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Beyond the average effects: The distributional impacts of export promotion programs in developing countries☆

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ABSTRACT

Do all exporters benefit the same from export promotion programs? Surprisingly, no matter how obvious this question may *a priori* be when thinking of the effectiveness of these programs, there is virtually no empirical evidence on how they affect export performance in different parts of the distribution of export outcomes. This paper aims at filling this gap in the literature. We assess the distributional impacts of trade promotion activities performing efficient semiparametric quantile treatment effect estimation on assistance, total sales, and highly disaggregated export data for the whole population of Chilean exporters over the 2002–2006 period. We find that these activities have indeed heterogeneous effects over the distribution of export performance, along both the extensive and intensive margins. In particular, smaller firms as measured by their total exports seem to benefit more from export promotion actions.

1. Introduction

Most countries around the world have implemented trade promotion programs. Effects of these programs are likely to be heterogeneous, varying along the distribution of export outcomes. In particular, given the tighter limitations they face in access to relevant export information, these effects are expectedly stronger for firms which are smaller and have less export experience. Further, policymakers are in general interested in the distributional impacts of such public programs. For instance, supporting the internationalization efforts of small and medium size enterprises (SMEs) and, more specifically, those of new and inexperienced exporters, is a common goal of export promotion agencies as declared in their statements of purpose. Thus, according to Chile's national agency's own definition, "PROCHILE's labor is based on four fundamental concepts: *supporting small and medium-sized firms in their internationalization process*, taking advantage of the opportunities created by the country's trade agreements, public–private associations, and positioning Chile's image in other markets". Similar examples are easily found for other countries. Information on the aforementioned impacts is therefore valuable to assess whether the programs are well targeted in the sense that companies which are primarily intended to be helped benefit most from them. Empirical evidence on these effects is, however, inexistent. In this paper we aim at filling this gap in the literature. In doing this, we perform efficient semiparametric estimation of quantile effects of assistance by PROCHILE using assistance, total sales, and highly disaggregated export data for the whole population of Chilean exporters over the 2002–2006 period.

PROCHILE is a well established export promotion agency with a long trajectory (it was created in 1974) and has offices and commercial representation in over 40 countries as well as 13 regional directorates within Chile.[1] This agency offers Chilean exporters a wide variety of services. Either individually or in association with other organizations it

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[1] PROCHILE was awarded a prize as the best developing country-based trade promotion organization at the World Conference of the Trade Promotion Organizations held in Buenos Aires in 2007.

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carries out training programs for inexperienced exporters oriented towards explaining the export process, as well as other programs with modules on market research, logistics, banking, international law, and business plans; collects and distributes relevant trade statistics and generates analyses on country and product market trends, both standard and customer-tailored; provides specialized counseling and technical assistance on how to take advantage of business opportunities abroad, in general, and on how to access specific markets (e.g., conditions in terms of technical regulations, quality standards, etc.), in particular; keeps an updated online exporter directory with detailed contact information and data on products exported, countries where these products are sold and ISO certification status; coordinates and, in some cases, co-finances firms' participation in international trade missions and trade fairs; and supports exporter committees and inter-firm coaching for entrepreneurs seeking to internationalize their companies.

A few previous studies have examined the effects of export promotion activities performed by PROCHILE. Thus, Álvarez and Crespi (2000) use a sample of 365 firms (i.e., 4.9% of the firms exporting over their sample period, 1992–1996) to evaluate the impact of three instruments managed by this agency, namely, exporter committees, international fairs, and a business information system. They find that overall trade promotion actions have had a positive and direct impact on the number of destination countries and indirectly on total exports and product diversification. In addition, the aforementioned instruments seem to affect differently firms' export performance. More precisely, exporter committees appear to be more effective than participation in fairs and usage of the commercial information system in promoting additional exports. Using a sample of 295 Chilean manufacturing SMEs, Álvarez (2004) further shows that the previous form of intervention is associated with a significant increase in the probability of being a permanent exporter, whereas trade shows and trade missions do not seem to help firms achieve such status.

These studies present average-like estimates of the impact of export promotion activities either jointly or individually considered. Despite their usefulness, these estimates may leave uncovered other important effects of such activities. For instance, existent studies indicate that firms with different degree of international involvement face different obstacles and accordingly have different needs (see, e.g., Diamantopoulos et al., 1993; Naidu and Rao, 1993; Czinkota, 1996; Moini, 1998). In particular, firms which are smaller and relatively inexperienced in international markets have greater limitations to becoming successful players in these markets (see, e.g., Naidu and Rao, 1993; Roberts and Tybout, 1997; Wagner, 2001; Bernard and Jensen, 1999, 2004). Thus, information-related impediments are more likely to serve as stronger deterrents for these firms (see Kneller and Pisu, 2007). Hence, we can conceivably think that trade supporting actions may potentially have different impacts for firms with different sizes and at different stages of their internationalization process. In this paper, we accordingly tackle the issue of effectiveness of these actions from a different angle: we investigate their distributional impacts. More specifically, we address two main questions: Do trade promotion programs have heterogeneous effects over the distribution of the relevant export outcome variables? What kind of firms benefits most from these programs?

In answering these questions, we use a comprehensive dataset covering all Chilean exporters, including annual firm-level data on total sales and exports disaggregated by product and destination country as well as information on participation in promotion activities organized by PROCHILE over the 2002–2006 period.[2] We believe that Chile is an interesting case study. This country has been at the forefront of trade liberalization in Latin America and the Caribbean, having signed several trade agreements with countries in the Americas, Europe, and Asia (see Moreira and Blyde, 2006). Remarkably, in 2007, 91.2% of Chilean exports were channeled through preferential trade arrangements (see DIRECON, 2008). Hence, the importance of tariffs as trade barriers for Chilean exporters is likely to be small relative to other barriers not directly addressed by these arrangements. This makes Chile an ideal candidate to assess the effects of policy interventions aimed at overcoming these other barriers. Information problems are one relevant trade-deterring factor (see Anderson and van Wincoop, 2004) and accordingly, trade promotion actions arise as a natural public policy to be evaluated. Further, despite the significant progress observed in terms of export diversification over the last 30 years (see Gutiérrez de Piñeres and Ferrantino, 1997), Chile is still an economy highly specialized in natural resources (see Moreira and Blyde, 2006). It is well known from the literature that lack of diversification can be potentially costly in terms of economic growth (see, e.g., Brainard and Cooper, 1968; Lederman and Maloney, 2003; and Herzer and Nowak-Lehnmann, 2006). Policies designed to foster diversification of exports might therefore have a substantial impact. This may be particularly true for export promotion activities. By informing on foreign markets and disseminating information on domestic products, these activities may contribute to overcoming information gaps, thereby increasing the likelihood that new goods are exported.

In order to uncover the effects of assistance by PROCHILE over different parts of the distribution of export outcomes, we use quantiles to derive discretized versions of these distribution functions and we semiparametrically estimate quantiles treatment effects by implementing the procedure proposed by Firpo (2007a). This method consists of a first step in which the conditional probability to participate in export promotion programs is computed and a second step in which the estimators are obtained as differences of respective quantiles for assisted and control firms adjusting for participation probabilities and calculated as solutions of minimization problems from observable data. Further, since there may be many unobservable characteristics that might potentially affect both selection into assistance programs and export outcomes, instead of performing the analysis on levels, we work with first-differences, much in the spirit of the conventional matching difference-in-differences approach (see, e.g., Blundell and Costa Dias, 2002). We thus ensure that we contrast the export performance of comparable firms and address the problem caused by the impossibility of observing this performance under non-assistance for assisted firms. Our procedure, however, yields estimates which are not directly interpretable as effects of trade promotion programs over the levels of export outcomes since quantiles of the first-differences of a given variable do not necessarily correspond to quantiles of the levels of this variable. Thus, in order to learn about such effects, we estimate kernel densities of the firms' (lagged) total exports both for groups of deciles where significant and non-significant impacts of trade assistance are observed, and for each decile of the distribution of the growth rate of firms' total exports, and use these densities to statistically assess whether larger effects on that distribution are accruing to smaller firms as defined in terms of their total exports.

We contribute to the existing literature in several ways. First, we estimate – for the first time to our knowledge – how export promotion services affect different groups of firms, i.e., beyond all firms as a whole and just a sample of them (e.g., SMEs), either for a developed or a developing country. Knowledge of these distributional impacts is valuable to ascertain whether such public interventions are overall well targeted. As pointed out by Frölich and Melly (2008), policy-makers will evaluate differently two programs with same average effect but whose effects are concentrated in the lower end of the outcome distribution in the first case and on its end tail in the second case. Henceforth, this information is extremely relevant from an

[2] In particular, our study aims at providing PROCHILE and other Latin American and Caribbean export promotion agencies with a set of analytical instruments to evaluate their actions. An assessment of these agencies and their activities from the point of view of social welfare is beyond the scope of this paper, which focuses only on the benefits of these actions in terms of export performance.

economic policy point of view. In particular, this is a valuable input in guiding the allocation of resources invested in export promotion and thereby for improving the design of existing policies. Second, we evaluate the effectiveness of these services in promoting additional exports over the distributions of both total exports and export margins, namely, the extensive margin (number of countries the firms export to and number of products they export) and the intensive margin (average exports per country, average exports per product, and average exports per country and product). Third, in performing this evaluation, we consider not only manufacturing but also the whole population of exporters, thus covering all economic sectors. This is important for a developing country such as Chile, where non-manufacturing exports explain a large fraction of total exports (see Moreira and Blyde, 2006).

We find that export promotion activities performed by PROCHILE have had differentiated effects over the distribution of export outcomes. These effects are mainly concentrated on the lower tail of the distribution of (growth of) total exports and the lower and upper ends of the distributions of (growth of the) number of countries and number of products. Matching these estimates with raw basic data on the profile of exporters we are able to conclude that the effects tend to be stronger for smaller firms as measured by their total exports. This is precisely what one would expect *a priori*. Overcoming barriers associated with internationalization is clearly more challenging for smaller, relatively inexperienced exporters, thus trade promotion programs are likely to be more effective in helping these firms.

The remainder of the paper is organized as follows: Section 2 reviews the theoretical arguments for export promotion and discusses their potential heterogeneous effects over different sets of firms as well as the challenges faced when assessing these effects. Section 3 explains the empirical methodology. Section 4 presents the dataset and descriptive evidence on firms' export performance and, in particular, on how the distribution of the corresponding indicators look like. Section 5 reports and comments the econometric results, and Section 6 concludes.

2. Export promotion: rationale, heterogeneous effects, and evaluation challenges

Export promotion policies are virtually ubiquitous (see Rauch, 1996). Over the last two decades, the number of export promotion agencies has increased by a factor of three (see Lederman et al., 2006). These kinds of public interventions might be and have been economically justified on the basis of market failures, primarily in the form of externalities.

The traditional rationale for such interventions is the existence of information externalities.[3] Information requirements associated with exporting are important (see, e.g., Johanson and Vahlne, 1977). Firms must learn about the alternative ways to ship their merchandises and their corresponding costs, the demand profiles of the potential markets abroad, the conditions to enter these markets, and the channels to generate awareness of their products and those through which these products can be marketed (see Volpe Martincus and Carballo, 2008a).[4] Specifically, firms pursuing cross-border economic opportunities must engage in a costly process of identifying potential trading partners and assessing their reliability, trustworthiness, timeliness, and capabilities (see Rangan and Lawrence, 1999).[5] A market failure arises in this case because there is a potential for free-riding on the successful searches of firms for foreign buyers (see Rauch, 1996). In other words, these searches and the associated transactions reveal information that may be used by other firms, who might eventually follow the pioneering ones without incurring into these costs (see Álvarez, 2007).[6] In doing this, the former obtain important benefits from the latter's initial investments and devaluate the potential benefits to be derived from their searches (see, e.g., Rauch, 1996; and Álvarez 2007). This is particularly true when companies attempt to enter a new export market or to trade a new product (see Hausman and Rodrik, 2003; Álvarez et al., 2007). Private returns from these exporting activities would accordingly be lower than the corresponding social returns and investment in their development would then be sub-optimally low (see Westphal, 1990).[7]

Actions executed by publicly funded-export promotion agencies can be viewed as a means of subsidizing searches, which counter the disincentives originated in potential free-riding (see Rauch, 1996). These actions help attenuate information problems, thereby reducing transaction costs and fostering trade (see, Álvarez and Crespi, 2000; and Volpe Martincus and Carballo, 2008a). In particular, they might affect exports along both the extensive and intensive margins. More precisely, trade promotion activities may encourage new firms to enter international markets and may also help already exporting firms enter new country and product markets and expand sales in current markets as well.[8] In this paper, we investigate the impact of such activities on these export margins, but that on the firms' extensive margin (i.e., the number of exporters).[9]

The effects of trade support might be heterogeneous along several dimensions. In general, the strength of these effects is likely to be related to the severity of the information problems involved in the specific trading operations. Thus, informational obstacles tend to be more important when firms attempt to sell new products abroad or to enter new export markets than when they pursue expanding exports of goods they have already been trading and/or to countries that are already among their destination markets. The effect of export promotion programs will accordingly be larger on the extensive margin of exports, i.e., the number of products exported and the number of countries the firms export to, than on the intensive margin, i.e., average trade flows (see Volpe Martincus and Carballo, 2008a).

[3] Externalities may also originate from managerial practices, training activities, technological change, and production linkages. Thus, exporters have been said to be likely to adopt efficient and competitive management styles and to provide employees with higher quality training, which may potentially benefit non-exporting firms, for instance, via turnover of managers and employees (see Kessing, 1967; Feder, 1983; and Edwards, 1993). In addition, externalities related to technological development may be extensive due to the imperfect tradeability of technology (see Westphal, 1990). In particular, exporters may transfer knowledge and provide suppliers with technical assistance and facilitate access to new and improved inputs by firms in downstream industries (see Álvarez and López, 2006). Export promotion might not only contribute to addressing these externalities but also other market failures, such as coordination failures between complementary industries, i.e., activities related through backward and forward linkages (see Trindade, 2005); imperfect-information driven barriers to entry when products have different attributes (see Grossman, 1989); imperfect information and higher uncertainty associated with trading with countries where different legislations are in place (see Lederman et al., 2006).

[4] Leonidou (1995) reviews 35 empirical studies on the impact of alternative trade barriers in either developed countries (United States and European countries) or newly industrialized Asian countries and concludes that availability of limited information to locate and analyze foreign markets appears as the most inhibiting barrier.

[5] Search is more difficult when economic opportunities and potential trading partners are geographically dispersed, while evaluation is more important when the cost of reversing allocative actions or their effects is high (see Rangan and Lawrence, 1999).

[6] Firms may learn about export opportunities from other firms through employee circulation, customs documents, customer lists, and other referrals (see Rauch, 1996). Evidence on spillovers has been presented in several papers, e.g., Aitken et al. (1997) and Greenaway et al. (2004). Thus, Aitken et al. (1997) and Greenaway et al. (2004) report significant spillovers from multinational enterprises (MNEs) to domestic firms in Mexico and the United Kingdom, respectively. More precisely, MNE activity is positively related to export propensity of local firms.

[7] In Hausman and Rodrik's (2003) model, investment in developing new export activities is too low ex-ante and entry is too high ex-post.

[8] As mentioned above, trade promotion actions may also affect the exporter status (permanent versus sporadic) (see Álvarez, 2004).

[9] Unfortunately, we do not have the required data to examine selection of firms into export markets and how assistance by PROCHILE shapes this selection process (e.g. sales for both exporters and non-exporters and a list of non-exporting firms assisted by PROCHILE).

Moreover, differentiated goods are heterogeneous both in terms of their characteristics and their quality. This interferes with the signaling function of prices, thus making it difficult to trade these goods in organized exchanges. In short, information problems faced when trading differentiated products are expectedly more severe than those arising when trading more homogeneous goods (see Rauch, 1999). Hence, export promotion assistance may potentially have different effects on export performance depending on the degree of differentiation of the products that the firms export. More specifically, trade promotion actions can be anticipated to have a stronger impact on the extensive margin of firms exporting differentiated goods, i.e., on the introduction of additional differentiated products and/or the incorporation of more countries to the set of destinations these products are exported to (see Volpe Martincus and Carballo, 2008b).

Furthermore, a firm based in a developing country must undergo product and marketing upgrades to succeed in exporting to developed countries. Properly shaping the marketing strategy is an information-intensive activity. For instance, firms need to learn and understand the preferences of foreign consumers, the nature of competition in foreign markets, the structure of distribution networks, and the requirements, incentives and constraints of distributors. These activities are intrinsically more difficult when exporting to more sophisticated markets (see Artopoulos et al., 2007). Thus, heterogeneous effects of export promotion might then also occur across destination countries with different levels of development.

In addition, the relative importance of export impediments such as those associated with identifying who to establish initial contact with, the marketing costs implied by doing business overseas, establishing the initial dialogue with prospective customers or business partners, and building relationships, are likely to vary with the firms' exporting experience. Thus, exploiting a survey of 460 British firms, Kneller and Pisu (2007) show that the frequency of firms indicating the aforementioned barriers as difficulties to exporting declines with the experience of firms in export markets, as measured by the number of years they have been active in these markets. This suggests that there is a process whereby firms learn how to deal with export barriers through direct experience in international markets.[10] Similarly, it has been shown that smaller firms face greater limitations than larger firms in trading across borders (see, e.g., Roberts and Tybout, 1997; Bernard and Jensen, 1999, 2004; Wagner, 2001, 2007; and Álvarez, 2004). These differences across firm-sizes may be related to heterogeneity in access to information (e.g., through market studies), but also in the ability to cope with the sunk cost of entry such as those originated in setting up an export department or redesigning products for foreign customers.[11] The effects of export promotion programs can be consistently expected to also change with size categories and stages of the firms' internalization process. In this paper, we precisely aim at providing insights on whether trade promotion activities have differential effects over size and the extent of involvement in foreign trade, as proxied by firms´ total exports.

Assessing the effectiveness of export promotion programs implies evaluating the effects of a large scale public policy. In order to identify such effects one needs to determine first how exports would have been in the absence of this support, which is essentially a counterfactual analysis. Constructing a valid control group to get a proper counterfactual may turn out to be a challenging task. The most obvious candidates are those firms that have not been served by the agencies. However, firms receiving assistance can hardly be considered random draws, i.e., there may be non-random differences between assisted and non-assisted firms that may lead to potentially different export outcomes. As we will see below, failure to account for these differences would clearly produce a selection bias in estimated impacts. In particular, if assisted firms are systematically better than non-assisted firms along specific dimensions which are not properly controlled for in the analysis, the estimates would overstate the causal effect of export promotion assistance. In our empirical analysis we will account for observable differences using rich information on firm characteristics to reweight the unconditional differences between export outcomes. Nevertheless, we should notice that upward biases are a potential risk inherent to these kinds of evaluation approaches, which unfortunately cannot be fully ruled out (see, e.g., Arnold and Javorcik, 2005; Girma and Görg, 2007; and Görg et al., 2008).

In general, most evaluation exercises take the main assumptions of the Roy (1951)–Rubin (1974) model as granted.[12] Specifically, cross- and general equilibrium effects are ignored. However, these assumptions are likely to be violated in many contexts. This might happen, for instance, when estimating the effects of foreign acquisitions on wages (see Girma and Görg, 2007). Evaluation of export promotion policies is of course not an exception (see, e.g., Volpe Martincus and Carballo, 2008a). As we have referred to above, there may be information externalities associated with exporting activities. In fact, Álvarez et al. (2007) report evidence in favor of the existence of such spillovers in the case of Chile. They find that the probability of firms to introduce given products to new countries or different products to the same countries increases with the number of firms exporting those products and to those destinations, respectively. If these spillovers would be associated with participation in specific export promotion actions, then the outcome differences between assisted and non-assisted firms corrected by observable heterogeneity across these groups would underestimate the true impact of these actions (see, e.g., Heckman et al., 1999; Miguel and Kremer, 2004; Ravallion, 2008). In particular, under perfect dissemination of information across firms, this impact would not be statistically different from zero and could accordingly not be identified. Further, differences in estimated effects over the quantiles of the distribution of the relevant export outcomes being considered might be the result of differential extents of spillovers across firm categories defined by these quantiles. Thus, it could be argued that, if a positive significant effect was encountered only for smaller firms, this might be due to smaller spillovers benefiting these firms. Note, however, that this is less likely to be an issue in our case because, as explained below, we work with first-differences of the export outcomes and there is *a priori* no reason why spillovers should vary systematically with these variables' growth rates. In order to informally confirm these priors we have estimated both OLS and fixed effect regressions of our main outcome variable (i.e., firms' total exports) on binary variables for each decile (but one) and these variables interacted with the indicators capturing spillovers proposed by Álvarez et al. (2007), namely, the (lagged) average number of firms exporting the same products and the (lagged) average number of firms exporting to the same countries, on one hand; and the (lagged) average number of firms selling the same

[10] The nature of the information barriers also changes with this experience. Before the firms start exporting information needs usually relate to the identification of foreign market opportunities (see Wiedershaeim-Paul et al., 1978). During the initial export stages, firms have limited knowledge regarding international business and overseas market characteristics and accordingly require general and experiential information to ameliorate the high uncertainty they are confronted with (see Seringhaus, 1987). After gaining experience abroad and gathering objective and specific information on foreign markets, the level of uncertainty associated with operating abroad diminishes and firms can progress to more advanced stages of exporting, thus developing more sophisticated information needs (see Welch and Luostarinen, 1988).

[11] Other factors that may also play a role are, e.g., differences in access to management capability and financial resources in capital markets.

[12] For instance, the definition of potential outcomes implicitly relies on the assumption of no interference between different units (see Cox, 1958) or stable-unit-treatment-value assumption (see Rubin, 1980). More precisely, potential outcomes of each firm are not affected by the allocation of other firms to programs (see Frölich, 2004).

goods to the same markets, on the other hand.[13] We find that spillover do not seem to have systematic patterns across quantiles.[14] In sum, even though spillovers are not likely to significantly affect our cross-quantile inferences, we should keep in mind that our procedure resembles the standard approaches used in the evaluation literature as it does not completely eliminate the overall risk of potential underestimation of the causal effects.

3. Empirical methodology

The effects of export promotion programs may vary over the distribution of export performance indicators. Furthermore, policy-makers are in general likely to not be neutral to these distributional impacts. Hence, it is extremely important both from economic policy and analytical points of view to learn about these impacts. Assessing whether specific group of firms benefit more than others from these public programs requires going beyond the estimation of average effects.

One way to characterize the heterogeneous impacts of a policy intervention on different parts of the relevant outcome distribution in a setting like ours, with binary treatment and scalar outcomes, consists of computing *quantile treatment effects on the treated*.[15] This is precisely the approach we use in this paper. In particular, we primarily apply the method proposed by Firpo (2007a) to obtain efficient semiparametric estimations of these effects. This method has two steps. First, the probability of program participation or *propensity score* is estimated nonparametrically. Second, estimators are calculated as the adjusted difference between two quantiles, which can be expressed as solutions to minimization problems where the minimands are sums of check functions.

Formally, let D_i be an indicator codifying information on treatment by PROCHILE.[16] Specifically, D_i takes the value 1 if firm i has been assisted by the agency and 0 otherwise. Further, let X_i be a vector of covariates corresponding to observable firm characteristics. Let Y_{ikc} be (the natural logarithm of) firm i's exports of product k to country c, and Y_i accordingly be firm i's total exports. The presentation hereafter focuses on firms' total exports, but *mutatis mutandis* also applies to measures of export performance along the extensive margin (number of countries the firms export to and number of products exported) and the intensive margin (average exports per country, average exports per product, and average exports per country and product).

Each firm either participates or not in trade promotion programs. Hence, while ex-ante each of the potential levels of exports is latent and could be observed if the firm participated or not in these programs, ex-post, only exports corresponding to participation or non-participation are observed. Hence, for each firm, a realization from only one element of $\{Y(0), Y(1)\}$ is observable. The remaining outcome is counterfactual and unobservable by definition (see Lechner, 2002).

The difference between potential exports $Y_i(1)$ and potential exports $Y_i(0)$ is the gain or loss in terms of exports that firm i would experience if it participates in export promotion activities relative to what it would register if it has not participated in these activities, i.e., this difference is the causal effect of assistance by PROCHILE. Since, as mentioned before, it is impossible to observe $Y_i(1)$ and $Y_i(0)$ for the same unit, such an individual treatment effect can never be observed. This is the so-called fundamental problem of causal inference (see Holland, 1986). The statistical solution to this problem consists of using the population of firms to learn about the properties of the potential outcomes. Usually, an average treatment effect is then computed. In this case, we are interested in the distributional impacts of trade promotion, so we estimate *quantile treatment effects*. Further, since we are dealing with programs with voluntary participation, we believe that it is more relevant to determine the effect of these programs on those who participated and accordingly focus on the *quantile treatment effects on the treated*. Formally, these effects are given by:

$$\Delta_{\tau|D=1} = q_{1,\tau|D=1} - q_{0,\tau|D=1} = inf_q\{Pr[Y(1) \le q] \ge \tau\} - inf_q\{Pr[Y(0) \le q] \ge \tau\} \quad (1)$$

where $\tau \in (0,1)$; and *inf* denotes inverse function.

In general, treatment effects cannot be directly identified from the data. Concretely, estimating these effects by the difference between exports of assisted firms and those of non-assisted firms would lead to biased estimates. This bias can be decomposed into three components: differences in the range of values of the relevant observable characteristics of the groups being compared, differences in the distribution of these values over the common range, and differences in outcomes that persist after controlling for observable factors (see Heckman et al., 1998).

Identifying assumptions are therefore required to estimate the counterfactual, in this case, the exports of assisted firms if they had not been assisted at different quantiles, and thus to compute the treatment effects. The method proposed by Firpo (2007a) relies on two assumptions: the conditional independence assumption and the common support condition.[17] The former states that program participation and program outcomes are independent, conditional on a set of observable attributes. The rationale is that firms which are very similar in terms of the characteristics determining selection into program and potential outcomes should have similar exports when participating, so that the differences in exports between participating and non-participating firms could be used as an estimate of the treatment effect if enough pairs of similar firms exist (see Rubin, 1974; Frölich, 2004). The common support condition requires that $\forall\, x \in \chi$ both treatment assignment levels have a positive probability of occurrence (see Firpo, 2007a). In other words, all participating firms have a counterpart in the group of non-participating firms and all firms are a possible program participant (see Blundell and Costa Dias, 2002).

Under the assumptions presented above, Firpo (2007a) demonstrates that a consistent estimator of the quantile treatment effect on the treated can be obtained as the difference between the solutions of two minimizations of sums of weighted check functions:[18]

$$\hat{\Delta}_{\tau|D=1} = \hat{q}_{1,\tau|D=1} - \hat{q}_{0,\tau|D=1} = argmin_q \sum_{i=1}^{N} \hat{\varpi}_{1,i|D=1}\rho_\tau(Y_i - q) - argmin_q \sum_{i=1}^{N} \hat{\varpi}_{0,i|D=1}\rho_\tau(Y_i - q) \quad (2)$$

[13] Álvarez et al. (2007) assess whether spillovers play a role in the introduction of new products to new destination countries as captured by a binary variable that takes the value of one if this introduction takes place and zero otherwise. Thus, they perform their analysis at the firm-product-country level. Their spillover indicators are accordingly product-, country-, and product-country-specific. Since we work at the firm-level, we take averages over these dimensions for each firm.

[14] If anything, these spillover effects seem to be larger for the first decil, which is precisely, as we will see in Section 5, the decil where the strongest impacts of export promotion are found. These results are not reported, but are available from the authors upon request.

[15] See, e.g., Abadie et al. (2002); Chernozhukov and Hansen (2005). Athey and Imbens (2006); Firpo (2007a,b), and Frölich and Melly (2008).

[16] We will use assistance, support, treatment, and participation interchangeably throughout the paper.

[17] The conditional independence assumption (see Lechner, 1999) is also known as selection on observables (see Barnow et al., 1981; Heckman and Robb, 1985) and ignorable treatment assignment (see Rosenbaum and Rubin, 1983).

[18] More precisely, Firpo (2007a,b) shows that this estimator is consistent, asymptotically normal, and semiparametric efficient. Further, this estimator does not require computing the conditional quantiles to calculate the marginal quantiles for the treated and control outcomes.

Table 1

Aggregate export and treatment indicators								
Year	Total exports	Number of countries	Number of products	Number of exporting firms	Number of exporters assisted by PROCHILE	From which (%):		
						Micro	PyMEX	Medium large	Large
2002	17,100	159	3,749	6,042	321	1.3	64.8	7.8	26.2
2003	19,710	163	3,853	6,357	940	1.9	64.0	9.3	24.8
2004	30,410	171	3,852	6,563	1,821	2.7	61.8	9.8	25.7
2005	37,990	167	3,901	6,781	1,841	3.6	60.7	8.6	27.1
2006	54,990	166	3,840	6,879	1,796	2.8	64.0	8.8	24.4

Source: Authors' elaboration on data provided by PROCHILE.
Total exports are expressed in millions of US dollars.

where the check function $\rho_\tau(.)$ evaluated at the real number of a is $\rho_\tau(a)=a(\tau-1\{a\leq 0\})$ (see Koenker and Bassett, 1978) and the $\hat{\varpi}$ s are the individual weights given by:[19]

$$\hat{\varpi}_{1,i|D=1} = D_i \Big/ \sum_{i=1}^{N} D_i \tag{3}$$

$$\hat{\varpi}_{0,i|D=1} = \left[\hat{p}(X_i)\,/\,(1-\hat{p}(X_i))\right]\left[(1-D_i)\Big/\sum_{i=1}^{N} D_i\right]$$

Koenker and Bassett (1978) show that sample quantiles can be found by minimizing a simple sum of check functions. In this case, we minimize instead a weighted sum of check functions, where the weights are introduced to correct for differences in the distribution of observable characteristics between the treated and control groups thus allowing strictly comparing similar firms. These individual weights are calculated from the participation probability conditional on these attributes or *propensity score*.[20] This score is estimated in a first step using the estimation strategy proposed by Hirano et al. (2003). Specifically, a logistic power series approximation, i.e., a series of functions of the covariates is used to approximate the log-odds ratio of the propensity score. The log-odds ratio of $p(x)$ is equal to $log(p(x)/(1-p(x))$. These functions are chosen to be polynomials of x and the coefficients that correspond to those functions are estimated by the pseudo-maximum likelihood method.[21]

While this procedure eliminates the first two sources of the bias referred to above, namely, the bias due to differences in the support of the covariates in the treated and comparison groups and the bias due to differences between these groups in the distribution of the covariates over the common support, it assumes away the third potential source of bias, namely, selection into assistance on unobservables (see, e.g., Heckman et al., 1998; Sianesi, 2004). In general, there may be several characteristics that are not observed by the econometrician and, as a consequence, systematic differences between assisted and non-assisted firms may persist after conditioning on observables. Assuming that selection on unobservables is zero can therefore be very restrictive. However, selection on an unobservable determinant can be allowed for as long as we assume that this determinant lies on a separable individual specific component of the error term (see Blundell and Costa Dias, 2002). This is precisely what we do in this paper. More precisely, we use as outcome variable the first (logarithmic) difference of exports. In this case, identification is based on the assumption that the change in time-varying unobserved effects does not affect selection into programs and exports (see Heckman et al., 1997; and Blundell and Costa Dias, 2002).[22]

We should then mention herein that if unobserved time-variant firm-specific factors (e.g., developing an effective innovative marketing strategy) leading to improved export performance are more likely to be present among firms participating in export promotion activities organized by PROCHILE, our procedure might overstate their true causal effects on export outcomes. Even though, unfortunately, we cannot completely exclude this possibility, we are confident that, given the selection process into trade support (see Section 5), our data do not leave much room for time-varying unobservables that may be correlated with both this selection and export performance. Similarly, as discussed in Section 2, first-differentiation helps alleviate concerns of cross-quantiles biases due to potential systematic information spillovers patterns over export size categories, but, unfortunately again, it does not necessarily fully preclude the overall risk of underestimation.

We should also notice that first-differentiation allows relaxing selection on observables but it comes at a cost. Specifically, our procedure yields estimates of the impact of trade promotion actions across quantiles of the distribution of the growth rates of exports. Hence, it creates a gap between these estimated impacts and those in terms of export levels because quantiles of the first-differences do not correspond to quantiles of the levels. In other words, our estimates cannot be interpreted directly as effects of these actions across quantiles of the distribution of export levels. In order to gain insights thereon, we compare the distribution of (lagged) export levels corresponding to firms in quantiles of the distribution of first-differentiated exports registering assistance effects of different magnitude.

The significance of these treatment effects will be assessed on the basis of analytical standard errors, as computed using the expression provided in Firpo (2007a). According to Firpo's Monte Carlo study, these analytical standard errors are close to those bootstrapped based on 1000 replications for all sample sizes and quantiles.

4. Data and descriptive statistics

In our empirical analysis we use two main databases. The first database has annual firm-level export data in U.S. dollars disaggregated by product (at the 8-digit HS level) and destination country over the 2002–2006 period. The sum of the firms' exports almost adds up to the total merchandise exports as reported by the Central Bank of Chile, with the annual difference never exceeding 4%. Hence, our data cover virtually the whole population of exporters. Along with these data, there is a binary variable identifying which firms have been assisted by PROCHILE in each year.[23] Second, we have annual data on total sales for all these exporting companies, in particular, available information allows us to distinguish among four size categories in terms of sales: micro firms (0 to 60,000 U.S. dollars); PyMEX (60,001 to 7,500,000 U.S. dollars); medium large firms (7,500,001 to 12,500,000 U.S. dollars); and large firms (12,500,001 U.S. dollars and upwards).[24] These databases have been kindly provided by PROCHILE.

[19] In a simple regression model, $Y=X'\beta+\varepsilon$, the parameters vector β is usually estimated through a quadratic loss function $r(u)=u^2$, i.e., estimation is performed by minimizing $\sum_i r(Y_i-X_i'\beta)=\sum_i(Y_i-X_i'\beta)^2$ over β (see Yu et al., 2003). The "check function" is the loss function in the quantile regression function.

[20] Rubin (1977) and Rosenbaum and Rubin (1983) have shown that instead of conditioning on the attributes, it is possible to condition on the propensity score. This allows considerably reducing the dimension of the estimation. Thus, when applying matching, each assisted firm is paired with the more similar non-assisted firms on the basis of their propensity scores. The impact of export promotion activities could be then estimated by comparing the exports of matched firms.

[21] See Firpo (2007a, 2007b) for additional details.

[22] As mentioned before, this is the standard identification assumption several recent empirical trade papers using matching difference-in-differences rely upon (see, e.g., Arnold and Javorcik, 2005; Girma and Görg, 2007; and Görg et al., 2008).

[23] PROCHILE introduced Customer Relationship Management in 2002. Recall that the number of assisted firms only considers exporting firms.

[24] This is the classification used by PROCHILE.

Table 2

Distribution of export indicators and total sales									
Export indicators and total sales\deciles	10	20	30	40	50	60	70	80	90
Number of firms	3,262	3,262	3,262	3,262	3,263	3,262	3,262	3,262	3,262
Total exports	2135	5235	11,669	23,422	50,160	113,202	258,307	694,767	2,601,423
Number of countries	1	1	1	1	1	2	3	4	8
Number of products	1	1	1	1	2	3	4	6	11
Average exports per country and product	1015	2111	3885	6815	11,860	20,304	36,392	70,832	184,000
Average exports per country	1280	2922	5676	10,935	20,529	41,080	88,160	219,866	707,095
Average exports per product	2000	4470	9028	16,598	29,860	54,127	103,333	210,000	555,009
Total sales	1	2	2	2	2	2	2	3	4

Source: Authors' elaboration on data provided by PROCHILE.
Total Sales: 1–4 correspond to the four segments identified: 1. 0–60,000 dollars; 2. 60,001–7,500,000 dollars; 3. 7,500,001–12,500,000 dollars; 4. 12,500,001 dollars upwards.

Table 1 presents basic aggregate export and treatment indicators. Chilean exports have grown 221.6% between 2002 and 2006. A large fraction of this aggregate export growth is due to significant expansions along the intensive margin, i.e., larger average exports per country and larger average exports per product. The total number of destination countries and the total number of products have increased only slightly over these years (4.4% and 2.4%, respectively), while the number of firms selling their products abroad has risen moderately, almost 14% from 2002 to 2006. The fraction of these firms that have received assistance from PROCHILE has substantially augmented, from 5.0% to almost 30.0% over the sample period. Noteworthy, PyMEXs represent the largest category in the group of firms supported by this agency. Specifically, the share accounted for by these firms has ranged between 60.7% and 64.8% over the sample period.

Table 2 describes the distribution of each export outcome variable as well as that of total sales in terms of own deciles over our sample period. The median Chilean exporter (fifth decile) is a PyMEX selling two products abroad, to just one country, for approximately US 50,000 dollars. Sales abroad by this exporter have increased 31.5% from 2002 to 2006. The first four deciles exhibit the same diversification patterns both in terms of countries and products, i.e., firms therein export only one good and to only one country. However, total exports register a tenfold increase from the first to the fourth decile. Average exports behave accordingly similarly. In other words, in this part of the distribution export expansion primarily takes place along the intensive margin. In the ninth decile total sales are larger than U.S. 12.5 million dollars and total exports exceed 2.5 millions U.S. dollars, while the corresponding numbers of destination countries and products are eight and eleven, respectively. Notice that the ratio of the ninth decile to the first decile of total exports is 1218.5. This ratio has moved from 1110.4 up to 1266.5 between 2002 and 2006, which suggests that the degree of inequality in the distribution of external sales over exporters has risen in recent years.[25]

Fig. 1 provides a detailed visual representation of the distribution of firms' exports for the final sample year, 2006. Consistently with data reported in Table 2, the left panel of Fig. 1 clearly shows that most Chilean firms export just a few products to a few countries. More specifically, in 2006 around 50.0% of the firms exported to just one country, regardless the number of products. This proportion is significantly higher than that reported for French manufacturing firms, 34.5%–42.6% (see Eaton et al., 2004; and Mayer and Ottaviano, 2007), and that informed for Irish firms, 34.0% (see Lawless, 2007), but smaller than those of the United States and Peru, which approximately amount to 60.0% (see Bernard et al., 2005; and Volpe Martincus and Carballo, 2008a). Further, in Chile, eight exporters trade with more than 50 countries, i.e., 0.1% of the total number of exporters. In Peru, firms with such a geographically diversified export pattern are three, accounting for 0.05% of the exporting companies (see Volpe Martincus and Carballo, 2008a). Furthermore, 43.7% of the firms exported just one product to one country, 66.7% just less than 5 products to less than 5 countries, and 83.0% less than 10 products to less than 10 markets. Notice that the main diagonal of Fig. 1 is almost empty, meaning that there are many firms that export relatively few products to many countries, some firms that export many products to relatively few countries, but only few firms that simultaneously export many products to many countries.

The right panel of Fig. 1 reveals that overall exports are largely accounted for by firms whose exports are relatively concentrated in a few products. Firms that export less than 10 products jointly account for 43.7% of the total exports in 2006, whereas those exporting less than 25 products explain together almost 95.0% of this aggregate. In particular, exporters who sell just one product to one country represent 0.6% of total exports, whereas firms exporting up to 10 products to up to 10 countries explained 11.2% of this total. If we consider the number of destination countries pooling across the number of products traded, we observe that the share of total exports from firms that export to just one country is 1.6% of total exports, while that from firms who sell to less than 10 markets is 14.5%. These shares are significantly smaller than those of Peru in 2005, 4.8% and 38.9%, respectively (see Volpe Martincus and Carballo, 2008a). On the other hand, the share corresponding to firms that export just one product to one or several countries is 4.8%.

Do export promotion activities affect these export performance patterns across firms?[26] In the next section we formally estimate the effect of assistance on assisted firms over different parts of the distribution of all export outcome variables.

5. Econometric results

In this section we report, first, average treatment effects and then quantile treatment effects as obtained using the empirical approach explained in Section 3. As stated therein, this semiparametric method

[25] Similarly, the ratio of the ninth decil to the first decil of the number of destination countries has increased from 7 to 9 over this period.

[26] A naïve approach to answer this question would be to compare, say, firms' total exports of assisted firms with those of the non-assisted firms. This can be done by contrasting kernel density estimates of the distribution of total exports for both treated and non-treated companies. In our case, the density of the former firms is clearly to the right to that corresponding to the latter firms, which indicates that supported companies export more than the non-supported ones. As discussed above, this comparison may yield a poor measure of the impact of the aforementioned activities because the so-computed impact might stem from systematic differences between firms belonging to treatment and non-treatment groups. One way to address this issue consists of adjusting for these differences, i.e., estimating total exports for firms in the latter group if they had similar characteristics to those in the former group and then compare both distributions. We have estimated this counterfactual distribution using the semiparametric procedure proposed by Di Nardo et al. (1996) and considering the variables included in the specification of the propensity score defined below (see Section 5). Even after this adjustment, the conditional density of total exports of supported firms is still to the right. Further, according to the Kolmogorov–Smirnov test, the difference between these distributions is statistically significant. Hence, assisted firms seem to perform better in terms of exports than non-assisted ones, even after controlling for observable differences. These figures as well as the corresponding tests are available from the authors upon request.

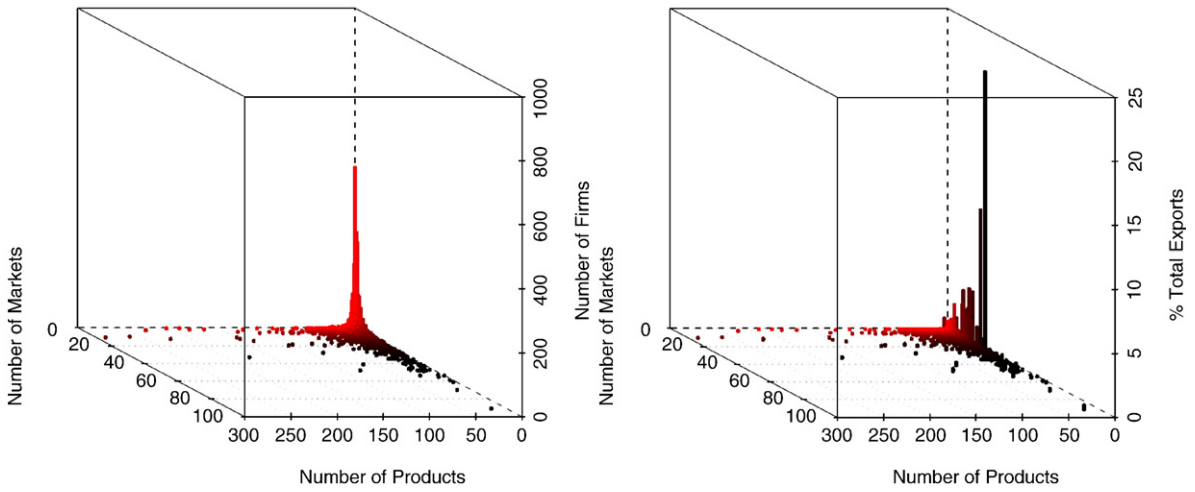

Fig. 1. Distribution of firms across product-market export patterns (left) and distribution of export shares across firms with different product-market export patterns (right), 2006. Source: Authors' elaboration on data provided by PROCHILE.

consists of two steps. In the first stage, the propensity scores are estimated. In doing this we approximate their log-odds ratio by a polynomial. The order of this polynomial is determined by the leave-one-out cross-validation method based on Hall (1987), in which the optimal number of terms minimizes a Kullback–Leibler distance. The order in which terms are added has been defined using a nonparametric extension to the propensity-score model selection described in Rosenbaum and Rubin (1984) and Dehejia and Wahba (1999), which instead prioritizes models that are able to balance each covariate average given propensity-score groups between treated and comparison groups (see Firpo, 2007b).[27]

We thus need to first estimate the probability that firms receive support from PROCHILE. This agency administers several programs (e.g., "PyMEX Exporta", inter-firm coaching, trade missions and trade fairs, etc.). As highlighted above, a core mission of PROCHILE is *to support small and medium-sized firms in their internationalization process.* Hence, in principle, PROCHILE primarily focuses on small and medium-sized companies that export or have export potential. More specifically, the agency's declared main target firms are PyMEX, i.e., firms with total sales between 60,001 and 7,500,000 US dollars and that have registered at least one export activity during the year. Further, the aforementioned values serve as parameters defining eligibility criteria and conditions of assistance for specific programs. Thus, for instance, only firms with total sales below 7,500,000 US dollars are eligible to participate in "PyMEX Exporta", whereas firms with total exports exceeding this amount have access to smaller co-payments from PROCHILE in diverse instruments (see PROCHILE, 2008).

With the exception of (general) export information requests, eligible firms must apply to obtain assistance.[28] Once they apply, their ability to operate in foreign markets ("export potential") is assessed through standardized tests (e.g., "export potential test"), which, in general, ask for information on the firm such as international operations, experience accumulated in external markets, and products offered. Upon approval of these tests firms are admitted to the respective program.

As seen in Section 4, PyMEX (and micro companies) consistently account for the largest share of firms served by PROCHILE. Smaller firms with relatively limited experience in international markets can then be expected to be more likely to be selected for assistance. On the other hand, beyond the agency's primary targets, it may be also possible that firms self-select into assistance. More precisely, relatively larger and more experienced firms may be more aware of and use more frequently export promotion services (see, e.g., Reid, 1984; Kedia and Chhokar, 1986; and Ahmed et al., 2002).

In our analysis, we accordingly include measures of size and previous export experience as determinants of the propensity to participate in the activities organized by PROCHILE. In particular, we include (lagged) total sales, (lagged) total exports, the (lagged) number of countries the firms export to, and the (lagged) number of products exported, in the specification of the propensity score (see also Ashenfelter, 1978; Becker and Egger, 2007).[29] In addition, previous use of services provided by PROCHILE may affect current participation. For instance, firms satisfied with these services are more likely to come back to the agency for additional assistance. Accordingly, we also control for previous treatment status by incorporating a binary variable indicating whether the firm received support in the previous period (see Görg et al., 2008). Finally, we also incorporate year fixed effects to account for macroeconomic factors affecting participation rates.

Applying the nonparametric method described above leads to a model for the selection equation consisting of the constant, all linear terms, and the interaction between lagged treatment and lagged total exports.[30] The coefficients and the marginal impacts of these variables on the probability of participating in export promotion activities organized by PROCHILE as obtained from a *logit* estimation indicate that this probability increases with firms´ total exports and the

[27] In particular, starting from a full linear model, terms are included according to their degree, with the lower degree and, among those with the same degree, those involving fewer variables entering first.

[28] Operatively, firms can ask for application forms using PROCHILE's website.

[29] Specifically, one one-year lag binary variable for each but one of the sale segments identified, one-year lag (of the natural logarithm) of total exports, one-year lag (of the natural logarithm) of number of countries the firms export to, and one-year lag (of the natural logarithm) of number of products they export. Using US data, Bernard et al. (2006) find that trading a larger number of products is associated with higher productivity. The same argument would hold for the number of destination countries. A similar pattern seems to prevail in Chile. Thus, Álvarez and López (2005) show that Chilean permanent exporters are more productive than non-, entrant-staying, entrant-exiting, and quitting exporters. Consistently, Álvarez (2007) informs that permanent exporters have higher labor productivity than sporadic ones. Applying these typology to our data, we clearly observe that the former export more products to more countries (a detailed table is available from the authors upon request). Hence, by including those export indicators, we are likely to be also implicitly accounting for productivity differences across (groups of) firms and henceforth at least partially controlling for the possibility that the agency picks "winners".

[30] Model specifications for estimations on alternative samples are indicated below the tables reporting the respective results.

Table 3

Average assistance effects on assisted firms		
Export performance indicator	Semiparametric efficient estimation	Matching difference-in-differences
		Kernel
Total exports	0.068**	0.095***
	(0.030)	(0.033)
Number of countries	0.024**	0.048***
	(0.010)	(0.012)
Number of products	0.004	0.001
	(0.014)	(0.016)
Average exports per country and product	0.039	0.046
	(0.027)	(0.029)
Average exports per country	0.043**	0.047**
	(0.027)	(0.020)
Average exports per product	0.063**	0.095***
	(0.028)	(0.027)

Source: Authors' elaboration on data provided by PROCHILE.
The table reports estimates of average effect of assistance by PROCHILE on assisted firm as obtained using the semiparametric method proposed by Firpo (2007a) (see Section 3) and a conventional matching difference-in-differences procedure based on a kernel estimator. In both cases, we use the propensity score specification resulting from the estimation strategy proposed by Hirano et al. (2003). This consists of a constant, lagged size categories in terms of total sales (three binary variables), lagged (natural logarithm of) total exports, lagged (natural logarithm of) number of products exported, lagged (natural logarithm of) number of countries served, lagged treatment status, the interaction between lagged (natural logarithm of) total exports and lagged treatment status, and year fixed effects. Kernel matching is based on the Epanechnikov kernel with a bandwidth of 0.04. Analytical standard errors reported in parentheses. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

number of countries they export to.[31] On the other hand, smaller firms as measured by their total sales (micro, PyMEX, and medium large) have higher probabilities (than large firms) of being selected for assistance.[32]

Using the propensity scores obtained with this model specification, we then estimate the treatment effects as indicated in Eq. (2). In this regard, we should recall that, since we are estimating the impacts of interest on first differences, we are also controlling for unobserved firm-specific time-invariant variables such as the location of firms and main sector of activity, and, given the relatively short length of our sample period, also, to a large extent, for factors such as managerial attitudes, qualification profile of personnel, and innovation capabilities, which may play a role in determining both service usage and export performance.[33] We believe that we are thereby able to account for the most important factors that jointly explain firms' demand for export promotion programs as well as agency's supply of these programs and therefore assume that they act idiosyncratically given that information.

The first column of Table 3 presents the average assistance effect on assisted firms for our six performance indicators pooling over these years.[34] The estimates suggest that, on average, export promotion activities performed by PROCHILE seem to have significant positive effects on the growth of total exports as well as on that of their extensive margin, especially on the country dimension. However, there is substantial variation across years.[35] In particular, in 2006, the rate of growth of exports was on average 6.8% ($(e^{0.066}-1)x100=6.8$) higher for firms assisted by PROCHILE, while that of the number of countries the firms export to was 3.1% ($(e^{0.031}-1)x100=3.1$). Thus, for instance, the sample average (logarithm) annual growth rate of total exports is 13.33%, so this would imply that assisted firms would have a rate 0.88 percentage points higher than non-assisted firms. PROCHILE's trade promotion actions also seem to have a significant impact on the intensive margin of firms' exports. In particular, these actions seem to stimulate larger exports per country and per product. This might be explained by the fact that the agency can help firms obtain new business contacts in regions other than those they are exporting to in the countries that are already among their destination markets.[36] These results are qualitatively similar to those found in Colombia (see Volpe Martincus and Carballo, 2009).

For the sake of comparison we include in the second column of Table 3 the average treatment effects obtained when applying the conventional matching difference-in-differences estimation procedure outlined in Blundell and Costa Dias (2002). We compute the propensity scores with a logit model with the same specification indicated above and use the kernel estimator to estimate average impacts of assistance on firms' export performance.[37] Estimates of these average impacts are similar to those reported above, thus confirming our findings.[38]

Evidence presented so far focuses on average effects and accordingly does not allow for assessing where in the distribution of the outcome variables support from PROCHILE has the greatest effects. We now turn to examining these distributional impacts.

Table 4 reports estimates of quantile effects of assistance by PROCHILE on assisted firms' export performance for nine percentiles (10th, 20th, up to 90th) pooling over years, whereas Fig. 2 shows the assistance effect over the whole distribution of these outcome variables along with the respective 5% confidence intervals.[39] According to both pooled and year-by-year estimates, this assistance has a significant impact on the lower tail of the distribution in the case of total exports, i.e., first to fourth deciles. Notice that the strongest effect corresponds to the lowest decile and that the estimated effects monotonically decrease from the second to the fourth deciles. Moreover, significant effects are observed in both tails of the distributions (first to third and seventh to ninth deciles) in the distribution of the growth rate of the number of countries. Interestingly, while we do not find a significant average assistance effect on the number of products, we do observe significant positive impacts on specific parts of the relevant distribution. As with the case of the number of countries, these are concentrated in the lower and upper ends of the distribution (second to third and seven to eighth deciles).

Who are the firms in these deciles? What characteristics do these firms share? Answering these questions is extremely important from

[31] A table with these estimation results is available from the authors upon request.
[32] According to the likelihood ratio test, these regressors are jointly significant at the 1% level. The *pseudo*-R^2s for this model is 0.24, which is similar in magnitude to the highest *pseudo*-R^2 observed in dichotomous variable models aiming at explaining participation probabilities in diverse public programs evaluated in recent empirical papers (see, e.g., Sianesi, 2004; and Görg et al., 2008).
[33] Unfortunately, we do not have firm-level data to directly account for these other variables.
[34] Note that, since we are including lagged values of the covariates, estimations are performed on the period 2003–2006.
[35] Figures showing year-by-year estimates for all exercises discussed here are included in an appendix which is available from the authors upon request.
[36] Using the same econometric approach, Volpe Martincus and Carballo (2008a,b) find that export promotion activities have a positive effect on the extensive margin of firms' exports but they do not have any robust impact on the intensive margin in the cases of Peru and Costa Rica, respectively.
[37] We have tested whether the estimated propensity score is able to balance the values of covariates between matched treatment and comparison groups. In particular, we have assessed the matching quality using four alternative tests: the standardized differences test; the *t*-test for equality of means in the matched sample; the test for joint equality of means in the matched sample or Hotelling test; and the *pseudo* R^2 along with likelihood-ratio test testing the null hypothesis of joint insignificance of regressors included in the propensity score specification after matching (see, e.g., Smith and Todd, 2005; Girma and Görg, 2007; and Caliendo and Kopeinig, 2008). The evidence from these tests clearly suggests that our matching procedure has been successful in finding appropriate non-assisted firms to compare with each assisted firm. The results of these tests are not reported here but are available from the authors upon request.
[38] Inference is based on analytical standard errors. Bootstrapped standard errors obtained with 500 replications are similar to the former. These estimates are available from the authors upon request.
[39] This figure has been constructed estimating the quantile effects for each percentile (1st, 2nd, up to 99th).

Table 4

Quantile assistance effect on assisted firms									
Export performance indicator\deciles	10	20	30	40	50	60	70	80	90
Total exports	0.270***	0.146***	0.051***	0.024**	0.016	0.007	0.013	0.021	0.067
	(0.042)	(0.023)	(0.015)	(0.011)	(0.010)	(0.011)	(0.012)	(0.017)	(0.049)
Number of countries	0.087*	0.037***	0.073***	0.000	0.000	0.000	0.049***	0.023*	0.182***
	(0.046)	(0.014)	(0.010)	(0.002)	(0.002)	(0.002)	(0.012)	(0.013)	(0.013)
Number of products	0.000	0.000	0.031*	0.000	0.000	0.000	0.067***	0.118***	0.000
	(0.012)	(0.016)	(0.017)	(0.004)	(0.004)	(0.004)	(0.011)	(0.015)	(0.010)
Average exports per country and product	0.183***	0.115***	0.078***	0.066***	0.008	0.006	0.050***	0.053***	0.026
	(0.031)	(0.022)	(0.017)	(0.016)	(0.015)	(0.015)	(0.017)	(0.020)	(0.031)
Average exports per country	0.176***	0.101***	0.034**	0.011	0.011	0.006	0.028**	0.035**	0.028
	(0.033)	(0.020)	(0.015)	(0.012)	(0.011)	(0.012)	(0.014)	(0.017)	(0.027)
Average exports per product	0.224***	0.140***	0.106***	0.088***	0.061***	0.044***	0.025	0.005	0.014
	(0.033)	(0.021)	(0.017)	(0.014)	(0.013)	(0.014)	(0.016)	(0.019)	(0.028)

Source: Authors' elaboration on data provided by PROCHILE.
The table reports estimates of the effects of assistance by PROCHILE on assisted firms for six export performance indicators over nine percentiles (10th to 90th) of their distributions. These effects have been estimated using the semiparametric method proposed by Firpo (2007a) (see Section 3). The propensity score specification resulting from the estimation strategy proposed by Hirano et al. (2003) consists of a constant, lagged size categories in terms of total sales (three binary variables), lagged (natural logarithm of) total exports, lagged (natural logarithm of) number of products exported, lagged (natural logarithm of) number of countries served, lagged treatment status, an interaction between lagged (natural logarithm of) total exports and lagged treatment status, and year fixed effects. Analytical standard errors reported in parentheses. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

an economic policy perspective because this will shed light on how well targeted export promotion programs are. As mentioned in Section 3, our estimates provide measures of the effects of these programs over the quantiles of the distribution of export growth rates and cannot therefore be directly interpreted as estimates of their impacts over the quantiles of the distribution of export levels. Hence, in order to exactly identify which kinds of firms accrue the positive effects of these programs, we estimate kernel densities of (the natural logarithm of) firms' total exports in the previous year both aggregating over deciles of the distribution of first-differentiated firms' total exports where significant and non-significant effects of trade promotion have been found and for each decile of the distribution of first-differentiated total exports. Notice first that the density of exports for the set of firms with significant impacts is to the left of that for the set of firms with no significant impacts (Fig. 3, left).[40] More interestingly, the density of exports for the (two) group (groups) of firms where the strongest effects have been detected is clearly located to the left of those for the groups of firms where weaker or no significant effects have been registered (Fig. 3, right).[41] Further, these differences are significant from a statistical point of view. Using the procedure proposed by Delgado et al. (2002), we find that the distribution of total exports for firms with non-significant impacts statistically dominate those for firms with significant impacts, in general, and for firms with the strongest impact, in particular.[42] This result holds for both the pooled sample and each sample year.[43] This suggests that trade promotion activities seem to be well targeted according to the agency's declared goals, in the sense that smaller exporters benefit proportionally more than larger exporters.

When considering together both sets of estimation results, i.e., pooled and year-by-year, we can also conclude that the lower end of the distribution of intensive margin indicators (average exports per country, average exports per product, and average exports per country and product) benefit the most of export promotion actions. Henceforth, trade promotion programs appear to foster a more balanced export growth path across firms along this dimension.

As mentioned before, participation may be correlated over time as firms may reuse services perceived as effective in helping them to achieve their goals. To double-check whether this might be affecting our estimates, we confine our attention to the first program participation (see, e.g., Lechner, 2002; and Gerfin and Lechner, 2002). In particular, for each sample year we only consider those firms that were never assisted before, so that once they participated in some activity organized by PROCHILE, they do not enter again neither in the treated nor in the control group.[44] Thus, for 2003 we exclude firms receiving a service in 2002; for 2004 we drop out firms assisted in 2002 or 2003; for 2005, we remove firms participating in 2003 or 2004; and for 2006, we eliminate firms supported in 2002, 2003, 2004 or 2005.[45] Estimation results are reported in Table 5. Overall these results exhibit similar patterns to those of the baselines ones.[46]

We next investigate whether these results also hold when we consider relevant subsamples.[47] Developed countries are more sophisticated markets. Information needs associated with operating

[40] We have performed a similar analysis on the number of destination countries and the number of products exported defining alternatively the deciles in terms of the distributions of their respective growth rates. Conclusions based on this ordering are less clear-cut.

[41] The medians of exports for firms in the former groups are below 54,542 U.S. dollars.

[42] The same is true for firms within the decil where the second strongest impact is observed. The results of all these tests are available from the authors upon request.

[43] Since this testing procedure requires independence of observations and our dataset is a panel of firms so that observations on exports for consecutive years are likely to correspond to the same set of firms and cannot accordingly be considered independent, we have performed the test both for the pooled sample and for each sample year (see Fariñas and Ruano, 2005).

[44] This procedure has been replicated on each subsample we consider (OECD countries and manufacturing and differentiated products). Further, since there might be lagged effects of assistance, in an alternative exercise we have assumed that firms keep being assisted over the remaining sample period once they have been assisted in a particular year. In most cases, results are similar to those reported here. These results are available from the authors upon request.

[45] We have also controlled for PROCHILE's priorities in terms of destinations and products as indicated by the agency itself by adding a binary variable to the propensity score specification that takes the value of one if the firms export a prioritized good to a prioritized country and zero otherwise. Results from this estimation coincide with those presented here. These results are not reported but are available from the authors upon request.

[46] Notice that, even though trade promotion actions seem to have significant positive impacts over a broader range of the distribution in the case of total exports, this impact is virtually monotonically decreasing as one moves upwards in this distribution (see Table 5). Further, according to year-by-year estimates no significant effects are detected above the fifth decile in more recent years. Moreover, a significant positive effect on the growth of the number of products is observed in upper parts of the respective distribution in these years.

[47] Tables and figures presenting the estimation results based on these subsamples are available from the authors upon request.

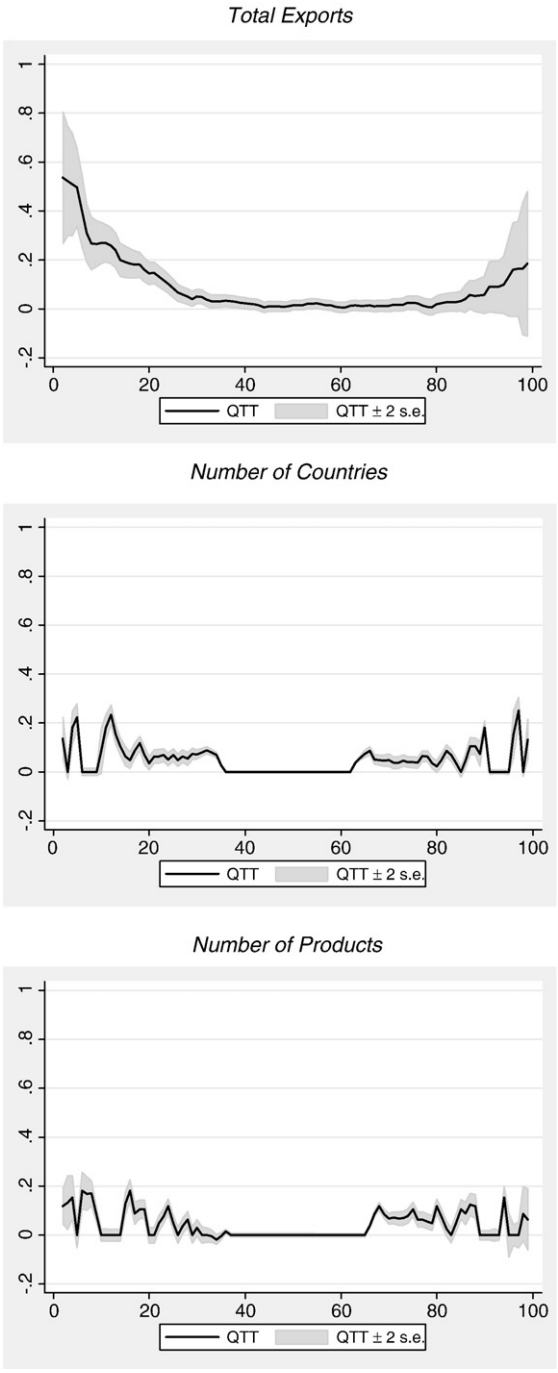

Fig. 2. Quantile assistance effect on assisted firms, 2003–2006.
Source: Authors' elaboration on data provided by PROCHILE. The figures show estimates of the effects of assistance by PROCHILE on assisted firms over the 100 percentiles of the distributions of firms' total exports, number of countries the firms export to, and number of products exported, along with the corresponding two standard errors confidence intervals. These estimates have been obtained using the semiparametric method proposed by Firpo (2007a) (see Section 3).

in these countries are accordingly larger. In particular, acquiring the required information on these markets is likely to be more challenging for smaller and relative inexperienced firms. Hence, export promotion assistance may be particularly effective in ameliorating these information gaps and thereby in promoting exports of this segment of firms to OECD countries. We thus have empirically explored the distributional impacts of trade promotion activities on firms' exports to OECD countries. Pooled as well as year-by-year estimations reveal that, as before, effects on total export growth tend to be stronger in the lower end of the distribution (first to fourth deciles), whereas those on the growth of the number of products and the number of countries are so in the lower and the upper tail of the distributions (second to third and seventh to ninth deciles). We should further notice that the estimated impacts on the lower deciles of total exports are similar in magnitude to that found on our full sample. In general, firms exporting to these countries are larger.[48] Densities of exports for the group of firms where (stronger) significant effects have been found are again located to the left of those corresponding to the group of firms with (weaker) non-significant effects.[49] Hence, conditional on this size difference, smaller exporters also tend to benefit more from trade promotion actions in this case.[50] Finally, no clear patterns can be detected for exports on the intensive margin.

Similarly, as discussed in Section 2, trading differentiated goods is more demanding in terms of information requirements. Smaller and inexperienced exporters are in a particularly less favorable position to meet these requirements. Trade promotion services can be therefore expected to have strong effects on export activities involving differentiated goods for this group of firms.[51] Following Hummels and Klenow (2005), we use two alternative definitions of differentiated products. First, we include only those HS codes that correspond to manufacturing categories, as defined by Standard Industrial Trade Classification (SITC) categories 5 to 8. Second, we consider only those HS codes that correspond to differentiated products according to the four-digit SITC based classification developed by Rauch (1999). In particular, we follow the liberal classification because it is more stringent in typifying goods as differentiated, which we believe is more appropriate for a developing country such as Chile.[52] Results indicate that, in the case of manufacturing, estimated distributional effects on the growth of total exports qualitatively coincide with those reported above. The same holds for the number of products and for the number of countries, in most years. In the case of differentiated goods, the distributional patterns of effects are broadly similar to the baseline ones, especially for total exports and these measures of export extensive margin. Overall, exporters of manufacturing and differentiated products are relatively small.[53] Thus, small firms selling abroad these products also profit from assistance by PROCHILE.[54]

Summing up, keeping in mind the caveats expressed before, the evidence suggests that export promotion activities seems to have been effective in helping Chilean firms improve their export outcomes, primarily those at the lower end of the respective distributions.

6. Concluding remarks

Export promotion programs are common components of most countries' trade policies. These programs have been traditionally

[48] The median exporter to OECD countries exported 76,152 U.S. dollars (for comparison with the overall median exporter see Table 3).
[49] A figure with these densities is available from the authors upon request.
[50] Observed positive significant impacts correspond to groups of firms for which (lagged) median exports does not exceed 100,000 U.S. dollars.
[51] Volpe Martincus and Carballo (2008b) show that export promotion activities by Costa Rica's national agency, PROCOMER, have a positive impact on the country-extensive margin of firms trading differentiated products, i.e., these activities have helped Costa Rican firms expand their exports mainly by reaching new destination countries.
[52] Results based on the conservative classification are similar and are available from the authors upon request.
[53] The median exporter of these goods exported 17,237 U.S. dollars and 19,140 U.S. dollars over the sample period, respectively.
[54] Being most firms relatively small, no clear pattern across deciles of export levels should be expected.

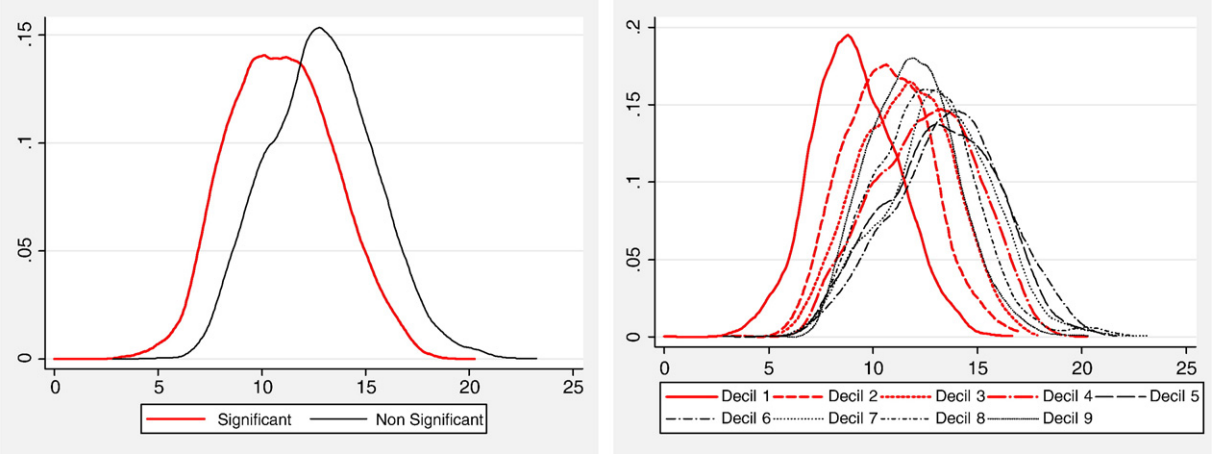

Fig. 3. Distribution of (lagged) exports (in natural logarithm) over the deciles defined in terms of export growth, 2003–2006.
Source: Authors' elaboration on data provided by PROCHILE.

justified as interventions that correct market failures such as information externalities. Recent studies have attempted to evaluate their average effectiveness. Although useful, average estimates are likely to mask important differential impacts. More specifically, firms at different stages of their internationalization process face different barriers in their exporting activities and accordingly have different needs in terms of assistance. It can therefore be expected that given trade promotion programs have heterogeneous effects over the distribution of export outcomes. Learning about these distributional impacts is required to evaluate whether, overall, the program mix is well targeted in the sense that benefits are primarily accruing to the intended beneficiaries and henceforth to guide allocation of scarce resources across alternative programs. This relevant information cannot be obtained from average effects. In this paper we provide, to our knowledge for the first time, insights on how export promotion services affect firms' export performance over its whole distribution.

In doing this, we estimate semiparametrically quantile treatment effects using annual data on assistance by PROCHILE as well as total sales and highly disaggregated export data for the whole population of Chilean exporters over the 2002–2006 period. We find that the impact of trade promotion assistance does indeed vary significantly over the distribution of export outcomes, along both the extensive and intensive margins. In particular, stronger effects are observed on the lower end of the distribution of (growth of) total exports and the lower and upper ends of the distributions of (growth of the) number of countries and number products. Combining these estimation results with data on firms' export antecedents, we observe that smaller and relatively inexperienced firms, as measured by their total exports, benefit most from promotion actions. This coincides with our priors since these firms are more affected by obstacles associated with internationalization. Finally, we should once again stress that caution is required when interpreting these estimates. As discussed above, our semiparametric quantile estimates, similar to those obtained from standard evaluation methods, might either overestimate the true causal effects of export promotion activities due to potentially important unobserved time-varying firm-specific factors positively affecting both selection into these activities and export outcomes, or underestimate them due to information spillovers across firms.

Table 5

First assistance Quantile assistance effect on assisted firms									
Export performance indicator\deciles	10	20	30	40	50	60	70	80	90
Total exports	0.256***	0.202***	0.123***	0.071***	0.063***	0.051***	0.061***	0.046	0.091
	(0.063)	(0.033)	(0.021)	(0.017)	(0.016)	(0.016)	(0.019)	(0.027)	(0.064)
Number of countries	0.000	0.031	0.080***	0.000	0.000	0.000	0.057***	0.069***	0.000
	(0.007)	(0.021)	(0.005)	(0.002)	(0.002)	(0.002)	(0.020)	(0.014)	(0.005)
Number of products	0.000	0.046**	0.015	0.000	0.000	0.000	0.025**	0.000	0.000
	(0.017)	(0.022)	(0.018)	(0.006)	(0.005)	(0.005)	(0.011)	(0.024)	(0.018)
Average exports per country and product	0.199***	0.104***	0.098***	0.051***	0.053***	0.030	0.017	0.025	0.116***
	(0.042)	(0.030)	(0.024)	(0.021)	(0.020)	(0.020)	(0.023)	(0.030)	(0.048)
Average exports per country	0.213***	0.131***	0.074***	0.025	0.027	0.049***	0.037*	0.028	0.079*
	(0.046)	(0.027)	(0.021)	(0.018)	(0.018)	(0.018)	(0.020)	(0.025)	(0.045)
Average exports per product	0.231***	0.184***	0.096***	0.088***	0.087***	0.075***	0.073***	0.074***	0.107***
	(0.050)	(0.028)	(0.023)	(0.020)	(0.019)	(0.019)	(0.022)	(0.026)	(0.045)

Source: Authors' elaboration on data provided by PROCHILE.
The table reports estimates of the effects of assistance by PROCHILE on assisted firms for six export performance indicators over nine percentiles (10th to 90th) of their distributions. These effects have been estimated using the semiparametric method proposed by Firpo (2007a) (see Section 3) for first-time users. The propensity score specification resulting from the estimation strategy proposed by Hirano et al. (2003) consists of a constant, lagged size categories in terms of total sales (three binary variables), lagged (natural logarithm of) total exports, lagged (natural logarithm of) number of products exported, lagged (natural logarithm of) number of countries served, an interaction between lagged (natural logarithm of) total exports and lagged (natural logarithm of) number of countries, an interaction between lagged (natural logarithm of) total exports and lagged (natural logarithm of) number of products, and year fixed effects. Analytical standard errors reported in parentheses. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

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