently exported. All of these financial instruments supposedly decrease the financial constraints facing entrants in the export market, with the aim of stimulating their performance. Thus, the goal of the paper is to evaluate the impact of these public financing programs offered by Brazilian ECA´s to boost the industrial export performance of these firms.

More specifically, we test the impact of these programmes on survival in export activity (represented here by the conditional probability of exporting), the extensive (number of export destinations) and intensive (export value) margins of exports. For this, we employ a unique dataset with information on three different export support programmes in Brazil. These data only include entrant manufacturing firms in the international market between 1998 and 2003 (years in which the firms enter foreign

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[2] There is a literature related to this theme that seeks to analyze the effectiveness of export promotion agencies (EPAs). As an example, there are articles by Volpe Martincus and Carballo (2008), Cadot et al. (2015), Lederman et. Al. (2010) and Cross (2014). In general, this literature shows limited and heterogeneous effects on the effectiveness of these agencies in the promotion of these countries. Although the empirical approach adopted in our work is similar to those articles, the object of analysis is different. The role of EPAs is to assist firms in their internationalization efforts, seeking to mitigate the sunk costs associated with firms' entry in the international market, which is different from what we intend to analyze here, which would be the effectiveness of financial and exemption support instruments.

[3] Lobo and Silva (2012) and Galetti and Hiratuka (2013) conducted some attempts to evaluate BNDES-Exim and Proex financing lines. Their results indicated positive effects of the BNDES-Exim program on the permanence of exporting firms in the international market and on the exported value. But these analyzes suffer from various statistical and econometric constraints, casting doubt on the validity of these results.

markets), forming an unbalanced panel that contains approximately 8,500 companies in the Brazilian manufacturing industry, followed for a maximum of 10 years (until 2007).

The identification strategy is based on a sample of entrants in the international market that used financial instruments beginning in the firm's second year as an exporter. Thus, we seek to eliminate the effect of feedback between continuity in export activities and the company's export and productive performance, with entrants which consequently influences the firm's ability to raise external resources and could obscure the causal effect relationship export financing and export performance. As Albornoz et al. (2012) argue, we also ensure that we have information on the export potential of the firm because we guarantee firm survival in export activity after the first year of exporting.

The use of propensity score matching and panel data techniques to control for observable and unobservable time-invariant determinants of firm exports also contributes to the identification strategy. These determinants may be related to the presence of selection bias in obtaining public financing for export activity. Thus, these methodologies reduce the heterogeneity of the data and increase comparability between firms that have accessed the instruments in question and those that have not.

As a general result, we find that the use of financing programs for exports has a positive impact on the export performance of entrant firms in the international market. These results provide evidence that financial and fiscal instruments can improve the export performance of manufacturing companies by relieving financial constraints, thus providing further evidence on the relationship between financial constraints and international trade, and the effectiveness of export credit agencies in their role in promoting exports in developing countries.

However, these impacts differ according to the type of program used. The Proex programme and Drawback mechanism have the greatest impact of those studied and affects the three measures of export performance. This is an interesting result given that there are no analyzes in literature that combine different types of programs as in our article.

Both instruments increase the firm's ability to continue exporting between 3% and 15%. The same does not happen with the other financing program analysed (BNDES-Exim). Regarding the extensive margin, the estimated increase in the number of export destinations for firms that made use of Drawback and Proex is from 13% to 14% and from 39% to 43%, respectively. On the intensive margin, the more conservative estimates

indicate that Proex and Drawback lead respectively to a 74% and 90% increase in the exported value. However, the Exim programme – which prioritises high value-added manufacturing sectors (especially capital and transport goods) – also does not have a significant impact on the three performance variables analysed. We observe a significant impact of between 18% and 22% on the number of export destinations for this instrument, but only for the average effect over time.

In addition to this introduction, this paper consists of more four sections. The first section describes the Brazilian export promotion instruments analysed in this study. Then, we present the data sources and discuss the identification strategy. The third section presents the main stylized facts concerning firm export performance, distinguished by whether firms make use of the financing instruments considered here. The fourth section discusses the estimation results. In the final section, we present some final considerations on the contribution of these programmes to the export performance of manufacturing firms.

1. Public Financing/Exemption for Exports in Brazil

With the import substitution process in the 1960s, the Brazilian federal government established a set of new rules and instruments that initiated the modern phase of Brazilian foreign trade due to the need to diversify and increase the Brazilian exports (Law 5025 Of June 10, 1966), according to Fonseca (2015).

Within this new structure, export promotion instruments such as the Drawback institute and an official financing mechanism for Brazilian exports of manufactured products are created. Currently the special customs Drawback regime has three modalities: exemption, suspension and refund of taxes. According to the Brazilian Federal Revenue, the first modality consists of the exemption of the taxes levied on the importation of merchandise, in equivalent quantity and quality, destined to the replacement of another previously imported with payment of taxes and used in the industrialization of exported product. The second modality suspends the taxes collected on the importation of merchandise to be used in the industrialization of the product to be exported. The third deals with the refund of taxes paid on the importation of input used

in exported product. However, there is practically no use of the third option, the first two being the most relevant [4].

During this period, the National Financing Fund for Exports (FINEX) was created as official financing for Brazilian exports of manufactured goods. According to Pinheiro et. al. (1993), FINEX provided the pre-shipment mode for the export of capital goods and durable consumer goods and the working capital financing system for companies producing industrialized goods for export. In the category of post-shipment financing, the equalization of interest rates and direct financing to the exporter corresponded to the lines of larger participations [5] [6].

The worsening financial constraints of the 1980s and the trade liberalization movement initiated in the late 1980s meant that the public financing and export subsidy mechanisms were gradually deactivated, with the exception of the Drawback. According to Pinheiro (1993), export financing basically depended on private operations (such as securitization) in 1990.

But the pre-shipment financing for capital goods was restarted at the end of 1980 with the creation of FINAMEX operated by BNDES. The post-shipment financing operations began in August 1991. With the extension of the financing lines, the name FINAMEX is replaced by BNDES-Exim, and includes new funding modalities in 1993 and special pre-shipment in 1997. BNDES-Exim also starts financing for micro, small and medium-sized companies [7]. The funds for the BNDES-Exim financing lines come from the Worker Support Fund (FAT) and external lines (from multilateral organizations for example).

Brazilian government regulated the Export Financing Program (Proex) through Law No. 8187 of June 1991. Initially the intention was to finance exports of capital goods.

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[4] For more information see http://idg.receita.fazenda.gov.br/orientacao/aduaneira/regimes-e-controles-especiais/regimes-aduaneiros-especiais/drawback.

[5] In 1969 and 1970 there were also created, respectively, two fiscal subsidies, the IPI and ICM premium credits. Befiex (Commission for Special Export Programs) has been created to serve large companies with long-term export projects for manufactured goods.

[6] According to Catermol (2008), the Pre-Shipment lines provide resources in adequate time to the production cycle of the company to export in general. The Post-Shipment line is intended to support marketing itself, allowing Brazilian exporting companies to submit a financing proposal compatible with their competitors from other countries.

[7] BNDES-Exim has five modalities: pre-shipment, agile pre-shipment, pre-shipment anchor, special pre-shipment, and post-shipment.

According to Fonseca (2015), the Brazilian government adopted a model similar to that of credit agencies to exports such as those used by the United States (Ex-Im Bank), Germany (Kreditanstallt ̈fr Wierderaubau) and Japan (Export-Import Bank of Japan). Proex absorbed the still active FINEX credit lines and reintroduced the system of equalization of interest rates valid at the time of FINEX.

Proex has funds from the National Treasury and the operations are managed by Banco do Brasil (BB). Proex presents direct financing to the exporter or importer (Proex Financing). Proex also offers a line of equalization of interest rates (Proex Equalization) that seeks to equate the financing conditions offered by financial institutions with those practiced in the international market.

Proex Finance supports Brazilian exports of goods and services with gross annual sales of up to R $ 600 million, in almost all types of goods and services, except commodities. Their terms vary from 60 days to 10 years of payment. Most industrialized products have a term of less than 24 months. The Proex Equalization line assumes part of the financial charges, making them equivalent to those practiced in the international market. This modality can be contracted by Brazilian companies of any size, and the equalization deadlines vary from 60 days to 15 years, defined by the added value of the merchandise or the complexity of the services provided.

De Negri et. al. (2010) indicate that 2,804 firms made use of the Drawback program among the 17,903 companies that exported in the year 2007. That is, 15.7% of the companies or approximately 30% of the value exported that year (corresponding to US $ 50 billion in exports) made use of Drawback [8]. Among the companies that used Drawback, 2,435 were industrial companies (86.8%), the rest were service companies (10.5%) and the agricultural sector (2.6%). The sectors that have most accessed the drawback regime are the automotive, other transport equipment, extraction of metallic minerals and metallurgy.

Proex Direct Finance is intended primarily to support micro, small and medium enterprises and corresponds to approximately 65% of available resources in the Proex programme between 2004 and 2007. The remaining 35% of resources (equalization) is intended to offer exporters financial conditions that preserve the competitiveness of Brazilian products and services abroad – regardless of firm size. According to De Negri

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[8] The percentage of firms that used Drawback between 2003 and 2007 was 14.7%.

et. al. (2010), exports of companies supported by Proex Financing accounted for 5.2% and 3.8% respectively of total industrial and total exports of the Brazilian economy. The firms benefited by Proex Equalization accounted for 10.3% of industrial exports and 7.6% of total exports in the period between 2003 and 2007.

BNDES-Exim has historically concentrated its resources on supporting capital-intensive sectors such as other transportation materials, electrical machinery and equipment, high value added products and mechanical machinery and equipment. Catermol (2005) mentions that from 70% to 80% of the value disbursed by the BNDES export lines are to support the capital goods segment. Lobo and Silva (2010) pointed out that disbursements of the BNDES Exim lines reached US$ 8.3 billion in 2009, and that approximately 82.2% were for the manufacturing industry. According to De Negri et. al. (2010), exports of companies supported by BNDES Exim represented 16.8% of total exports and 22.7% of industrial exports between 2003 and 2007. Although BNDES Exim is restricted to a smaller set of companies, they are bigger.

The difference between the Exim and Proex programmes lies in the funding grant rules. The first has a term of up to two years, and the Long-Term Interest Rate (TJLP) – established by the Brazilian Finance Ministry – is the interest rate charged, with a maximum spread of 2% per year, resulting from intermediation by a commercial bank. However, Proex has a financial term of up to ten years; the Libor is the interest rate charged, and the maximum spread is 2.5%.

2. Data Source and Identification Strategy

We restrict our sample to entrant firms in the export market belonging to the manufacturing industry that during some point of the observation period (i) have used one, and only one, of the export support programs (Drawback, Exim or Proex)[9] or (ii) never used any of the three programs. The data are annual for the period 1996-2007. We observe firm entry over six years (entrants during the years 1998 to 2003) and followed

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[9] We exclude other observations because of the low number of firms using multiple instruments in the database. There are few firms with multiple instruments. So, we could not identify the effect of the difference attributable to the use of another instrument. In the database, only 45 firms accessed more than one programme during the entire period (of 787 firms that used some of the export financing instruments).

for a maximum of ten years, thereby generating an unbalanced panel of exporters. We still observe the firm up to two years before entering the international market.

The database is the result of integrating information from (i) the Annual Social Information (RAIS-MTE)[10]; (ii) the Ministry of Development, Industry and Foreign Trade (MDIC); (iii) the Secretary of Foreign Trade of the the Ministry of Development, Industry and Foreign Trade (SECEX-MDIC); and (iv) BNDES. We present the variables used in the study and their sources in Table 1. Table 2 provides a description of the sample of new exporters per year and with respect to the use of any of the three programs analysed. According to Table 2, the vast majority of entrants in the international market (at least 93%) did not use financial programs or compensation at any time during the period of analysis. Note that the most commonly used instrument is Drawback, followed by Proex and Exim.

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[10] RAIS is an administrative record of the labour force profile, organized by Ministry of Labour and Employment (MTE), which is mandatory in Brazil for all firms regardless of sector.

Table 1 – Description of the variables analysed

Variable	Description	Source
Export value	*Dummy* = 1 if the firm is exporter	
	Log of value in US$ (current)	SECEX
Firm is importer	*Dummy*=1 if the firm is importer	SECEX
Average wage of employees	Log of Value in current R$	RAIS
Employed persons up to high school	Log of the number of employees	RAIS
Employed persons in R&D		RAIS
Company age	Number of years of firm's activity	RAIS
Number of export destinations	Number of countries	SECEX
Technol. intensity of the firm industry (High, Medium-high, Medium-low, Low)	*Dummy* = 1 if the firm belongs	RAIS[11]
Geographical regions of the country	Geographic region of the firm's activity	RAIS
Drawback	*Dummy* = 1 if the firm used the programme	MDIC
BNDES Exim		BNDES
Proex		MDIC

Table 2 - Firms by year of entry and instrument use – Unmatched sample

Year of entry	Drawback		BNDES Exim		Proex		
	Use	*Never use*	*Use*	*Never use*	*Use*	*Never use*	**Total**
1998	91	1,150	14	1,227	24	1,217	**1,241**
1999	82	1,427	17	1,492	31	1,478	**1,509**
2000	79	1,438	8	1,509	23	1,494	**1,517**
2001	83	1,429	8	1,504	36	1,476	**1,512**
2002	94	1,326	5	1,415	28	1,392	**1,420**
2003	88	1,236	4	1,320	27	1,297	**1,324**
Total	**517**	**8,006**	**56**	**8,467**	**169**	**8,364**	**8,523**

We built the database to only include firms that are new to the international market to isolate the effect of financing on export performance. So we avoid the problem of an endogenous relationship between continuing export activities and the firm's ability to

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[11] The data obtained indicate the sector of activity of the firm. But we divide into categories of technological intensity based on OECD (1997).

obtain external financing. That is, firms that continually operate in the export market face better production and profitability prospects, increasing the likelihood of their receiving export financing, thereby generating a feedback mechanism between productive (and export) performance and the ability to obtain export financing. To avoid this feedback effect, the first step in the identification strategy is to estimate the impact of export financing only on new entrants to foreign markets.

Another important consideration is the large number of firms that exit foreign markets after only one year of exporting activity. This may lead to upward bias in estimates related to the impact of funding on export performance because firms that do not receive funding may experience reduced survival probability in foreign markets. We seek to identify the causal effect of funding on export performance by defining the sample. The sample is constructed following the assumption that an entrant can only access the export support programmes from its second year of operating in a foreign market.[12] This ensure that we have information on the export potential of the firm because we guarantee firm survival in export activity after the first year of exporting. This design seems reasonable given the low number of firms that get some sort of funding/exemption for export in the first year in the international market, while there are a large number of firms (without access to any program) which remain only in the entry year in the export market.

Firms that are larger, more productive and have higher export values are more likely to access public export support programmes. Also, Markwald and Puga (2002) and the Brazilian National Confederation of Industry (Confederação Nacional da Indústria, 2008) present a survey indicating that a considerable number of industrial firms do not know export incentive mechanisms such as Proex and Exim. This evidence that firms do not know these programs makes it essential to construct a control group based on observable characteristics of entrant firms that have not received export support –thereby reducing heterogeneity in the panel data and avoiding self-selection problems, which bias the estimation of the coefficient related to the effect of the programmes on export

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[12] This implies the exclusion of 43% of firms in the overall database. Overall, 8,523 companies entered the export market and of these, 3,563 companies have not accessed any funding mechanism and have stopped exporting in the second year. In the universe of 787 firms that used a financing mechanism for export, 49 accessed such a mechanism in the entry year in the foreign market. Of these 49 firms, only 6 firms accessed such a mechanism in the first year and no longer exported the following year.

performance. The construction of the control group increases the comparability between firms using and those not using the export support programmes.

We define two subgroups for each instrument: (i) firms that did not use any of the three programs throughout the period and (ii) those that used the Drawback, Exim or Proex program (only one of them) at some point. Therefore, we construct three matched samples, one for each financing instrument. The strategy to define this control group and enhance comparability between companies that used and those that did not use the support programs consists of applying propensity score matching (PSM) based on Caliendo and Kopeinig (2008) and Dehejia and Wahba (2002). We consider matching that respects the common support condition, had a caliper (maximum propensity score distance) of 0.1 and 5 nearest neighbours with replacement[13]. We do the matching by creating a control group and one treatment group for each of the programs separately and for each year of entry in international markets. Then we put together all matched samples per entry year for each program to obtain a control and treatment group for each program regardless of the entry year.

According to this strategy, we perform the matching based on predetermined observable characteristics, evaluated until the year in which the export support programmes are assessed. To implement PSM, the vector of covariates includes the following variables: number of persons employed by a firm, the real average income of employees in year in question (year in which the firm entered foreign markets) and lagged (in the year before entry), the company's age in the year in question, the firm's regional location and sector classification by technological intensity, a dummy for export destination (U.S., Europe and Mercosur), export value, the number of export destinations in the year of entry and the probability that the firm will continue exporting in the second year after international market entry, estimated from a survival model.[14] [15]

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[13] We try to caliper variations and 3 to 5 nearest neighbours. We use the caliper to reduce the bias, although it increases the variance (Caliendo, Kopeinig, 2008).

[14] We calculate the survival probability between the first and second year in the international market from a survival model with an exponential distribution. The covariates are firm characteristics (technological intensity of the sector, geographic region, firm age, number of employees, a dummy variable indicating whether imported that year, etc.) in the entry year. Thus, this survival probability variable (as well as the export value and number of destinations in the entry year) is predetermined given the experimental design.

[15] As the number of variables is very large in the probit analysis and the sample is small for each year of entry, we use a stepwise process to reduce the dimensions of the probit model. The stepwise estimation includes a backward-selection search for the regression model.

The resulting sample appears to exhibit good matching performance between the control and treatment groups for each entry year and for each program after the implementation of PSM. We present pseudo R² tests in Table A1 of the Appendix, which indicate no statistically significant differences between the treatment and control groups after PSM.[16] The number of firms in each sample for each program after matching is reported in Table 3.

Table 3 - Firms by year of entry and the use of instruments – Matched sample

	Drawback		BNDES Exim		Proex	
Year of entry	*Use*	*Never use*	*Use*	*Never use*	*Use*	*Never use*
1998	53	139	6	21	14	55
1999	48	168	11	37	23	93
2000	46	133	4	15	15	65
2001	47	167	5	15	25	110
2002	54	192	2	6	18	60
2003	75	244	3	15	23	91
Total	**323**	**1043**	**31**	**109**	**118**	**474**

We also use the panel structure to control for the self-selection of firms that accessed the financial support instruments and to mitigate endogeneity of the covariates, which we therefore include lagged by one year. The vector of covariates (in logarithms) includes the number of employees in a given year, number of technical-scientific employees of the firm, proposed by Araújo et al. (2009), age of the firm, average real wages of the firm, a dummy defined as 1 if the firm imports (in the year of matching), and year dummies for 1998 through 2006.

We use two types of dummy variables, D_{jt}, to measure the impact of financial support instrument j, where j = Drawback, Exim or Proex. The first type of treatment dummy variable is defined as 1 in the year that the firm receives the treatment and remains 1 in subsequent years, measuring the mean effect of the treatment. The second type of treatment dummy "tracks" the firms in the year in which they receive the treatment and

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[16] The complete set of matching tests is not presented here for reasons of space. We would have the t test for the different variables in the six years of international market entry and six common support graph before and after matching for each program, which can be requested to the authors. In the case of Exim financing, it is not possible to calculate the pseudo R² statistic because of the sample size, but the average test (Student t-test) indicates no statistically significant differences between the covariates of treatment and control groups.

in subsequent years. For example, if a panel allows a firm to be tracked for up to four years after receiving the treatment, then there would be five treatment dummies: one indicating whether this firm is in the year it receives the treatment, the second indicating whether the firm received the treatment one year ago, and so forth. In this case, we insert these five dummy variables in the same econometric model. This second strategy allows us to assess in which year a peak occurs (if any), or for how long the (supposedly positive) effect may persist.

Table 4 reports the descriptive statistics for the main variables used in the study for the matched sample throughout the period. Treated firms are more likely to remain in the export market, have larger numbers of destinations and have higher export values regardless of the program used, which are the dependent variables of our models. Despite some exceptions, if firms access funding, they grow in size (a larger number of employees), increase the number of employees in research and development, pay higher wages on average under the three export support programs.[17] [18]

Table 4 - Descriptive statistics of the treatment and control groups for each program

|	Drawback		BNDES Exim		Proex	
Variable	Treatment	Control	Treatment	Control	Treatment	Control
Export frequency	94.3%	75.1%	88.0%	71.2%	93.3%	73.8%
Employed persons up to high school	133.57	122.83	290.80	296.33	104.29	95.05
Employed persons in R&D	1.71	1.21	8.72	2.10	0.88	0.59
Average wage of employees	1147.89	1019.28	1034.91	975.63	775.01	807.45
Company age	16.16	16.55	18.49	19.42	15.96	16.22
Number of export destinations	4.22	3.01	7.51	3.76	5.33	3.23
Export value	2,109,613	717,430	4,834,330	1,074,964	1,051,566	667,607
Import frequency	73.9%	49.2%	60.0%	47.7%	36.0%	35.7%
Number of observations	**2,188**	**5,295**	**220**	**575**	**802**	**2,394**

3. Stylized facts of the matched sample

[17] We perform the firm matching for the entry year so that the difference between variables may have occurred later.

[18] If the firm participates in the Exim programme, it does not increase its total number of employees but increases the number of employees in research and development. In turn, firms that used the Proex program do not have higher average wages than those that did not. Finally, with the exception of Proex, the number of treated firms that are also importers is considerably higher than in the control group.

In this section, we highlight three stylized facts of new entrants in the export market and discuss the role of funding with the matched sample that contains treated and control firms.[19] Figure 1 presents the local polynomial regression to the proportion of firms that continue exporting based on the number of firms that enter international markets according to the access to the programmes.[20][21] In Figure 1, the first stylized fact is that *there is a decrease in the number of firms in the export market over time.* The proportion of firms that continue exporting declines over time in both groups (treatment and control) – even considering the re-entry of exporting firms – although the survival rate is significantly higher for the treatment group. Firms have a dropout rate from the export market of approximately 24% after the second year of exporting. However, this rate is only 10% on average for firms that receive financial support for exports and 28% for control group firms. After the fifth year of exporting, 88% of firms that have made use of the funding programmes are still exporting, while only 56% of the control group (firms that did not take up the funding instruments) remain in the export market.

Figure 1 – Proportion of firms that export in each period based on the number of firms that enter international markets according to access to support programmes

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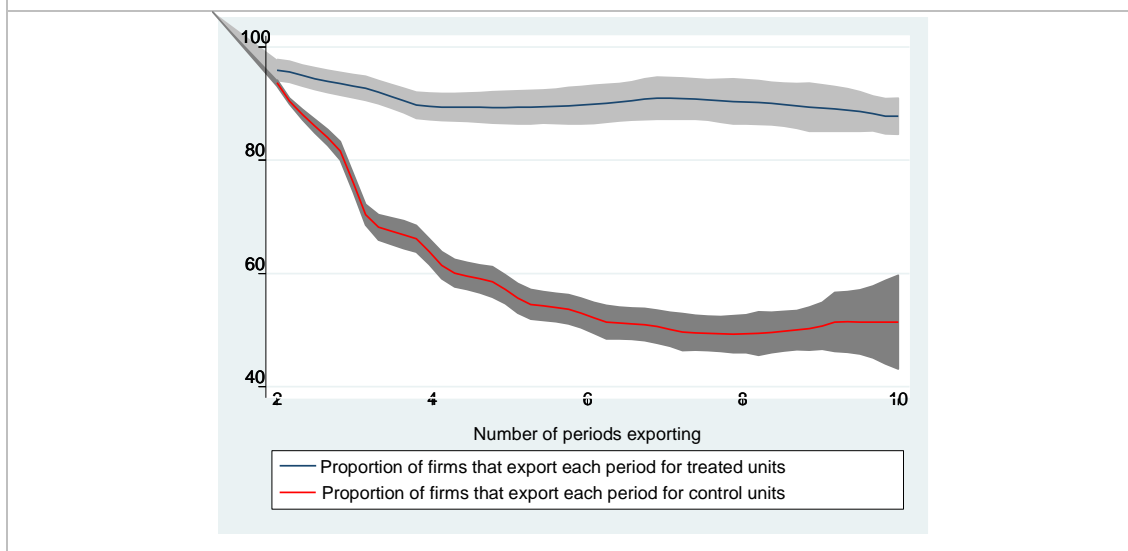
[19] We join all the three matched samples for each program only in this section of stylized facts.
[20] Because of the identification strategy, firms have to survive into the second year after entry. Therefore, firms do not abandon foreign markets in the year following entry.
[21] We consider the replacement of firms in the export market. That is, if the firm exported for three consecutive years and only exports again in the fifth year, we use the firm's data in the fifth year but not in the fourth year.

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The second stylized fact is that *firms tend to increase the number of export destinations over time*. Figure 2 presents the local polynomial regression to the average number of export destinations according to the year of entry between the treatment and control groups. In percentage terms, the major increase in the number of destinations occurs in the second year of export activity (an average increase of 37% for several entry years). Firms that accessed the funding increase the number of destinations by 62% on average in the second year of exporting, while for firms that did not access funding is 28%. The average number of destinations of firms that accessed funding jumps from 1.8 to 5.3 over five years of exporting, while the increase is from 1.7 to 3.6 over five years of exporting among firms that did not access funding. However, the increase in the number of export destinations for control group is not sustainable if we expand the time that firms remain on the market.

Figure 2 – Average number of export destinations according to access to support programmes
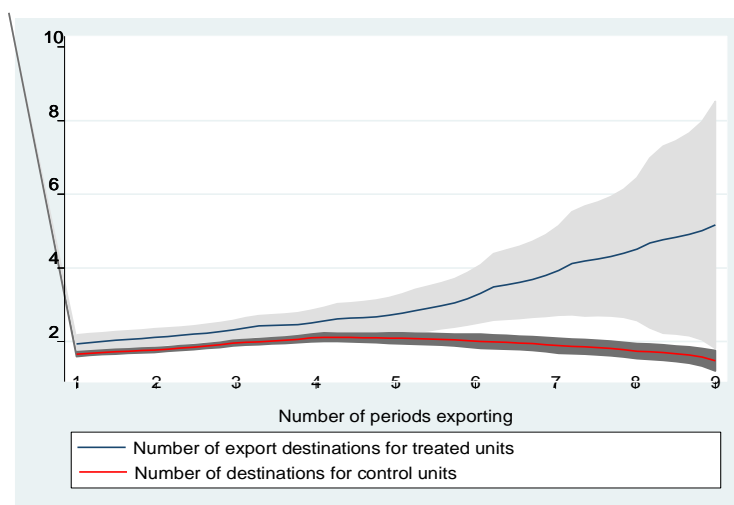
The third stylized fact is that *firms increase their export value over time*. Figure 3 presents the local polynomial regression to the export value in US$ for new entrants according to the access to support programmes. Firms increase their average export value at an annual rate of 46% on average (this growth rate decreases the longer the firm is in the export market), and the peak of this increase usually occurs in the second year after entry, with an average percentage increase of 109%.

Figure 3 – Value exported in US$ by firms according to the access to support programmes
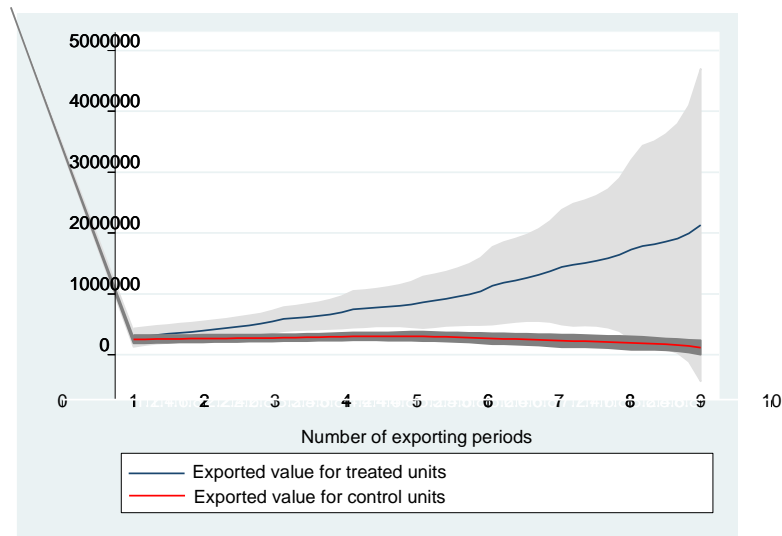
Firms that accessed support programmes systematically exhibit a higher export value than those firms that did not, regardless of the year of entry. We also note that the increase in the export value in the second and third years of exporting is important for firms that access programmes, with an average increase of 189% in the second and 80% in the third year of exporting, while there is an increase of 87% and 44% in the second and third years of exporting for firms that did not access any export support instrument.

4. Results with matched sample – controlling for observable characteristics

Below, we present and discuss the results only for the matched sample and focus on the coefficients related to the financial support dummy variables to be brief. In Table A2 of Appendix, we present the coefficients obtained for the sample without the experimental design defined above to assess the effectiveness of the identification strategy. In general, the results indicate a reduction in selection bias when we compare the estimates between the samples with and without the use of our experimental design, expressed by the reduction of the coefficients value. Except for Exim, experimental design increases the effect of programs on the likelihood of remaining exporting and decreases the effect on the intensive and extensive margins.

i. Likelihood of exporting

We adopt a dynamic linear probability model to measure the impact of financial support on the continued presence of firms in foreign markets. This choice is justified by the movement of entry and exit of exporting, which is not captured adequately by survival models, and to facilitate the interpretations of coefficients. If we had estimated a survival model, we would not have used the firm's information while it was not exporting. So we adopt the dynamic linear probability model for the panel data because it considers when the firm is not exporting. Therefore, we attempt to capture the impact of financial program conditional on a firm's previous exporter status using the dynamic linear probability model.[22]

The choice of the dynamic method is based on two reasons. First, the dynamic probability model is similar to the survival model in the sense that analyzes the probability of exporting at the moment (to be "alive") conditional to export until then (if kept "alive"). The second reason is that exports series tend to be highly positively serially correlated (see, e.g., Roberts and Tybout, 1997; Bernard and Jensen, 2004). Potentially, this could lead to severe serial correlation problems (Bertrand et al, 2004).

For each type of financial support, we estimate these models using the fixed effects estimator and first-difference generalized method of moments (GMM) estimator provided by Arellano and Bover (1995). The estimated equation has the following functional form:

$$Y_{it} = c_i + \delta_t + \gamma Y_{it-1} + \sum_{l=1}^{4} \beta_l D_{jt+l} + X'_{it-1}\theta + \varepsilon_{it} \qquad (1)$$

where the dependent variable, Y_{it}, is a dummy variable for export status in period t, which takes value 1 if the firm exports and 0 otherwise, D_{jt+l} is a dummy variable that takes value 1 if the firm obtains financial support from instrument j in period t+l and 0 otherwise. We exclude the effect of the financing dummy variable in the same year in which the firm has access to the instrument only for the linear probability model (i.e., the results in this subsection). If the firm received funding in a given year, it necessarily

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[22] Girma et al. (2007) and Esteve-Pérez et al. (2011) are examples of duration models applied to estimating the impact of firm survival in international markets.

exported in that year. This would inflate the estimated average effect over time. X'_{it-1} is a vector of covariates lagged by one year, c_i are the time-invariant components, and δ_t are common time effects (annual dummy variables).

The main question in this section is whether the financial support instruments improve the likelihood of exporting. Table 5 presents the estimates of the effect of each financial support instrument (Drawback, Exim and Proex) for the matched sample based on these two estimators: fixed effects and Arellano-Bover (first-difference GMM). In essence, the fixed effects model estimation provides a higher bound coefficient, and the Arellano-Bover model has the lower bound magnitude.[23] [24]

We expect that the results related to the probability of exporting are positively correlated with the impacts on the extensive and intensive margins. In accordance with the stylized facts already presented, we expect that persistence in export activity implies increasing returns based on the learning to export argument. Following the firm's entry into the international market, the firm discovers whether it is productive or not to remain in that market like Albornoz et al. (2012). In other words, there is a feedback between permanence, number of destinations and exported value. Thus, there is also a greater probability that, as the firm continues exporting, it increases the number of export destinations and the exported value.

On average, a firm that did not access the Drawback or Proex programmes increases its export probability based on the two methods.[25] However, the average impact of Exim is not statistically significant in either model. A possible explanation is that this programme prioritizes large firms, which may not be particularly dependent on this resource for remaining in the international market. If the firm does not access the exemption, the Drawback program has an average effect of increasing the likelihood that the firm will remain exporting in a range between 13.3% and 3.6%.

Furthermore, the effect of the Proex program is decreasing over time, as expected, according to the estimates of the fixed effects model. However, this result is not robust in

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[23] We tested for the presence of autocorrelation in the original error of the Arellano-Bover model. The test indicated the absence of autocorrelation for all models.

[24] In the case of the fixed-effect models of probability and the intensive margin, we use standard errors corrected by clustering at the industry level. We consider that there must be some correlation of firm characteristics at the industry level because the export programmes can support more some industries. We did not use this correction in the other models (that were not of fixed effect) because such correction was not possible.

[25] The mean effect is a step dummy variable, equal to 1 in the year following the firm obtaining the funding or the exemption in the probability model.

the Arellano-Bover estimates. In the case of Proex, this effect is only statistically significant in the period after the firm had access to funding according to the Arellano-Bover model estimates. If the firm accessed financing, the probability of remaining exporting in the following period increases by 5.1%.

In this first part of our analysis, we observe major effects from two types of export promotion programmes: the compensatory subsidy of Drawback and the financial support from Proex (which is provided mainly to small and medium-sized firms). In this first stage, we analyzed whether the programs would have an effect on expanding the country's export base. We will then evaluate the effect of the programs in the extensive margin in the sequence (next subsection) and then in the intensive margin.

Table 5 – Dynamic linear probability model for exporting

Programme	Methodology	Effect size				
		Mean	D_{t+1}	D_{t+2}	D_{t+3}	D_{t+4}
Drawback	Fixed Effects	0.133 ***	0.132 ***	0.138 ***	0.138 ***	0.109 ***
		(0.01)	(0.02)	(0.03)	(0.03)	(0.03)
	Arellano-Bover	0.036 **	0.028	0.069 **	0.084 **	0.054
		(0.02)	(0.03)	(0.03)	(0.04)	(0.05)
Exim	Fixed Effects	0.079	0.078 **	0.087	0.054	0.061
		(0.05)	(0.03)	(0.06)	(0.05)	(0.06)
	Arellano-Bover	0.016	0.057	0.053	0.021	0.024
		(0.71)	(0.75)	(0.46)	(0.40)	(0.29)
Proex	Fixed Effects	0.135 ***	0.105 ***	0.084 *	0.066 *	0.089
		(0.02)	(0.03)	(0.04)	(0.03)	(0.05)
	Arellano-Bover	0.051 *	0.055 *	0.022	0.003	-0.024
		(0.03)	(0.03)	(0.04)	(0.04)	(0.02)

Obs.: ***, ** and * refer to the significance of the coefficient at the 1%, 5% and 10% levels, respectively.

The standard deviation is in parentheses.

ii. Extensive margin: number of export destinations

As Contessi and de Nicola (2013) note, it is possible to analyse the importance of financial constraints on the extensive margin of exports by considering the number of destinations and number of products exported. Given the identification strategy that we adopt in this work and data availability, we restrict our analysis to the impact of funding on the number of destination markets.

For this purpose, we will estimate a count model with fixed effects, where N_{it} is the number of export destinations. The negative binomial model is used in this work (a generalization of the Poisson model) because it is more general than the Poisson model. The negative binomial model has an additional parameter to model overdispersion (variance greater than the mean).[26] In the case of overdispersion, the negative binomial model provides a better fit than does the Poisson model. We adopt the conventional parameterization given by the following:

$$E(N_{it}|X_{it-1}, c_i) = \mu = exp\left(c + \delta_t + \sum_{l=0}^{4} \beta_l D_{jt+l} + X'_{it-1}\theta + c_i\right) \qquad (2)$$

$$V(n'|\mu, \alpha) = \mu(1 + \alpha'\mu)$$

$$N_{it} \rightarrow negative\ binomial$$

We estimate two different models. In the first model, we use the vector of covariates mentioned above. In the second model, we also include the value exported by the firm lagged by one year as a regressor to control for feedback. We should control for a firm that continuously exports receiving feedback and adjusting its behaviour in the following period. Thus, we have an upper and lower bound for the estimated coefficients, without and with lagged export value included in the vector of covariates.

The estimates of the negative binomial model for the number of firm export destinations are presented in Table 6. The coefficients associated with the programmes are presented in the incidence rate ratio (IRR) format. An IRR coefficient above 1 denotes

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[26] The mean of the negative binomial distribution is given by $E(y'|\mu, \alpha) = \mu$, and the variance is given by $V(y'|\mu, \alpha) = \mu(1 + \alpha'\mu)$, where α is a constant parameter. The model is given by $\mu = exp(x'\theta)$. Thus, the variance exceeds the mean if $\alpha > 0$ and $\mu > 0$ (Cameron and Trivedi, 2005).

a contribution to increasing the number of export destinations. An IRR value of less than 1 leads to a reduction in the number of export destinations.

However, our data for number of export destinations exhibit a characteristic that deserves attention. Although the sample contains only firms newly engaging in export activity in the analysed period, the movement of exit and entry in the international market produces a significant number of observations with zero destinations (approximately 10% of the sample). Because the zero value would inflate the effect of the support programmes on the number of export destinations and the export value, we exclude observations with zero export value or zero export destinations.[27] If we were to not exclude observations with export destinations equal to zero, we would simultaneously capture the effect of these programmes on survival and on the number of destinations.[28] Thus, we condition on survival when we exclude an observation with a number of destinations equal to zero. We also consider only firms that are exporting in the analysed period for the exported value model in the following subsection, following the same argument as above.

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[27] For example, if the firm exports in the period during which it has access to financing and does not export in the following period and then returns to exporting in all other periods, the firm will be present in the sample for all periods except one.

[28] Further results (unreported) indicate that including observations with destinations equal to zero increases the estimated effect of the programs. This argument would be in line with that of Albornoz et al. (2012) – related to the second prediction of this paper – who argue that conditional on survival, we studied the behaviour of the extensive margin.

Table 6 – Count model for the number of export destinations

Programme	Specification	Effect size					
		Mean	D_t	D_{t+1}	D_{t+2}	D_{t+3}	D_{t+4}
Drawback	Basic	1.143 ***	1.163 ***	1.174 ***	1.074	1.039	1.067
		(0.03)	(0.04)	(0.05)	(0.05)	(0.06)	(0.07)
	with Export Value (t-1)	1.125 ***	1.146 ***	1.153 ***	1.057	1.025	1.061
		(0.03)	(0.04)	(0.04)	(0.05)	(0.05)	(0.07)
Exim	Basic	1.218 **	1.180	1.190	1.058	1.157	0.998
		(0.12)	(0.13)	(0.13)	(0.12)	(0.13)	(0.11)
	with Export Value (t-1)	1.177 *	1.133	1.133	1.022	1.132	0.984
		(0.12)	(0.12)	(0.13)	(0.11)	(0.12)	(0.11)
Proex	Basic	1.429 ***	1.489 ***	1.436 ***	1.327 ***	1.223 ***	1.159 *
		(0.06)	(0.07)	(0.07)	(0.08)	(0.08)	(0.10)
	with Export Value (t-1)	1.387 ***	1.453 ***	1.376 ***	1.288 ***	1.199 ***	1.139
		(0.06)	(0.07)	(0.07)	(0.07)	(0.08)	(0.10)

Obs.: ***, ** and * indicate that the coefficient is significant at the 1%, 5% and 10% levels, respectively.

The standard deviation is in parentheses.

A firm experiences an increase in the number of export destinations (on average, the effect is statistically significant) after it has accessed any financial support instrument based on the results in Table 6.[29] The greatest effect is observed among firms that obtained Proex resources – as they tend to be small firms. On average, a firm that accessed Proex experiences an increase in its number of export destinations by between 39% and 43%. The Exim programme has a positive mean effect of between 18% and 22%, while the Drawback programme increases the number of export destinations by between 12% and 14%. These estimates highlight the positive impact of having access to financing or compensation on the extensive margin of exports.

Although Exim funding has no effect in any particular year, this programme has a statistically significant mean effect. Only Proex has a significant effect on the extensive margin in almost any period after a firm have accessed the programme. A treated firm has a greater increase in the number of export destinations in the first and second year after accessing Proex, but this effect is significantly reduced over time. Drawback has an effect for only two years after a firm receives the tax exemption.

These results indicate that programmes that benefit smaller firms (which have greater financial constraints) tend to be a better policy, as the case of Proex indicates. The Drawback mechanism also benefits firms by allowing them to improve export profitability, encouraging an increase in the number of export destinations for firms that tend to export continuously.

iii. Intensive margin: export value

Markwald and Puga (2002) and Kannebley et al. (2009) highlight the importance of persistence in exporting activity to the evolution of the value of exports by Brazilian firms. These authors demonstrate that most of the amount exported is concentrated among firms that are continuously present in the external market. This raises the question of whether instruments providing financial support for export activity are able to expand the exported value directly and/or increase the persistence of firms in the foreign market, which is related to the possibility of reducing the financial constraints on the intensive margin of exports, as Manova (2013) suggests.

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[29] The mean effect is a step dummy variable, equal to 1 in the year the firm obtains the financing or exemption in the intensive and extensive models.

As explained above, we exclude observations with zero export value to avoid inflating the results.[30] We estimate a panel data model with fixed effects to measure the impact of financial support on the value exported by the firm, where the dependent variable, V_{it}, is the log of export value. As in the count models, we estimate two different models. In the first, we consider the usual vector of covariates, and in the second we also include the number of export destinations lagged by one period, as a control for feedback. The estimated equations have the following functional form:

$$V_{it} = c + \delta_t + \sum_{l=0}^{4} \beta_l D_{jt+l} + X'_{it-1}\theta + c_i + \varepsilon_{it} \qquad (3)$$

Table 7 presents the results for the panel model with fixed effects. On average, a firm exhibits increased export value (the effect is statistically significant) for any period after accessing Drawback or Proex. The estimates of these programme effects are lower than the basic specification when we add the lagged number of export destinations. Then, we can interpret these two estimates (without and with the lagged number of destinations) as a range in which the inclusion of feedback leads to a more conservative estimate of the impact. In general, the tax exemption provided by Drawback has a larger effect than the access to financing provided through Proex. On average, after accessing one of these programmes, the export value increases by 90% under Drawback and 74% under Proex by the more conservative estimate.[31]

In turn, the Proex effect decays rapidly and is not statistically significant three years after the firm has accessed funding. In addition, there is a considerable reduction in the effect of Proex between the first and second year after financing, which is also the case for the compensatory subsidy in lower value. Finally, Exim has no effect on the export value over time, similar to the linear probability model. The Exim programme finances large companies (which have lower financial constraints), which export products with higher added value, concentrated in a few sectors. Thus, the benefit of this instrument may have lower marginal effectiveness on the value of exports.

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[30] We estimate a Tobit model for panel data with fixed effects developed by Honoré (1992) as an alternative to control for this censorship problem, and the results (omitted here) indicate considerably larger effects.
[31] We use $100 * [\exp(\hat{\beta}) - 1]$ to interpret the estimated effect.

Table 7 – Intensive margin models (export value)

Programme	Specification	Mean		D_t		D_{t+1}		D_{t+2}		D_{t+3}		D_{t+4}	
						Effect size							
Drawback	Basic	0,764	***	0,897	***	0,725	***	0,601	***	0,506	***	0,685	***
		(0,09)		(0,10)		(0,09)		(0,126)		(0,171)		(0,233)	
	with # of Destinations (t-1)	0,645	***	0,800	***	0,594	***	0,452	***	0,360	**	0,540	**
		(0,09)		(0,10)		(0,10)		(0,12)		(0,16)		(0,196)	
Exim	Basic	0,358		0,814	*	0,718	**	0,152		-0,246		-0,330	
		(0,31)		(0,41)		(0,30)		(0,18)		(0,394)		(0,26)	
	with # of Destinations (t-1)	0,081		0,627		0,461		-0,064		-0,443		-0,468	*
		(0,27)		(0,39)		(0,279)		(0,18)		(0,38)		(0,26)	
Proex	Basic	0,792	***	1,139	***	0,693	***	0,511	***	0,230		0,128	
		(0,14)		(0,09)		(0,18)		(0,16)		(0,21)		(0,27)	
	with # of Destinations (t-1)	0,554	***	0,969	***	0,385	**	0,248	*	0,022		-0,067	
		(0,13)		(0,08)		(0,17)		(0,14)		(0,198)		(0,25)	

Obs.: ***, ** and * refer to the significance of the coefficient at the 1%, 5% and 10% levels, respectively.

The standard deviation is in parentheses.

Concluding remarks

This paper presents evidence on the role of public financing in the export performance of manufacturing firms in Brazil. This reinforces the interest about export credit agencies in developing countries. The empirical approach adopted allows us to analyse some causal relationships between financial constraints and international trade.

Using a unique dataset with detailed information on Brazilian exporters, we compare the effects of two financial instruments to support exports – Exim and Proex, each with different targets and types of beneficiaries – and a compensatory subsidy – the Drawback mechanism – on the survival and the extensive and intensive margin of international market entrants between 1998 and 2007. The main focus of the Proex programme is on micro, small and medium-sized companies, for which financial constraints are more pronounced. Conversely, the Exim programme was created as a sectoral instrument benefits primarily medium-sized and large firms for which financial constraints are less severe. The Drawback mechanism does not target any specific type of firm or sector and consists of a compensatory subsidy that affects export profitability, what prompts the firm to engage in export activity.

Our results suggest an equivalence between the Proex credit program and the Drawback compensatory subsidy in stimulating exports of industrialized products in Brazil. This evidence has never before been produced in empirical studies. This indicates the possibility of viable alternatives for stimulating exports.

The first piece of evidence in this regard was the positive impact of Proex and of Drawback on the survival of manufacturing firms in foreign markets, with the Exim programme having virtually no positive impact. A stylized fact in the literature is the positive relationship between permanence in export activities and the number of destination markets and export value. By stimulating continued operation in foreign markets, Proex and Drawback contribute to market and the export value expansion by entrants firms during the period analysed. This association can only be detected by applying our experimental design, which allowed us to reduce the selection bias associated with the demand for the instrument by the entrants in foreign markets.

The identification strategy essentially reduces the survival bias that would imply a learning process that occurs regarding the export potential of entrants in foreign markets in subsequent years. Thus, we are able to verify that the export support for firms with a greater likelihood of being financially constrained, thus increasing their likelihood of

survival, also allows them to pursue market expansion strategies and increase exported value per worker. Additionally, we find that the impact of export promotion programmes persisted over time, albeit with a gradual decline – given the statistically significant results that we obtain.

Besides, this paper produces evidence favourable to models of heterogeneous firms with financial constraints. We also highlight the importance of export credit agencies offering public financing to export, mainly in developing which systematically suffer from credit market failures. However, our article adds that correctly targeting export financing policy is important in such a policy that has positive results.

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Appendix A – Table of matching quality and tables comparing the results between unmatched and matched samples

Table A1 – Omnibus test for the overall balancing of matching methodology

Enter year	Drawback		Proex	
	Pseudo-R²	P-value	Pseudo-R²	P-value
1998	0.05	0.999	0.26	0.975
1999	0.06	0.998	0.47	0.428
2000	0.04	1.000	0.36	0.862
2001	0.08	0.980	0.19	0.922
2002	0.05	0.996	0.29	0.829
2003	0.09	0.875	0.11	0.997

Table A2 - Comparison of the results of the linear probability model, count model (extensive margin) and export value model (intensive margin), with and without the experimental design considering the matched samples

Programme	Methodology	Linear Probability Model Mean Effect (1)	(2)	Specification	Extensive Margin (Number of Destinations) Mean Effect (1)	(2)	Specification	Intensive Margin (Export Value) Mean Effect (1)	(2)
Drawback	*Fixed Effects*	0.073 ***	0.133 ***	*Basic*	1.160 ***	1.143 ***	*Basic*	0.770 ***	0.764 ***
		(0.02)	(0.01)		(0.03)	(0.03)		(0.09)	(0.09)
	Arellano-Bover	-0.006	0.036 **	*with Export Value (-1)*	1.141 ***	1.125 ***	*with # of Destinations (-1)*	0.654 ***	0.645 ***
		(0.02)	(0.02)		(0.03)	(0.03)		(0.09)	(0.09)
Exim	*Fixed Effects*	-0.029	0.079	*Basic*	1.165	1.218 **	*Basic*	0.188	0.358
		(0.04)	(0.05)		(0.11)	(0.12)		(0.36)	(0.31)
	Arellano-Bover	0.054	0.016	*with Export Value (-1)*	1.080	1.177 *	*with # of Destinations (-1)*	-0.176	0.081
		(0.56)	(0.71)		(0.11)	(0.12)		(0.31)	(0.27)
Proex	*Fixed Effects*	0.115 ***	0.135 ***	*Basic*	1.479 ***	1.429 ***	*Basic*	0.816 ***	0.732 ***
		(0.03)	(0.02)		(0.06)	(0.06)		(0.14)	(0.14)
	Arellano-Bover	0.050 *	0.051 *	*with Export Value (-1)*	1.434 ***	1.387 ***	*with # of Destinations (-1)*	0.570 ***	0.484 ***
		(0.03)	(0.03)		(0.06)	(0.06)		(0.14)	(0.12)

Obs.: ***, ** and * refer respectively to the significance level of the coefficient at the 1%, 5% and 10%.
(1)= Without Design, (2)= With Design
The standard deviation is in parentheses.