Cluster Development Policies and Firms' Performance: An Impact Evaluation[1]

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Abstract

Policies to promote the development of clusters are widespread in the world. However, impact evaluations of cluster programs at firm level are extremely scarce in the literature. The available evidence on the effectiveness of such programs based on impact evaluations is mixed. The objective of this paper is to contribute to this body of literature by evaluating the impact of a cluster program in Uruguay on firms' sales and exports. There is very strong evidence that the program had a positive impact on exports and the propensity to export of firms. The evidence of a positive impact on sales is weaker. In addition, we find that the timing is important when assessing the impacts of cluster programs.

Keywords: cluster policy, firms' performance, impact evaluation, firm-level panel data.
JEL Codes: C23, D22, L25, O12, O54.

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1. Introduction

Policies to promote the development of productive clusters are justified in the presence of economies of agglomeration and coordination failures. Agglomeration economies are the result of specific positive externalities of industry and business location (Arrow, 1962; Romer, 1986; Glaeser et al., 1992). In this context, as noted by Rosenstein-Rodan (1943), investment decisions are interrelated, and investment in a company can have a positive effect on the profitability of the investment in another company. This is particularly important when the geographical proximity and complementarities of the sector generate agglomeration economies.

Schmitz (1995) defines the concept of collective efficiency in order to discuss the positive impacts of factors related to the competitiveness of enterprises in industrial concentrations. Collective efficiency is defined as the comparative advantage from external economies and local joint actions. The cluster presents opportunities for significant external economies. Hence the analysis of industrial concentration is focused on the role of vertical and horizontal relationships that generate external economies and joint actions within clusters and that increase performance. Therefore, a significant part of the gain in competitiveness of firms results from interactions between companies and between companies and cluster institutions (Humphrey and Schmitz, 2002).

In the presence of externalities, the market allocates resources sub-optimally and this justifies the presence of cluster development programs (CDPs). These programs aim to promote the benefits of agglomeration economies by creating a set of incentives to mitigate coordination failures that prevent the development of certain industries in certain geographical areas. This implies, among other things, temporarily subsidizing the provision of public goods or goods that are sector specific (club goods).

CDPs generally have as a first step the generation of incentives for the development of strategic plans in order to solve coordination problems and increase competitiveness of the cluster. These plans allow for an improved business environment, organization of the supply of business support and investment in basic infrastructure. In a second step a series of investments are carried out in order to improve the productivity and competitiveness of firms in the cluster. Co-financing of these actions is directly related to the private appropriability of the benefits of such actions or investments.

Therefore, the rationale for public intervention is based on the assumption that coordination failures emerge in the preliminary stages of developing a cluster and that public support is needed to facilitate interaction and coordination between agents. Therefore the public support must be directed to solve the problems of coordination and strengthen networks and governance of the cluster.

Impact evaluations of cluster programs at firm level are scarce in the literature. We are aware of only a few papers. So far, the evidence on the effectiveness of such programs based on impact evaluations is mixed, and it seems that the devil is in the details, i.e. in the definition of the target clusters and the implementation of the program.

Figal-Garone *et al.* (2015) study the impact of a Brazilian CDP on small and medium firms' exports and employment. Using a fixed effect regression model with and without entropy balancing they find evidence of a positive direct effect of the program on employment growth, the value of exports and the likelihood of exporting. They also find different effects in the short and medium and long term.

Martin *et al.* (2011) analyze the impact of a French CDP on firms' employment, exports and total factor productivity. Using a fixed effects regression and difference-in-differences with matching they conclude that the program did not have a robust impact on firms' performance variables. They suggest that the problem was that for political reasons the program directed the funding to sectors-regions which were in decline.

Nishimura and Okamuro (2011) evaluate the impact of an industrial cluster program for small and medium enterprises in Japan that aims at promoting local network for innovation on R&D productivity (i.e. its impacts on patents). Using instrumental variables regressions, they find that the participation in the program alone does not have an effect on R&D productivity. Only firms that participate in the program and collaborate with partners outside the cluster (e.g universities) show higher R&D productivity (in terms of number of patents).

Finally, Falck *et el.* (2010) study the impact of a CDP aimed at increasing innovation and competitiveness in high-tech industries in a region of Germany on R&D spending, patents and innovation. Using a triple difference strategy they find weak (significant at 10%) positive

effects of the program on the propensity to innovate, positive effects on the propensity of patenting and a negative effect on R&D spending.

The objective of this paper is to contribute to this body of literature by evaluating the impact of a CDP in Uruguay on firms' performance, in particular, on sales and exports. The Program for the Competitiveness of Clusters and Production Chains (PACC)[2] was created in 2005 with the aim to contribute to the development and the competitiveness of clusters and supply chains. Since its inception the PACC has worked with 21 clusters. The program is divided into three components: a strategic plan, matching grants for different projects and strengthening of the supporting institutions of the cluster.

In what follows in section 2 we describe the theory of change implicit in the PACC program and the main characteristics of the program. In section 3 we describe the empirical methodology and data. Section 4 analyses the results of the empirical exercises. Finally, section 5 concludes.

2. Theory of Change

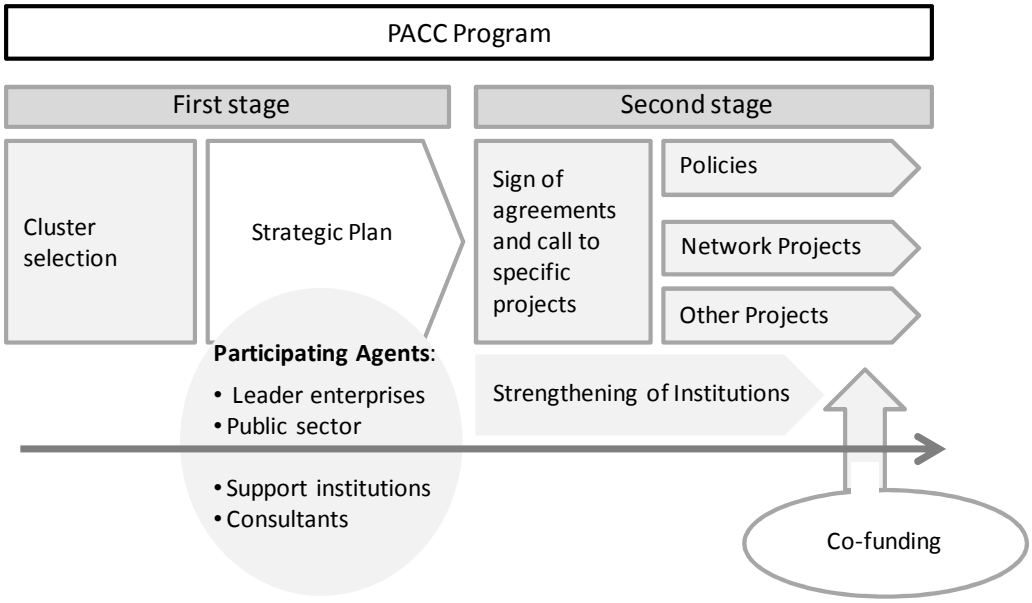
2.1 The intervention

The PACC program had two main stages (see Diagram 1): 1) cluster selection and preparation of competitiveness strengthening plans and, 2) execution of projects and actions to strengthen public and private supporting institutions.

The process starts with a call for clusters spread among interested agents through public agencies. Enterprises gathered around a sectoral chamber or association and together with a government agency (ministry or local government) submit applications. After a cluster is selected, its members should develop a strategic plan. The strategic plan contains the proposal of specific projects that are co-funded by the public sector according to the level of appropiability of the outcomes by individual firms vs. the cluster. Those projects with high appropriability benefits for only a limited number of firms in the cluster receive a lower percentage of public funds in comparison with those that have an impact on the entire cluster. Simultaneously, there are initiatives directed to strengthening public and private supporting institutions.

[2] Programa de Apoyo a la Competitividad de Conglomerados.

Diagram 1. PACC's support model

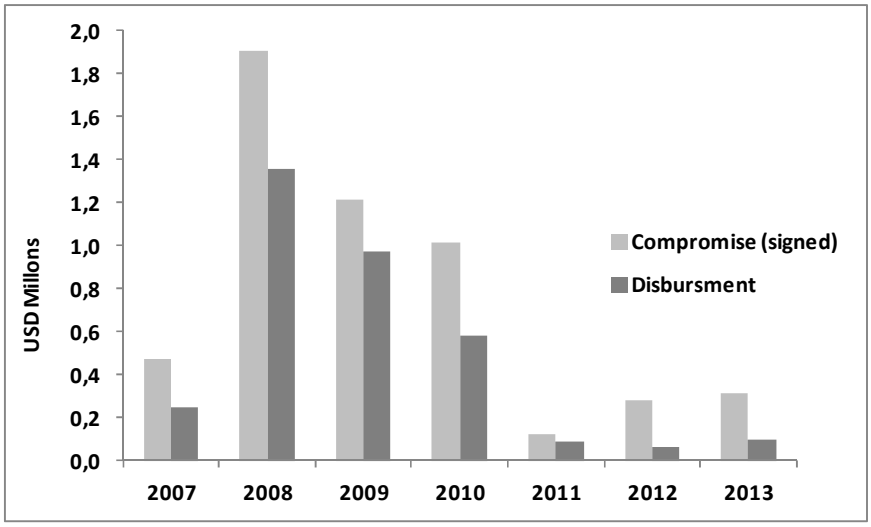


Source: PACC (2009).

The PACC program started in 2005, but the first disbursement for projects was made in the year 2007 and even though the program ended in the year 2014, most of the disbursement was made in the period 2008-2010 as can be seen in Graph 1. These projects had a wide scope: technical assistance, training, procurement of machinery and equipment for collective use, promotion of good manufacturing practices, environmental management, cleaner production, waste management, occupational health, actions directed to attraction of direct investment identified as critical in the strategic plan, development of collective trademarks, reorientation of training supply, facilitation of certification processes, market intelligence and access, development of distribution channels, technical assistance on quality-related topics, etc.

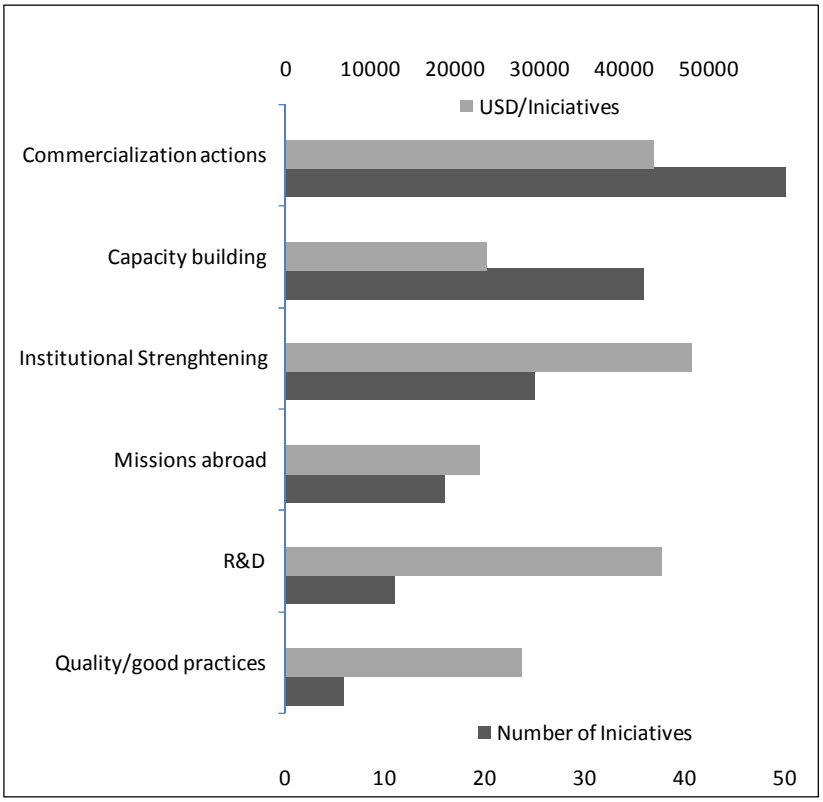
Graph 2 shows that the projects had been grouped under six types of initiatives. As can be seen, commercialization actions were predominant, with almost 60 actions. These kinds of initiatives cost an average of 40 thousand dollars per initiative. Capacity building initiatives were second in terms of frequency, with nearly 40 initiatives up to June 2013. The average cost of each was 20 thousand dollars. Institutional strengthening projects were third in terms of frequency, with more than 20 initiatives, and having been on average the most budget demanding (48 thousand dollars per initiative). Other projects included missions abroad, research and development, and quality enhancement actions.

Graph 1. PACC's co-financing compromises and disbursement



Note: we exclude tourism in Montevideo, tourism in Rocha, woods, automotive, oleaginous, editorial, music (all these cluster were in a very preliminary stage at the end of the program, and most of them had no project executed). Last data available: June 2013.
Source: PACC's administrative records.

Graph 2. Initiatives co-financed by PACC and average cost by type of initiative (in US dollars)



Source: PACC's administrative records.

The program also invested resources on the strengthening of execution capabilities of business support institutions, including supervisory and monitoring actions and coordination workshops in which officials, consultants and businessmen discuss relevant topics related to the program's impacts. Also the program provided financing for training activities, consulting services, and technical assistance for ministries and organizations aiming to improve their capacities to implement the support policies and to coordinate such activities with the PACC, among others.

2.2 Impact mechanisms

As discussed previously, the rationale behind CDP interventions is that firms´ competitiveness depends not only on individual actions, but also on the actions of other agents, and coordination failures among these in a geographical agglomeration or a production chain are limiting factors to achieve competitive states. Cluster development programs attempt to intervene on market failures that limit the individual performance of enterprises, by promoting economies of agglomeration, either based on geographical proximity, vertical specialization in production chains, or horizontal coordination. The externalities that justify this type of programs are mainly due to knowledge or technology spillovers, input/output sharing and labor-market pooling and reduced costs of discovery of new markets.

The causal mechanisms through which the PACC –thought of as a particular cluster development program, differing from other CDPs applied in different contexts or countries– would generate an increase in competitiveness, are explained in Diagram 2. Given the complexity of the program, in the diagram we discriminate the causal effects into four separate mechanisms, although it should be kept in mind that there are feedbacks from one to another.

Before presenting the main mechanism expected to be working in the case of PACC some other issues about the theory of change presented in the diagram need to be briefly discussed. First, we need to explicitly account for contextual events which may affect the observed outcome. For instance, a change in macro or meso level factors -i.e. those that affect all firms or group of firms as changes in norms or international markets- can act as a limiting condition for the achievement of some outcomes, even when the intervention and all mechanisms are working properly.

In addition, other micro aspects linked to firms' characteristics are also relevant for the success of the program (e.g. firms' capabilities, resources, technology and integration to international markets).

According to the type of interventions that the PACC generated, we can distinguish four potential mechanisms through which the interventions affected the ultimate goal of increasing competitiveness.

A first type of intervention of the PACC was directed to increasing coordination among private agents, generating cluster specific institutions. The underlying assumption was the existence of coordination failures along some value chains and in some regional clusters. This is the typical justification for cluster policies. In the presence of agglomeration economies (in regions or value chains) the facilitation of coordination and the spread of information among firms in the cluster should help to internalize the external economies related to knowledge spillovers, labor pooling and other input/output externalities; this in turn should have an impact on the average productivity of firms affected by the intervention and therefore on their "competitiveness" (Marshall, 1920). This is the first mechanism depicted in Diagram 2.

A second type of initiative was directed to coordinate investment in club goods. The second theoretical mechanism in Diagram 2, states that the coordination among all relevant actors in a cluster with specific purposes can lead to investment in strategic assets for the sector. For this causality to have a positive effect in the upcoming stages of this mechanism, the persistent participation of a critical mass of interested agents (enterprises, public institutions, R&D centers) is needed.

PACC supported the actions needed to generate a cluster strategic plan, following an inclusive perspective. The result of this process was a sector validated document containing the strategic lines of actions for the cluster. The consensual definition of strategic lines for the cluster, at least at a theoretic level should help to build consciousness on the benefits of cluster-level investments, even in those cases where the appropriability of the action is very low at the individual level, i.e. it should ease the creation of club goods. Given that the most common club goods generated were directed to the objective of facilitating the access to external markets (e.g. participation in fair trips), we expect this channel to have worked mostly through the impact on easing the access to external markets, and therefore increasing exporting opportunities.

One of PACC objectives was to coordinate the actions of public agencies. According to the program's records, 4% of the financial resources of the program were allocated to upgrade the coordination among public actors and to generate better public policies to promote the development of clusters. If coordination of public institutions is achieved, and this is conducive to better public policies, we expect this to have a positive effect on a cluster's competitiveness. This is the third mechanism in Diagram 2.

Co-financing is the final theoretical mechanism identified in Diagram 2. The biggest share of PACC resources was directed to co-finance the execution of the projects that resulted from the strategic plans (approximately 80% of funds). These funds could be used to purchase machinery and equipment, for the installation of technology centers, capacity building, traveling, or any other type of investment identified as a priority for the cluster. This funding is directed not only to generate club goods but also in some cases private goods. In theory, given that this funding was subsidized by the public sector it should increase the private investment's returns on both private and club goods and also lift some credit restrictions, where both channels lead to increased total investment. This in turn should lead to an increase in productivity and "competitiveness". Given that some of these investments were on club goods it also served as a way of strengthening and increase network links, and this could have an additional impact on the competitiveness of the cluster through the first theoretical mechanism.

Diagram 2. Causal mechanisms of the CDP as applied in Uruguay

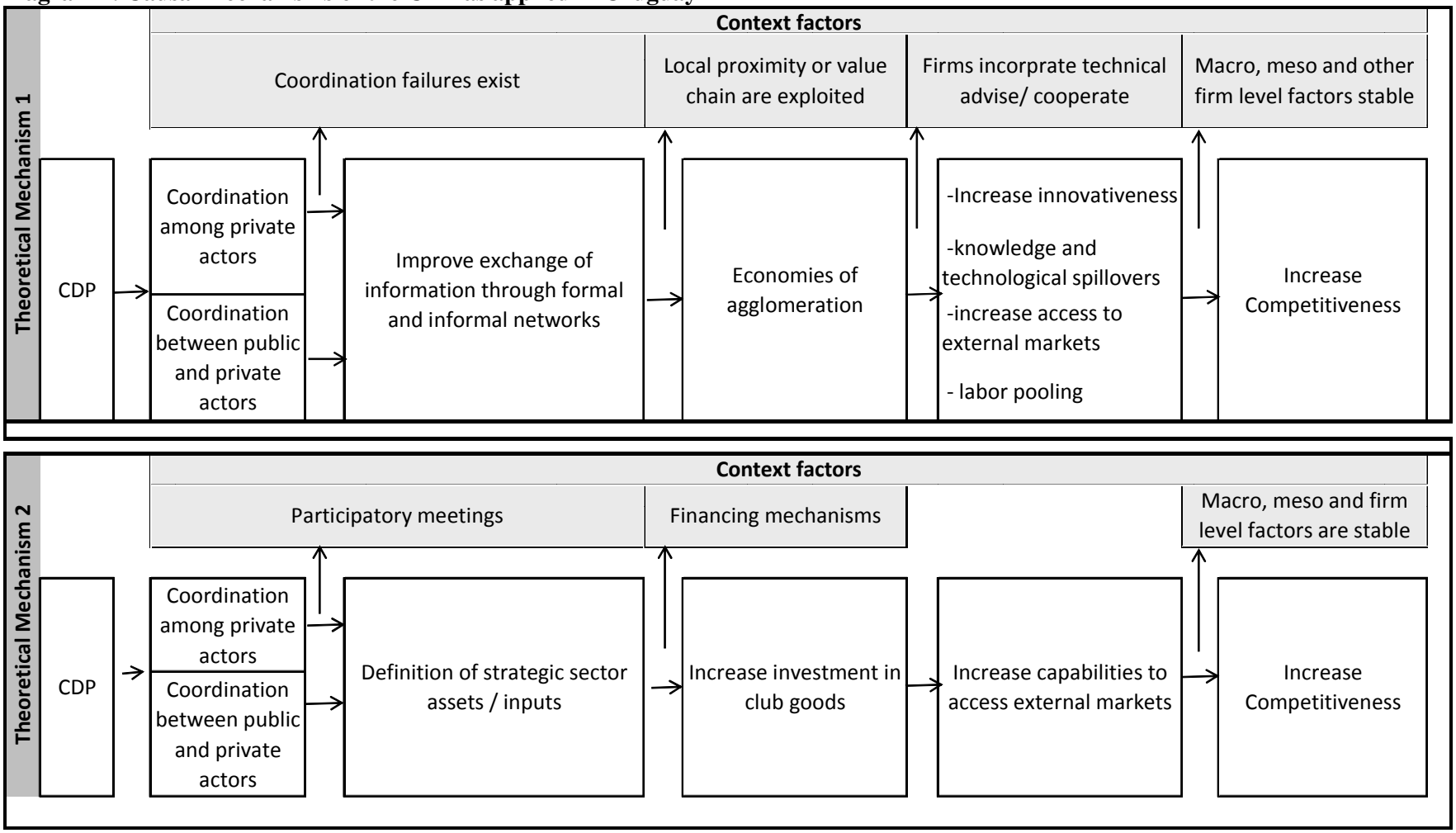
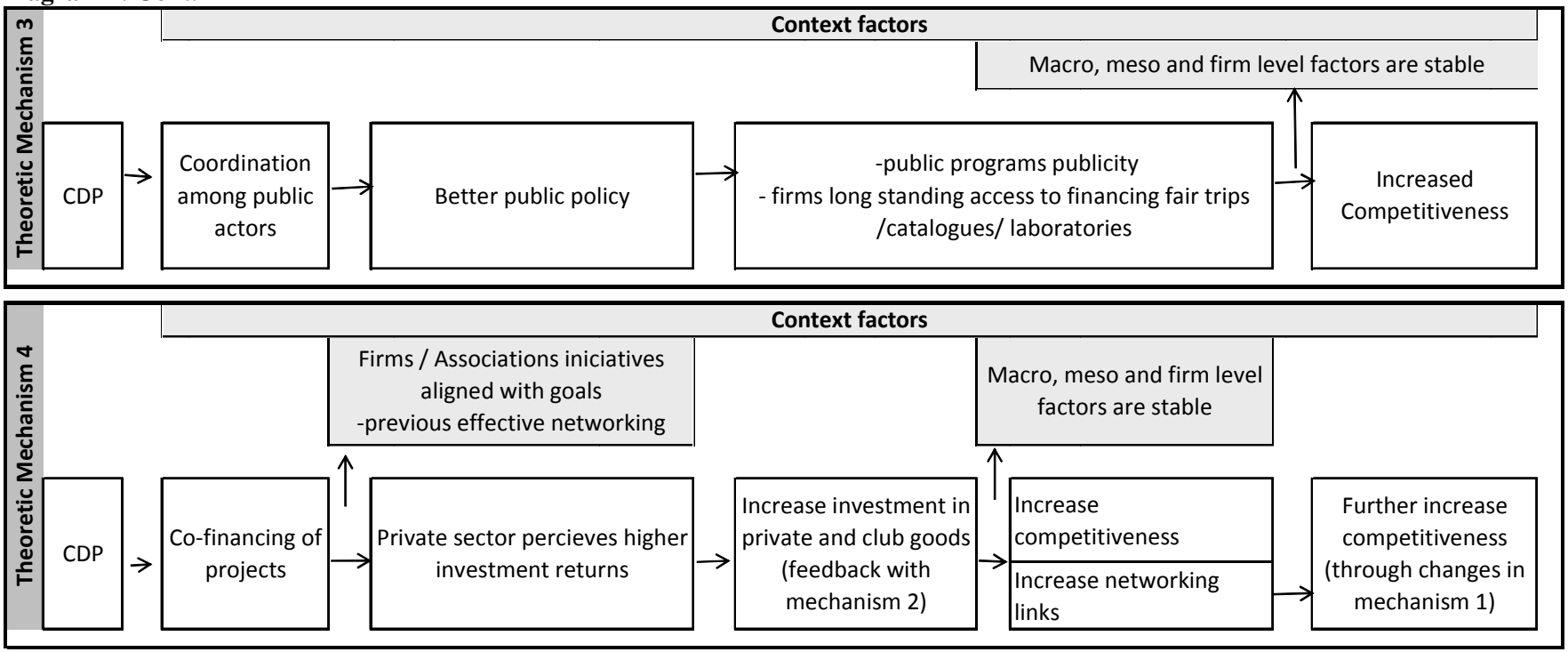


Diagram 2. Cont.



Source: Own elaboration.

3. Data and empirical strategy

3.1 Data

We have the following three sources of information: 1) program information containing a list of participating companies and clusters, the number and the date of the projects in which each company participated; 2) information of annual operating income (sales) for the period 2005-2012from the Internal Revenue Agency of Uruguay (DGI) and 3) information on annual exports of goods for the period 2004-2014 obtained from an exports database made available by Uruguay XXI Institute.

The program information database has been developed for the purpose of evaluating the program, although it was designed ex-post and therefore has some limitations. The list of participants refers to companies that belong to any of the 14 participating clusters that at some point up to 2012 were involved in some program's activities and could be identified from records of such activities.

The main limitation of available information relates to the unidentified participating companies, that is the firms that are not registered in the program database and firms that are registered but without fiscal identifier (RUT number). This primarily affects the representativeness of the treatment group and secondly it can potentially contaminate the control group. Unfortunately the type of bias that this could cause is unknown.

From a total of 725 companies that could be identified as participants in any of the14 clusters it was possible to assign RUT to 43% of them. This problem of information has a differentiated effect on the different clusters. As shown in Table 1, the lack of information is fairly widespread in the two largest clusters (in terms of number of participating firms): Apiculture and Tourism in Colonia. Both clusters were excluded from our sample.

Table 1. Number of firms according to records of the PACC and percentage of RUT numbers identified by cluster

Cluster	Firms identified as participants	Participants with RUT number	Percentage of firms with RUT
Life Sciences	8	8	100
Software	25	25	100
Naval	11	10	91
Clothing	30	27	90
Gemstones	9	8	89
Design	53	45	85
Food	29	24	83
Blueberries	42	26	62
Audiovisual	63	37	59
Footware & Leather goods	57	32	56
Olives	9	5	56
Viticulture	31	12	39
Apiculture	220	48	22
Tourism in Colonia	138	3	2
Total	**725**	**310**	**43**

Source: calculations based on information provided by the PACC.

The DGI database has information on annual sales from 2005 to 2012 for all companies registered at DGI that belong to the same sectors of the clusters. The sectors were defined based on the ISIC (Revision 4) and comprise the typical cluster activities although the correspondence is not exact.[3] In some cases it is possible that the reference sector is more comprehensive than the activity of the typical firms belonging to the cluster. It should be noted that, once the match between the list of participating companies and the sales database was made by DGI, the RUT of the company was removed to maintain the confidentiality of information at the firm level. Therefore it is not possible to match any additional firm-level information that is not contained in this database.

In our preferred estimations we restrict the sample to those companies (participants and non-participants) with positive sales every year between 2005 and 2012. There are a number of firms with zero sales in some years of this period but it is not possible to determine the causes of such records, therefore we prefer to exclude these firms from our sample. With this selection criterion we have a total of 111 participants and 2256 non-participant firms in the sales database (see Table 2). However, we will also show results for the full sample including

[3]The correspondence is the following: Food (ISIC = 10), Blueberries (ISIC = 0125), Audiovisual (ISIC = 59 and 9329), Footwear & Leather goods (ISIC = 1520), Life Sciences (7210), Design (ISIC = 7410), Viticulture (ISIC = 1102), Naval (ISIC=2410), Olives (ISIC =0126), Gemstones (ISIC =0899), Software (ISIC = 620 and 631), Clothing (ISIC= 1410 and 1430).

firms with zero sales in at least one year in the period (yielding a sample of 244 participants and 8736 non-participants)

Table 2. Number of selected firms in the sample of DGI for the assessment of impact on sales

	All firms			Restricted sample (positive sales in all years)		
Cluster	Treated	Control	Total	Treated	Control	Total
Food	24	3,464	3,488	23	1,091	1,114
Bluberries	24	13	37	9	2	11
Audiovisual	35	1,084	1,119	8	246	254
Footwear & leather goods	28	125	153	17	50	67
Life sciences	7	29	36	6	5	11
Design	41	171	212	10	25	35
Naval	10	285	295	4	104	108
Olives	6	2	8	0	0	0
Gemstones	7	82	89	2	16	18
Software	24	1,707	1,731	8	234	242
Clothing	26	1,537	1,563	14	365	379
Viticulture	12	237	249	10	118	128
Total	**244**	**8,736**	**8,980**	**111**	**2,256**	**2,367**

Source: calculations based on information provided by DGI.

The exports database contains information at firm level (identified by RUT number) on annual exports of goods (at 6 digit of the Mercosur Common Nomenclature, NCM) for all Uruguayan firms for the period 2004-2014. This database has information on exports of goods and therefore those clusters that are primarily services producers were excluded from the analysis (i.e. Software, Audiovisual and Design). The Naval cluster was excluded because none of the participating companies exported in the period under analysis. After excluding these clusters we are left with 142 participating firms in this database. Of these, 104 exported in at least one year in the period 2004-2014(38 never exported) and 70 exported in the year previous to the intervention.

In order to apply a first filter (i.e. a first matching criterion) on non-participating firms we identified groups of typical exportable goods for each cluster and then the control group was defined as those companies that in any year of the period 2004-2014 exported any of these products. The Table A1 in the Appendix shows the typical export goods of the clusters based on their NCM codes. From a total of 7373 non-participating firms we selected 1668 firms that had positive exports in at least one of these characteristics goods in at least one year in the period of analysis.

Table 3 shows the number of participating and non-participating firms that are included in the impact analysis on exports. We will perform the impact evaluation using three alternative

samples. The first sample includes all participating and non-participating companies, including the 38 participant firms that never exported in period. The second sample only includes companies that have exported at least in one year in the period (i.e. we will be excluding the 38 participant firms that never exported). Finally, the third sample will only include participants and non-participants that exported in the year before the intervention.

Table 3. Number of participating and non-participating firms with identifier (RUT) in by export status in the period 2004-2014

	All firms		Firms that exported in at least one year btw. 2004-14		Firms that exported the year before the intervention	
Cluster	Treated	Control	Treated	Control	Treated	Control
Blueberries	26	25	17	25	6	8
Life Sciences	8	320	8	320	5	135
Olives	5	12	4	12	1	5
Gemstones	8	81	4	81	2	28
Clothing	27	455	17	455	14	311
Footware & Leather Goods	32		20		12	
Food	24	775	22	775	18	232
Viticulture	12		12		12	
Total	142	1,668	104	1,668	70	719

Source: based on information provided by the PACC and Uruguay XXI Institute.

The treatment status of a firm is defined by the treatment status of its cluster in the program. It was assumed that the start of treatment for a cluster is the year when the first project in the cluster began. Table 4 shows the status of the treatment for each cluster by year. We also indicate if the cluster was included in the impact evaluation or not (as explained above some clusters were excluded for a number of reasons). From the 14 participating clusters that we have information on (see Table 1), 12 were included in the analysis of sales (2 were excluded because of lack of identifier codes for a high proportion of firms) and 8 were included in the analysis of goods exports (3 are services clusters and 1 did not export in the entire period). The number of pre and post intervention years varies by industry and also according to the database analyzed.

Table 4.Clusters included in the impact analysis of sales and export, time period covered and treatment status by cluster

	Time period covered by DGI database (sales)											
Cluster	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Included in the analysis of: Sales	Export
Food	0	0	0	0	0	1	1	1	1	1	1	YES	YES
Blueberries	0	0	0	1	1	1	1	1	1	1	1	YES	YES
Audiovisual	0	0	0	0	1	1	1	1	1	1	1	YES	NO
Foothware & Leather goods	0	0	0	1	1	1	1	1	1	1	1	YES	YES
Life Sciences	0	0	0	0	0	0	1	1	1	1	1	YES	YES
Design	0	0	0	0	0	1	1	1	1	1	1	YES	NO
Naval	0	0	0	0	0	0	1	1	1	1	1	YES	NO
Olives	0	0	0	0	0	0	0	0	0	1	1	YES*	YES
Gemstones	0	0	0	1	1	1	1	1	1	1	1	YES	YES
Software	0	0	0	0	1	1	1	1	1	1	1	YES	NO
Clothing	0	0	0	1	1	1	1	1	1	1	1	YES	YES
Viticulture	0	0	0	0	0	1	1	1	1	1	1	YES	YES
	Time period covered by Export database												

Notes:(*) all firms are excluded if we restrict the sample to those with positive sales every year between 2005 and 2012. The number 0 or 1 in the table indicates the status of the treatment for each cluster: = 1 on and after the year when at least 1project is executed under the PACC, and = 0 otherwise.

3.2 Empirical strategy

The identification of the impact of PACC on the performance of firms will be based on the assumption that participation in the program depends on both observable characteristics of firms and persistent unobserved factors over time. Under these assumptions the average effect of the program can be identified by a difference-in-differences (DID) regression, i.e., estimating the following equation for the outcome variable Y_{it}:[4]

$$Y_{it} = \beta D_{it} + \gamma X_{it} + \delta_t + u_i + e_{it} \qquad (1)$$

where D_{it} is 1 when the firm is a beneficiary of the program and 0 otherwise, X_{it} is a vector of control variables not affected by the program, δ_t is a time effect that affects all companies equally, u_i is the heterogeneity correlated with the other observed regressors (particularly D_{it}), and e_{it} is an error independent of the remaining regressors. Note that this specification

[4]An exposition of the methods available for evaluating quantitatively the impacts of cluster policies can be found in Giuliani et al. (2013).

allows the inclusion of specific time trends by sector (dummies resulting from the interaction of time dummies and sectoral dummies).

In the DID the key assumption for β to be a consistent estimator of the average treatment effect is that the trend in the outcome variable in the absence of treatment is the same between firms in the treatment group (participants) and the control group. While it is not possible to test the validity of this assumption, it is possible to analyze compliance before treatment comparing trends in outcome variables between groups in the period before the treatment.

The finding of different trends before treatment, which is equivalent to the significance of a false experiment, will invalidate the application of the method of DID, at least on the full sample. An alternative in this case is to restrict (or re-weight) the control group, matching treatments and controls based on observable pre-treatment variables.

In order to reinforce the validity of our identification assumption, we estimate equation (1) on a matched sample, selecting among firms in the comparison group that are more similar to participants in terms of pre-treatment variables. In particular, we apply the Nearest Neighbor Matching algorithm based on the Propensity Score within each sector. We perform estimates with one and five nearest neighbor with replacement.[5]

We also reinforce our estimates by using entropy balancing, a multivariate reweighting method proposed by Hainmueller (2012). This method allows us to reweight our full sample in such a way that the control group matches the covariate moments of the treatment group. The estimations presented below are based on balancing the mean of the pre-treatment variables within each sector.

We use the same variables in the matching (i.e. the propensity score) and in the reweighting method. In general these variables are transformations of the outcome variables in the pre-intervention period[6]. For sales we use the following two variables: 1) log of total sales in the year before the treatment and 2) average growth of total sales before the treatment. Meanwhile when analyzing export data we use the following ones: 1) log of total export in the year before the treatment, 2) log of total export to Mercosur (a region close to Uruguay) in the

[5]To be more precise, we use the option "ties" in the Stata package psmatch2. Therefore if there are more than one firm identified as a match (i.e. with identical characteristics) all of them will be included.

year before the treatment, iii) log of export of typical cluster good in the year before the treatment and iv) average growth of total export before the treatment.[7]

In order to analyze the timing of the effects we use the following specification:

$$Y_{it} = \beta_1 D_{1it} + \beta_2 D_{2it} + .. + \beta_k D_{kit} + \gamma X_{it} + \delta_t + u_i + e_{it} \qquad (2)$$

Where D_k take the value 1 if the firm (cluster) received the intervention *k* years before and 0 otherwise. β_i is the accumulated effect of the program *i* years after the intervention.

Finally, to address the validity of the control group and therefore the robustness of our estimates we assesses whether the pre-intervention time trends for participants and non-participant are different using the following equation:

$$Y_{it} = \varphi_j D_{it}^{j} + \beta D_{it} + \gamma X_{it} + \delta_t + u_i + e_{it} \qquad (3)$$

Where D^j take the value 1 for treated firms during the j-years before the intervention and 0 otherwise. Our data allow us to identify more than one trend break before the intervention. In the estimates presented in the Appendix we assesses whether the outcome variable present different trends one and two years before the intervention (i.e. *m*=1 and m=2). Under the null hypothesis of common trends all the coefficients φ must be statistically equal to zero. This is the condition that must be verified in order to validate our fixed-effects identification strategy.

We will also perform mean tests on the matching variables for intervention and control groups before and after the matching (or reweighting) in order to give some evidence of the quality of the matching (or reweighting) (see Appendix).

[6] Note that we are also implicitly using sector as matching/reweighting variable as we are implementing both methods within each sector.

[7] The growth is approximated by the log difference. The number of differences averaged (i.e. the number of pretreatment period) varies between 1 and 6 depending on the sector and the database.

4. Results

4.1 Sales

In Table 5 we report the results of the impact evaluation on sales with the sample of firms that have positive sales in all the period (both in the treatment and control group). We do not find any impact of the program on sales in any of the configurations presented in the table. Note that in Table 5 we are just trying to find an average effect for those firms affected on the entire period after the intervention. We also look for effects at different time lengths after the intervention in Table 6. The rows β_1-β_6 show the cumulative effect of the program for years 1 to 6 after the intervention (see equation (2)). As can be seen in Table 6 we do not find any positive affect at any time length for any of the models. In other words, this lack of effect seems to be very robust with this sample of firms. In the appendix we show that in general the hypothesis of parallel trends in sales in the treatment and control groups cannot be rejected.

When we use the full sample, without excluding firms that have zero sales in one of the years of the period, the picture gets blurred (Table 7). With the exception of the fixed effects models in columns 1 and 2, in all other cases we find a significant positive effect on sales at 5% confidence level. There is some evidence that the full effect of the program takes time to materialize: depending on the regressions it could take between 2 and 5 years (Table 8). In the appendix we show that the hypothesis of parallel trends in sales is rejected and therefore these results commented upon in this paragraph must be taken with great care.

Taking together the evidence presented in this subsection the conclusion should be that there is a weak and not consistent across samples evidence of a positive effect on sales.

Table 5. Estimation of the average treatment effects on (*log of*) sales
Sample 1: firms with positive sales in all the years

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β	-0.049	-0.053	0.015	0.018	0.02	-0.009	-0.028	-0.01
	(0.085)	(0.109)	(0.115)	(0.152)	(0.085)	(0.114)	(0.095)	(0.097)
Observations	18,936	18,936	1,504	1,504	3,064	3,064	18,936	18,936
R-squared	0.292	0.314	0.178	0.302	0.182	0.267	0.193	0.322
Number of id	2,367	2,367	188	188	383	383	2,367	2,367
Standard error	0.388	0.382	0.471	0.444	0.453	0.434	0.474	0.435
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Note: Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 6. Estimation of the dynamic average treatment effects on (*log of*) sales
Sample 1: firms with positive sales in all the years

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β_1	0.012	-0.018	0.039	-0.053	0.048	-0.031	0.041	-0.027
	(0.056)	(0.055)	(0.089)	(0.100)	(0.067)	(0.074)	(0.068)	(0.060)
β_2	-0.047	-0.078	-0.01	-0.098	0.005	-0.079	-0.006	-0.068
	(0.091)	(0.106)	(0.123)	(0.140)	(0.091)	(0.110)	(0.097)	(0.099)
β_3	-0.001	-0.033	0.045	-0.023	0.067	-0.018	0.041	-0.004
	(0.094)	(0.112)	(0.128)	(0.152)	(0.096)	(0.119)	(0.079)	(0.085)
β_4	-0.029	-0.027	0.012	0.042	0.05	0.035	0.023	0.045
	(0.098)	(0.123)	(0.158)	(0.166)	(0.113)	(0.130)	(0.111)	(0.106)
β_5	-0.216	-0.174	-0.182	0.024	-0.143	-0.046	-0.194	-0.011
	(0.131)	(0.169)	(0.196)	(0.213)	(0.122)	(0.154)	(0.161)	(0.163)
β_6	-0.349*	-0.273	-0.288	0.033	-0.239	-0.063	-0.281	0.003
	(0.184)	(0.249)	(0.236)	(0.253)	(0.171)	(0.215)	(0.234)	(0.234)
Observations	18,936	18,936	1,504	1,504	3,072	3,072	18,936	18,936
R-squared	0.293	0.311	0.187	0.278	0.188	0.254	0.187	0.254
Number of id	2,367	2,367	188	188	384	384	2,367	2,367
Standard error	0.388	0.383	0.469	0.443	0.452	0.433	0.466	0.446
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 7. Estimation of the average treatment effects on (*log of*) sales
Sample 2: all firms

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β	0.781*	0.498	2.209***	2.850***	1.864***	2.014***	1.138**	1.515***
	(0.369)	(0.436)	(0.461)	(0.623)	(0.354)	(0.398)	(0.386)	(0.442)
Observations	71,840	71,840	3,000	3,000	6,120	6,120	71,840	71,840
R-squared	0.071	0.082	0.111	0.18	0.089	0.161	0.103	0.183
Number of id	8,980	8,980	375	375	765	765	8,980	8,980
Standard error	4.692	4.665	3.775	3.668	3.862	3.729	3.983	3.804
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 8. Estimation of the dynamic average treatment effects on (*log of*) sales
Sample 2: all firms

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β_1	0.936**	1.113***	1.496***	1.393**	1.145***	0.963**	1.069***	1.305***
	(0.373)	(0.351)	(0.359)	(0.507)	(0.352)	(0.344)	(0.343)	(0.314)
β_2	1.187**	1.008*	2.351***	2.782***	1.914***	2.171***	1.406**	1.763***
	(0.398)	(0.501)	(0.542)	(0.809)	(0.440)	(0.548)	(0.471)	(0.479)
β_3	1.100**	0.519	2.913***	3.173***	2.333***	2.382***	1.404**	1.682**
	(0.388)	(0.638)	(0.605)	(0.663)	(0.404)	(0.459)	(0.481)	(0.581)
β_4	0.549	-0.133	2.995***	3.510***	2.269***	2.432***	0.948*	1.406**
	(0.371)	(0.648)	(0.690)	(0.718)	(0.433)	(0.335)	(0.513)	(0.573)
β_5	-0.083	-0.304	2.891***	3.926***	2.042***	2.422***	0.431	1.439**
	(0.378)	(0.353)	(0.855)	(0.886)	(0.497)	(0.475)	(0.740)	(0.464)
β_6	-0.467	-0.62	2.974**	3.591***	2.128**	1.871*	-0.031	1.203
	(0.688)	(0.642)	(1.130)	(0.726)	(0.685)	(0.862)	(0.883)	(0.847)
Observations	71,840	71,840	3,000	3,000	6,120	6,120	71,840	71,840
R-squared	0.071	0.082	0.116	0.186	0.091	0.163	0.105	0.183
Number of id	8,980	8,980	375	375	765	765	8,980	8,980
Standard error	4.692	4.665	3.767	3.658	3.86	3.725	3.978	3.803
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

4.2 Exports

Perhaps surprisingly, the picture when we analyze the impact of the program on exports is very different to the one commented upon in the previous subsection. Almost without exception in the many exercises that we performed, we find a positive effect. In Table 9 we show the results that include all the treated firms, in particular, those that never exported either before the intervention or after it. We expect the ATT to be downward biased in these estimations because the control group comes from an exports database and therefore by definition we do not have firms that never export in the control group. Note that with the exception of the fixed effects regression where we are not controlling for industry trends in all the other cases the ATT is significantly different from zero. Moreover the estimations imply a very high increase in exports, from 55% in the case of column 7 to 12 times higher in the case of column 4.[8]

In Tables 10 and 11 we also perform the same exercises as in Table 9 but with alternative samples. In Table 10 we only keep in the intervention group those firms that are exporting at

[8]The increase in exports is computed in the following way: e^{ATT}-1.

least in one year in period considered. As expected in general this increases the effect of the program.

Finally in table 11 we show the results which only keep in the control and intervention groups those firms that are exporting in the year before the intervention. Again the results are very consistent and seem to show a very important impact of the program on exports.

In the appendix we show tests of parallel trends previous to intervention and of quality of matching.

Table 9. Estimation of the average treatment effects on (*log of*) export

Sample 1: All firms

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β	0.973	0.946***	1.830***	2.563**	2.000***	2.298***	0.437*	0.750**
	(0.506)	(0.215)	(0.435)	(0.641)	(0.482)	(0.519)	(0.183)	(0.254)
Observations	19,888	19,888	2,343	2,343	4,697	4,697	19,888	19,888
R-squared	0.007	0.033	0.06	0.16	0.055	0.15	0.029	0.098
Number of id	1,808	1,808	213	213	427	427	1,808	1,808
Standard error	3.777	3.737	3.336	3.215	3.525	3.375	3.52	3.402
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 10. Estimation of the average treatment effects on (*log of*) export

Sample 2: Firms that export at least one year between 2004-2014

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β	1.389	1.359**	2.570***	3.697***	2.653**	3.109**	1.301***	1.825***
	(0.718)	(0.359)	(0.445)	(0.385)	(0.695)	(0.774)	(0.221)	(0.291)
Observations	19,470	19,470	1,925	1,925	4,136	4,136	19,470	19,470
R-squared	0.007	0.035	0.091	0.21	0.066	0.193	0.045	0.143
Number of id	1,770	1,770	175	175	376	376	1,770	1,770
Standard error	3.816	3.773	3.634	3.471	3.778	3.552	3.671	3.485
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 11. Estimation of the average treatment effects on (*log of*) export

Sample 3: Firms that export the year before PACC

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β	1.720***	2.423***	1.091	3.046**	1.465***	2.026***	1.384***	2.037***
	(0.130)	(0.310)	(0.656)	(0.866)	(0.235)	(0.361)	(0.177)	(0.288)
Observations	8,679	8,679	1,386	1,386	3,080	3,080	8,679	8,679
R-squared	0.088	0.189	0.076	0.218	0.079	0.184	0.08	0.211
Number of id	789	789	126	126	280	280	789	789
Standard error	3.674	3.483	3.272	3.113	3.633	3.47	3.289	3.063
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

In the next 3 tables we replicate the same exercises as in the previous 3 tables but now we try to find some patterns related to the time of exposure to the treatment. Even though there are some heterogeneities across samples and specifications, in general we can see that the accumulated impact of the program increases until the fourth or fifth year after the intervention. The results for the year 7 and 8 must be taken with great care because only half of the intervention group have experienced these number of years after the intervention and these firms are concentrated in a couple of sectors (clothes, and shoes and leather). In any case, the evidence shows the importance of taking into account the timing when analyzing the impact of this kind of programs (similar evidence was found by Figal-Garone *et al*., 2015).

Table 12. Estimation of the dynamic average treatment effects on (*log of*) export

Sample 1: All firms

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β_1	1.136**	1.126**	1.261*	1.458	1.223**	1.040**	0.707	0.772**
	(0.363)	(0.286)	(0.577)	(0.889)	(0.472)	(0.396)	(0.475)	(0.278)
β_2	1.289***	1.575***	1.355*	1.566**	1.561*	1.774***	0.673*	1.185***
	(0.259)	(0.134)	(0.528)	(0.585)	(0.656)	(0.439)	(0.326)	(0.186)
β_3	1.410**	1.394***	2.185***	2.921**	2.149***	2.316**	0.652**	1.198**
	(0.514)	(0.177)	(0.381)	(0.755)	(0.459)	(0.672)	(0.186)	(0.366)
β_4	1.654**	1.337***	2.644***	2.937***	2.743***	2.577**	0.947***	1.119***
	(0.543)	(0.094)	(0.443)	(0.692)	(0.586)	(0.655)	(0.153)	(0.219)
β_5	1.077	0.855***	2.624***	3.570**	2.583**	2.945**	0.269	0.780*
	(0.818)	(0.205)	(0.626)	(1.145)	(0.736)	(0.757)	(0.180)	(0.334)
β_6	0.572	0.601	2.393***	2.491	2.436***	2.858***	0.066	0.634
	(0.630)	(0.340)	(0.546)	(1.337)	(0.491)	(0.663)	(0.346)	(0.423)
β_7	-0.225	0.026	2.231**	4.867**	1.995**	3.330**	-0.872*	-0.211
	(0.664)	(0.341)	(0.713)	(1.830)	(0.740)	(0.949)	(0.407)	(0.690)
β_8	-0.411	-0.509	1.178	1.977**	1.677*	2.570***	-1.212*	-0.490**
	(0.963)	(0.332)	(0.882)	(0.655)	(0.770)	(0.499)	(0.479)	(0.164)
Observations	19,888	19,888	2,343	2,343	4,697	4,697	19,888	19,888
R-squared	0.008	0.033	0.068	0.166	0.059	0.153	0.037	0.1
Number of id	1,808	1,808	213	213	427	427	1,808	1,808
Standard error	3.775	3.736	3.327	3.208	3.521	3.372	3.507	3.398
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 13. Estimation of the average treatment effects on (*log of*) export

Sample 2: Firms that export at least one year between 2004-2014

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β_1	1.651**	1.698***	1.719*	2.206**	1.862*	1.651***	1.319*	1.360***
	(0.514)	(0.291)	(0.701)	(0.682)	(0.748)	(0.230)	(0.632)	(0.301)
β_2	1.890***	2.231***	2.024***	3.039***	2.314**	2.629***	1.365**	1.961***
	(0.437)	(0.136)	(0.423)	(0.619)	(0.889)	(0.405)	(0.509)	(0.323)
β_3	1.855**	1.894***	2.706***	3.445***	2.836***	3.414***	1.536***	2.266***
	(0.713)	(0.160)	(0.366)	(0.381)	(0.659)	(0.806)	(0.233)	(0.367)
β_4	2.251**	1.955***	3.778***	3.658***	3.661**	3.584**	2.090***	2.277***
	(0.843)	(0.252)	(0.423)	(0.211)	(0.941)	(0.971)	(0.344)	(0.508)
β_5	1.504	1.289*	3.454**	4.507**	3.312**	3.831**	1.390*	2.203*
	(1.190)	(0.575)	(1.059)	(1.178)	(1.163)	(1.444)	(0.663)	(1.016)
β_6	0.898	0.86	3.571**	4.612***	3.081***	3.630**	1.086*	2.034***
	(0.922)	(0.590)	(0.921)	(0.956)	(0.690)	(1.254)	(0.436)	(0.330)
β_7	-0.435	-0.202	2.682	6.112***	2.013*	4.023**	-0.247	1.006
	(1.127)	(0.701)	(1.371)	(1.190)	(0.988)	(1.441)	(0.782)	(0.616)
β_8	-1.019	-1.153	1.784	4.680**	1.471	2.722***	-1.046	0.319
	(1.587)	(0.951)	(1.829)	(1.559)	(1.208)	(0.660)	(1.186)	(0.636)
Observations	19,470	19,470	1,925	1,925	4,136	4,136	19,470	19,470
R-squared	0.01	0.036	0.103	0.216	0.071	0.196	0.056	0.146
Number of id	1,770	1,770	175	175	376	376	1,770	1,770
Standard error	3.813	3.77	3.616	3.465	3.772	3.549	3.651	3.481
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 14. Estimation of the average treatment effects on (*log of*) export

Sample 3: Firms that export the year before PACC

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β_1	1.428***	1.449**	1.121**	2.254**	1.219**	1.007	1.343**	1.195**
	(0.353)	(0.440)	(0.339)	(0.578)	(0.335)	(0.545)	(0.345)	(0.410)
β_2	1.263*	2.037**	0.911**	3.044**	1.053*	1.323*	0.989	1.321
	(0.526)	(0.519)	(0.348)	(1.162)	(0.484)	(0.577)	(0.509)	(0.802)
β_3	1.934**	2.795***	1.285	3.283**	1.637**	2.529***	1.727***	2.256**
	(0.514)	(0.364)	(0.771)	(0.885)	(0.460)	(0.478)	(0.405)	(0.663)
β_4	2.504***	2.696***	1.786*	3.283*	2.199***	2.092***	2.066***	1.971**
	(0.283)	(0.577)	(0.797)	(1.307)	(0.258)	(0.462)	(0.251)	(0.617)
β_5	2.323***	2.889***	1.368	4.132**	1.974***	2.726***	1.780***	2.707**
	(0.317)	(0.621)	(1.141)	(1.078)	(0.316)	(0.639)	(0.403)	(0.719)
β_6	2.214***	3.196***	1.088	3.517**	2.047**	2.829***	1.696**	3.121***
	(0.233)	(0.370)	(1.257)	(1.186)	(0.523)	(0.225)	(0.441)	(0.256)
β_7	0.468	2.687***	-0.529	2.32	0.191	2.250***	-0.266	2.311***
	(0.747)	(0.476)	(1.374)	(2.174)	(0.448)	(0.496)	(0.606)	(0.535)
β_8	-0.536	1.312	-2.211	0.764	-0.759	1.466	-1.383	1.53
	(0.741)	(0.756)	(1.724)	(2.347)	(0.722)	(0.764)	(1.011)	(1.049)
Observations	8,679	8,679	1,386	1,386	3,080	3,080	8,679	8,679
R-squared	0.091	0.19	0.097	0.223	0.085	0.187	0.098	0.214
Number of id	789	789	126	126	280	280	789	789
Standard error	3.671	3.482	3.243	3.112	3.624	3.469	3.259	3.057
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

4.3 Likelihood of exporting

In this subsection we show the results for the propensity to export. In other words, instead of the value of exports as dependent variable we now have a dummy variable indicating if the firm is exporting or not. We perform exactly the same exercises as in the previous subsection. The results are qualitatively similar. There is a robust positive effect of the intervention on the propensity to export. The estimates presented in table 15, that for the same reason as before we expect to be downward biased, show an increase in the propensity of exporting that ranges from 4.5% to 25%.

When we analyze alternative samples (as in tables 16 and 17) the effects are in general bigger. The effect of the intervention on the propensity to export seems to increase until the fourth or fifth year after the intervention (tables 18-20).

In the appendix we show pre-treatment trends equality tests and some mean tests showing the quality of the matching.

Table 15. Estimation of the average treatment effects on propensity to export

Sample 1: All firms

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β	0.084*	0.085***	0.165***	0.224***	0.176***	0.195***	0.044**	0.068*
	(0.034)	(0.015)	(0.038)	(0.045)	(0.043)	(0.038)	(0.016)	(0.027)
Observations	19,888	19,888	2,343	2,343	4,697	4,697	19,888	19,888
R-squared	0.006	0.032	0.056	0.145	0.054	0.146	0.021	0.085
Number of id	1,808	1,808	213	213	427	427	1,808	1,808
Standard error	0.358	0.354	0.303	0.294	0.321	0.308	0.317	0.307
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 16. Estimation of the average treatment effects on propensity to export

Sample 2: Firms that export at least one year between 2004-2014

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β	0.115*	0.117***	0.216***	0.297***	0.223**	0.252***	0.116***	0.159***
	(0.051)	(0.023)	(0.039)	(0.033)	(0.059)	(0.056)	(0.020)	(0.020)
Observations	19,470	19,470	1,925	1,925	4,136	4,136	19,470	19,470
R-squared	0.007	0.033	0.082	0.192	0.064	0.182	0.036	0.127
Number of id	1,770	1,770	175	175	376	376	1,770	1,770
Standard error	0.361	0.357	0.326	0.313	0.34	0.321	0.328	0.312
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 17. Estimation of the average treatment effects on propensity to export

Sample 3: Firms that export the year before PACC

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β	0.152***	0.221***	0.085	0.246***	0.121***	0.167***	0.119***	0.185***
	(0.017)	(0.025)	(0.045)	(0.060)	(0.017)	(0.027)	(0.015)	(0.023)
Observations	8,679	8,679	1,386	1,386	3,080	3,080	8,679	8,679
R-squared	0.098	0.204	0.064	0.201	0.077	0.179	0.075	0.195
Number of id	789	789	126	126	280	280	789	789
Standard error	0.334	0.316	0.291	0.278	0.321	0.307	0.289	0.271
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 18. Estimation of the dynamic average treatment effects on propensity to export

Sample 1: All firms

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β_1	0.098**	0.105***	0.113*	0.147	0.108*	0.094*	0.069	0.072**
	(0.036)	(0.025)	(0.055)	(0.078)	(0.045)	(0.037)	(0.048)	(0.028)
β_2	0.116***	0.147***	0.129**	0.148**	0.143*	0.161***	0.069*	0.114***
	(0.025)	(0.011)	(0.047)	(0.055)	(0.057)	(0.029)	(0.030)	(0.016)
β_3	0.125**	0.126***	0.194***	0.273***	0.190***	0.202**	0.063**	0.109**
	(0.040)	(0.018)	(0.029)	(0.058)	(0.041)	(0.057)	(0.019)	(0.041)
β_4	0.142**	0.118***	0.228***	0.236***	0.236***	0.209**	0.085***	0.101***
	(0.042)	(0.010)	(0.039)	(0.046)	(0.058)	(0.056)	(0.020)	(0.023)
β_5	0.076	0.057*	0.219**	0.288**	0.209**	0.233***	0.01	0.05
	(0.063)	(0.023)	(0.054)	(0.091)	(0.067)	(0.058)	(0.017)	(0.036)
β_6	0.05	0.049	0.218***	0.204*	0.214***	0.238***	0.014	0.054
	(0.044)	(0.029)	(0.041)	(0.089)	(0.043)	(0.049)	(0.030)	(0.045)
β_7	-0.008	0.023	0.220**	0.433**	0.183**	0.291**	-0.055	0.001
	(0.049)	(0.039)	(0.065)	(0.162)	(0.068)	(0.082)	(0.043)	(0.075)
β_8	-0.023	-0.036	0.131	0.178**	0.161**	0.219***	-0.085**	-0.039
	(0.061)	(0.018)	(0.068)	(0.046)	(0.056)	(0.031)	(0.024)	(0.024)
Observations	19,888	19,888	2,343	2,343	4,697	4,697	19,888	19,888
R-squared	0.007	0.032	0.062	0.15	0.057	0.148	0.027	0.087
Number of id	1,808	1,808	213	213	427	427	1,808	1,808
Standard error	0.358	0.354	0.302	0.293	0.321	0.308	0.316	0.307
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 19. Estimation of the average treatment effects on propensity to export

Sample 2: Firms that export at least one year between 2004-2014

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β_1	0.142**	0.155***	0.149*	0.191**	0.159*	0.140***	0.124	0.127***
	(0.051)	(0.030)	(0.072)	(0.066)	(0.071)	(0.021)	(0.063)	(0.030)
β_2	0.167**	0.205***	0.181***	0.268***	0.207**	0.235***	0.130**	0.185***
	(0.042)	(0.015)	(0.040)	(0.056)	(0.077)	(0.027)	(0.047)	(0.025)
β_3	0.160**	0.167***	0.226***	0.295***	0.240***	0.284***	0.139***	0.204***
	(0.056)	(0.009)	(0.031)	(0.029)	(0.053)	(0.062)	(0.019)	(0.027)
β_4	0.187**	0.167***	0.314***	0.276***	0.305**	0.278**	0.179***	0.196***
	(0.070)	(0.024)	(0.035)	(0.019)	(0.086)	(0.079)	(0.038)	(0.043)
β_5	0.099	0.082	0.258**	0.325**	0.252**	0.290**	0.095	0.161
	(0.093)	(0.046)	(0.079)	(0.090)	(0.097)	(0.111)	(0.052)	(0.084)
β_6	0.072	0.066	0.298***	0.365***	0.258***	0.283**	0.096**	0.170***
	(0.066)	(0.045)	(0.069)	(0.077)	(0.054)	(0.089)	(0.029)	(0.027)
β_7	-0.026	0.005	0.237*	0.514***	0.179*	0.346**	-0.003	0.103
	(0.083)	(0.065)	(0.102)	(0.116)	(0.084)	(0.129)	(0.063)	(0.079)
β_8	-0.081	-0.095	0.151	0.358**	0.132	0.217***	-0.076	0.022
	(0.101)	(0.058)	(0.125)	(0.110)	(0.084)	(0.054)	(0.070)	(0.029)
Observations	19,470	19,470	1,925	1,925	4,136	4,136	19,470	19,470
R-squared	0.008	0.035	0.091	0.196	0.068	0.184	0.045	0.13
Number of id	1,770	1,770	175	175	376	376	1,770	1,770
Standard error	0.361	0.357	0.325	0.313	0.34	0.321	0.326	0.312
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 20. Estimation of the average treatment effects on propensity to export

Sample 3: Firms that export the year before PACC

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
			1 neighbor		5 neighbors			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β_1	0.112**	0.130**	0.083**	0.180**	0.090**	0.083*	0.110***	0.112**
	(0.032)	(0.034)	(0.031)	(0.058)	(0.032)	(0.041)	(0.027)	(0.033)
β_2	0.109*	0.197***	0.076**	0.266**	0.090*	0.121*	0.086*	0.134*
	(0.048)	(0.039)	(0.027)	(0.098)	(0.040)	(0.048)	(0.042)	(0.063)
β_3	0.170**	0.262***	0.101	0.287***	0.135**	0.225***	0.152**	0.217**
	(0.059)	(0.032)	(0.066)	(0.070)	(0.047)	(0.048)	(0.044)	(0.060)
β_4	0.216***	0.243***	0.139**	0.246*	0.179***	0.165***	0.172***	0.180**
	(0.037)	(0.051)	(0.049)	(0.101)	(0.018)	(0.030)	(0.023)	(0.047)
β_5	0.187***	0.234***	0.086	0.295**	0.144***	0.194**	0.133**	0.217**
	(0.034)	(0.054)	(0.084)	(0.077)	(0.028)	(0.054)	(0.034)	(0.062)
β_6	0.209***	0.288***	0.095	0.292**	0.182***	0.238***	0.161**	0.277***
	(0.018)	(0.033)	(0.091)	(0.089)	(0.044)	(0.020)	(0.041)	(0.018)
β_7	0.084	0.263***	-0.019	0.216	0.047	0.193***	0.014	0.211***
	(0.067)	(0.037)	(0.094)	(0.151)	(0.040)	(0.033)	(0.043)	(0.037)
β_8	0.006	0.145**	-0.158	0.071	-0.031	0.123*	-0.07	0.151*
	(0.049)	(0.046)	(0.117)	(0.160)	(0.047)	(0.056)	(0.069)	(0.070)
Observations	8,679	8,679	1,386	1,386	3,080	3,080	8,679	8,679
R-squared	0.099	0.205	0.078	0.204	0.082	0.181	0.087	0.198
Number of id	789	789	126	126	280	280	789	789
Standard error	0.334	0.316	0.29	0.279	0.32	0.307	0.288	0.271
Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry trends	NO	YES	NO	YES	NO	YES	NO	YES

Cluster-robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

5. Conclusions

Policies to promote the development of clusters are widespread in the world. The rationale behind CDP interventions is that firms' competitiveness depends not only on individual actions, but also on the actions of other agents, and coordination failures among these in a geographical agglomeration or a production chain are limiting factors to achieve higher levels of competitiveness. Impact evaluations of cluster programs at firm level are extremely scarce in the literature. The objective of this paper is to contribute to this body of literature by evaluating the impact of a CDP in Uruguay on firms' sales and exports.

Consistently with one of the main focuses of the cluster program in Uruguay, the evidence shows that the program had a very strong and significant effect on exports and on the propensity of exporting. This effect is very robust across samples and econometric specifications. However, the evidence of a positive impact on sales is weak and in some cases with alternative samples we found no effect.

In addition we found that the timing is important when assessing the impact of this kind of programs. The evidence suggests that the maximum effect of the program can be found in the fourth or fifth year after the intervention (depending on the sample and econometric specifications). The fact that the effects are stronger after a few years could be due to the usual reason of slow diffusion but also to the heavy investment incurred in the first years of the program 2008-2010.

One of the aspects that is not well resolved yet in the literature is how to quantitatively capture the spillovers effects of cluster programs. One possible way forward to capture sector level impacts is to apply the novel approach of Multiple Synthetic Controls (Abadie *et al.* 2010). This will be part of the future research. In addition, we want to understand better heterogeneities across sectors and the impact on other outcomes.

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Appendix

Table A1. Identification of typical export goods by cluster based on the aggregation of goods from the Mercosur Common Nomenclature (NCM 2012, 6 digits)

	NCM codes
Food	04XXXX, 18XXXX, 19XXXX, 21XXXX, 22XXXX
Blueberries	081040
Footware & leather work	64XXXX, 41XXXX- 43XXXX
Life sciences	30XXXX, 9018XX-9027XX
Olives	1509XX
Gemstones	7103XX
Clothing	41XXXX-43XXXX, 5XXXXX
Viticulture	2204XX

Note: for NCM codes see https://www.mef.gub.uy/innovaportal/file/711/5/20111226_anexo.pdf

Table A2. Pre-treatment trends equality test on (*log of*) sales
Sample 1: firms with positive sales in all periods

	Full sample	Matched sample (nearest neighbor)		Reweighted sample
		1 neighbor	5 neighbors	
	(1)	(2)	(3)	(4)
Treatment since 1 year before the PACC	0.024	0.027	0.002	0.048
	(0.049)	(0.036)	(0.033)	(0.033)
Treatment since 2 years before the PACC	0.147**	-0.038	0.044	0.025
	(0.065)	(0.144)	(0.060)	(0.080)
Observations	18,936	1,504	3,064	18,936
R-squared	0.315	0.302	0.268	0.278
Number of id	2,367	188	383	2,367
Standard error	0.382	0.444	0.434	0.44
Fixed effects	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES
Industry trends	YES	YES	YES	YES

Cluster-robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A3. Pre-treatment trends equality test on (*log of*) sales
Sample 2: all firms

	Full sample	Matched sample (nearest neighbor)		Reweighted sample
		1 neighbor	5 neighbors	
	(1)	(2)	(3)	(4)
Treatment since 1 year before the PACC	1.006***	0.345	0.285	0.159
	(0.263)	(0.501)	(0.361)	(0.222)
Treatment since 2 years before the PACC	-0.095	-1.265**	-1.697***	-0.680**
	(0.298)	(0.513)	(0.535)	(0.288)
Observations	71,840	3,000	6,120	71,840
R-squared	0.082	0.182	0.164	0.183
Number of id	8,980	375	765	8,980
Standard error	4.665	3.666	3.723	3.803
Fixed effects	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES
Industry trends	YES	YES	YES	YES

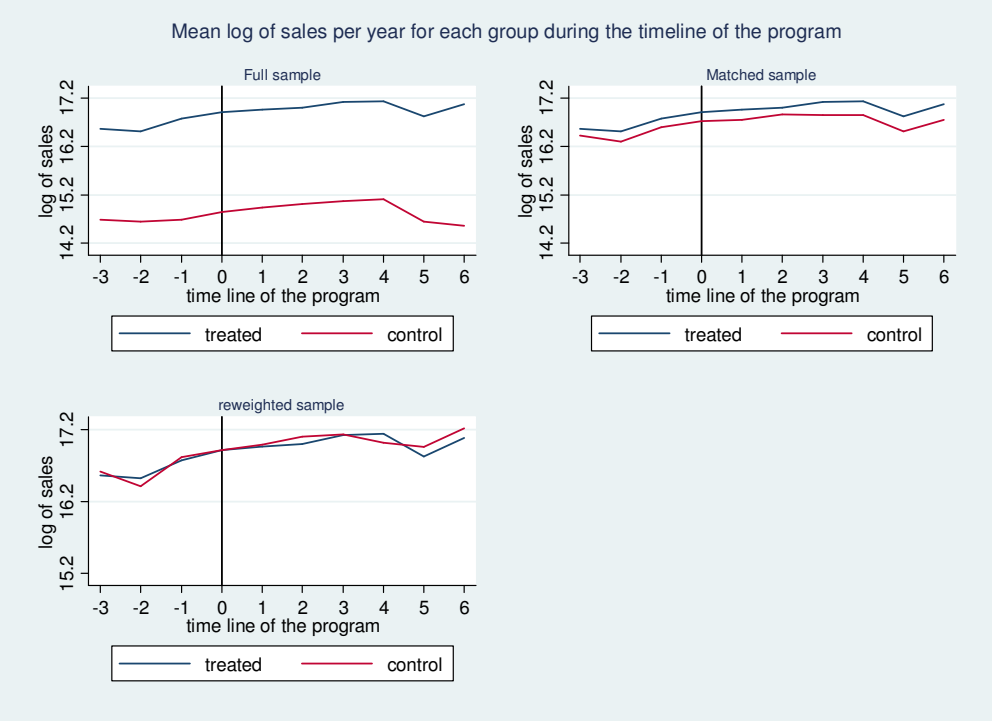
Cluster-robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A4. Mean of pre-treatment variable used in the matching (sales)

		Treated	Control				
			Full sample		Matched sample (nearest neighbor)		Reweighted sample
Cluster	Pre-treatment variable				1 neigbhor	5 neigbhor	
Food	sales	18.13	15.25	***	18.06	17.90	18.13
	sales growth	0.20	0.19		0.16	0.18	0.20
Bluberries	sales	17.66	17.57		17.57	17.57	17.66
	sales growth	-0.07	-0.32		-0.32	-0.32	-0.29
Audiovisual	sales	16.27	13.84	***	16.22	16.17	16.27
	sales growth	0.32	0.19		0.41	0.22	0.32
Footwear &	sales	16.15	14.08	***	15.97	15.73	16.14
leather goods	sales growth	0.11	0.12		0.15	0.18	0.11
Life Sciences	sales	17.15	15.27		17.56	15.27	16.24
	sales growth	0.35	0.17		0.20	0.17	0.35
Design	sales	14.82	13.61	***	14.09	13.89	14.82
	sales growth	0.28	0.22		0.36	0.27	0.28
Naval	sales	17.86	15.45	***	16.34	18.49	15.90
	sales growth	0.52	0.14	***	0.61	0.33	0.52
Gemstones	sales	14.22	15.30		13.07	13.66	14.23
	sales growth	-0.37	0.37		0.06	-0.04	-0.37
Software	sales	15.84	14.84		15.68	15.87	15.84
	sales growth	0.19	0.24		0.10	0.24	0.19
Clothing	sales	17.70	14.19	***	17.43	17.13	17.69
	sales growth	0.05	0.23		0.07	0.15	0.05
Viticulture	sales	17.18	15.08	***	16.95	16.70	17.17
	sales growth	0.11	0.08		0.18	0.12	0.11

Note: sales = log of total sales in the year before the treatment; sales growth = average growth of total sales before the treatment (approximated by the average of the log difference. The number of differences averaged varies between 1 and 5 depending on the cluster). Reject the null of equal mean between treated and control firms at *** p<0.01, ** p<0.05, * p<0.1

Graph A1. Sales trends before and after the intervention



Note: The lines in each graph show the annual mean of (log) sales of treated (blue) and control (red) firms. For the third graph the average of the of control firms is a weighted average based on multivariate reweighting method proposed by Hainmueller (2012). The horizontal axis indicates the years of exposure to the program which is specific for each sector, where 0 is the year of the start of PACC and the negative numbers (in absolute terms) indicate the number of years before the program.

Table A5. Pre-treatment trends equality test on (*log of*) export

Sample 1: All firms

	Full sample	Matched sample (nearest neighbor)		Reweighted sample
		1 neighbor	5 neighbors	
	(1)	(2)	(3)	(4)
Treatment since 1 year	0.345	-0.776	-0.865**	-0.168
before the PACC	(0.267)	(0.645)	(0.306)	(0.247)
Treatment since 2 years	0.475	0.251	0.257	0.345
before the PACC	(0.492)	(0.498)	(0.361)	(0.452)
Observations	19,888	2,343	4,697	19,888
R-squared	0.033	0.161	0.151	0.098
Number of id	1,808	213	427	1,808
Standard error	3.737	3.216	3.375	3.402
Fixed effects	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES
Industry trends	YES	YES	YES	YES

Cluster-robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A6. Pre-treatment trends equality test on (*log of*) export

Sample 2: Firms that export at least one year between 2004-2014

	Full sample	Matched sample (nearest neighbor)		Reweighted sample
		1 neighbor	5 neighbors	
	(1)	(2)	(3)	(4)
Treatment since 1 year	0.432	-0.818	-0.741*	-0.427
before the PACC	(0.300)	(0.759)	(0.366)	(0.232)
Treatment since 2 years	0.733*	1.116**	0.448	0.397
before the PACC	(0.335)	(0.420)	(0.262)	(0.316)
Observations	19,470	1,925	4,136	19,470
R-squared	0.035	0.211	0.193	0.143
Number of id	1,770	175	376	1,770
Standard error	3.772	3.471	3.553	3.485
Fixed effects	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES
Industry trends	YES	YES	YES	YES

Cluster-robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A7. Pre-treatment trends equality test on (*log of*) export

Sample 3: Firms that export the year before de PACC

	Full sample	Matched sample (nearest neighbor)		Reweighted sample
		1 neighbor	5 neighbors	
	(1)	(2)	(3)	(4)
Treatment since 1 year	-0.676	-0.333	-0.816	-0.544
before the PACC	(0.406)	(0.754)	(0.559)	(0.379)
Treatment since 2 years	0.181	0.557	0.769	0.884
before the PACC	(0.666)	(0.693)	(0.702)	(0.701)
Observations	8,679	1,386	3,080	8,679
R-squared	0.189	0.218	0.185	0.211
Number of id	789	126	280	789
Standard error	3.483	3.115	3.47	3.062
Fixed effects	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES
Industry trends	YES	YES	YES	YES

Cluster-robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A8. Mean of pre-treatment variable used in the matching

		Treated	Control						
			Full sample		Matched sample (nearest neighbor)				Reweighted sample
	Pre-treatment variable				1 neigbhor		5 neigbhors		
Bluberries	total export	2.90	3.88		7.93	*	6.47	*	2.90
	export to MCS	1.07	1.48		2.24		2.47		1.07
	specific goods exports	0.76	2.49		5.56	***	4.15	**	1.84
	export growth	0.35	0.43		1.21		0.71		0.35
Life Sciences	total export	8.37	4.70		8.83		9.68		8.37
	export to MCS	6.25	3.11		3.92		7.33		6.25
	specific goods exports	6.84	2.65	*	6.54		6.20		4.34
	export growth	0.85	0.10	**	1.35		1.00		0.85
Gemstones	total export	2.38	4.75		4.59		3.65		2.38
	export to MCS	0.00	2.21		0.00		0.00		0.01
	specific goods exports	0.00	3.33		4.59		3.65		2.38
	export growth	0.30	0.32		0.57		0.46		0.30
Olives	total export	2.73	4.01		6.33		5.29		2.74
	export to MCS	1.46	1.08		3.46		0.94		1.46
	specific goods exports	2.73	3.43		6.33		5.19		2.61
	export growth	0.57	-0.03		1.18		2.10		0.57
Food	total export	10.17	5.77	***	10.63		10.37		10.16
& Viticulture	export to MCS	7.17	2.57	***	6.55		6.42		7.16
	specific goods exports	9.19	6.53	***	11.88		11.47		9.18
	export growth	0.66	0.50	*	0.82		0.86		0.66
Clothing, Footwear &	total export	5.88	4.68		10.74	***	10.59	***	5.87
leather goods	export to MCS	4.13	2.62	**	7.41	**	7.76	***	4.13
	specific goods exports	3.86	4.49		10.47	***	10.19	***	3.87
	export growth	0.38	0.21		1.19		0.55		0.38

Note: total export = log of total export in the year before the treatment; export to MCS = log of total export to Mercosur in the year before the treatment; specific goods exports = log of export of typical "cluster" good in the year before the treatment; export growth = average growth of total export before the treatment (approximated by the average of the log difference. The number of differences averaged varies between 1 and 6 depending on the cluster).

Table A9. Pre-treatment trends equality test on propensity to export

Sample 1: All firms

		Matched sample (nearest neighbor)		
	Full sample	1 neighbor	5 neighbors	Reweighted sample
	(1)	(2)	(3)	(4)
Treatment since 1 year	0.045	-0.05	-0.069*	-0.001
before the PACC	(0.025)	(0.058)	(0.028)	(0.024)
Treatment since 2 years	0.016	-0.001	0.014	0.019
before the PACC	(0.047)	(0.041)	(0.036)	(0.049)
Observations	19,888	2,343	4,697	19,888
R-squared	0.032	0.145	0.146	0.085
Number of id	1,808	213	427	1,808
Standard error	0.354	0.294	0.308	0.307
Fixed effects	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES
Industry trends	YES	YES	YES	YES

Cluster-robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A10. Pre-treatment trends equality test on propensity to export

Sample 2: Firms that export at least one year between 2004-2014

	Full sample	Matched sample (nearest neighbor)		Reweighted sample
		1 neighbor	5 neighbors	
	(1)	(2)	(3)	(4)
Treatment since 1 year	0.05	-0.062	-0.055	-0.023
before the PACC	(0.028)	(0.068)	(0.036)	(0.022)
Treatment since 2 years	0.037	0.078	0.03	0.026
before the PACC	(0.036)	(0.052)	(0.034)	(0.038)
Observations	19,470	1,925	4,136	19,470
R-squared	0.033	0.192	0.182	0.127
Number of id	1,770	175	376	1,770
Standard error	0.357	0.313	0.322	0.312
Fixed effects	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES
Industry trends	YES	YES	YES	YES

Cluster-robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

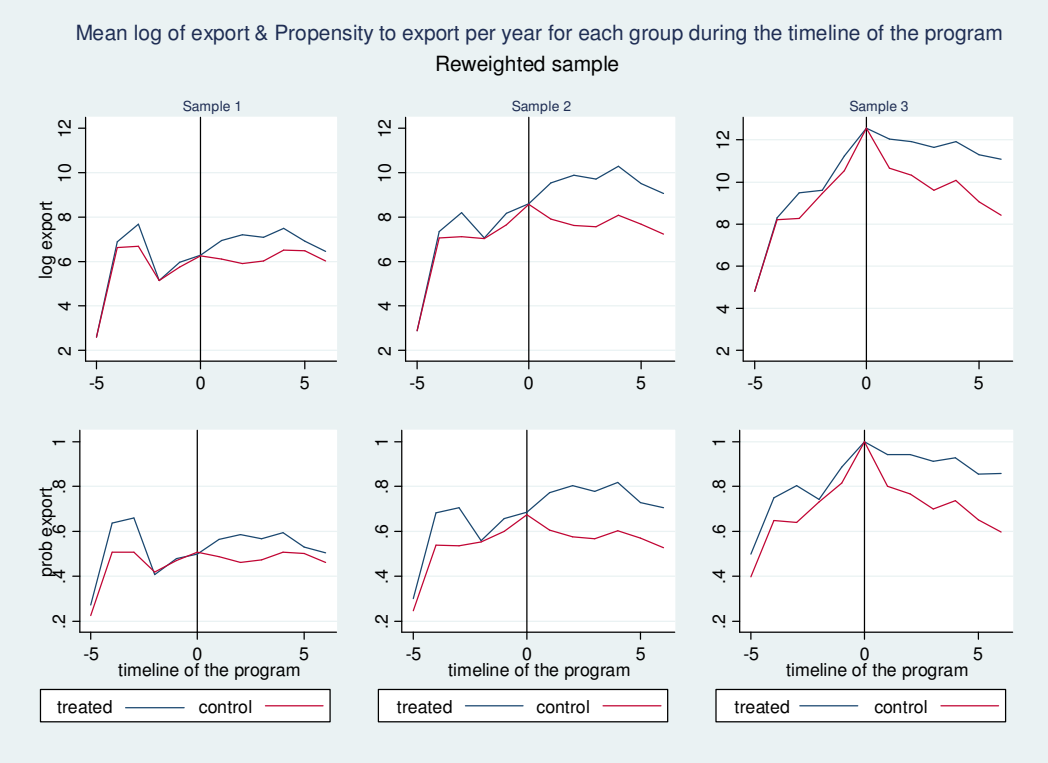
Table A11. Pre-treatment trends equality test on propensity to export

Sample 3: Firms that export the year before de PACC

	Full sample	Matched sample (nearest neighbor)		Reweighted sample
		1 neighbor	5 neighbors	
	(1)	(2)	(3)	(4)
Treatment since 1 year	-0.067	-0.006	-0.049	-0.029
before the PACC	(0.040)	(0.062)	(0.050)	(0.024)
Treatment since 2 years	-0.008	-0.001	0.043	0.057
before the PACC	(0.059)	(0.078)	(0.068)	(0.062)
Observations	8,679	1,386	3,080	8,679
R-squared	0.204	0.201	0.179	0.195
Number of id	789	126	280	789
Standard error	0.316	0.279	0.307	0.271
Fixed effects	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES
Industry trends	YES	YES	YES	YES

Cluster-robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Graph A2. Exports and propensity to export trends before and after the intervention



Notes:
(1) The lines in each graph show the annual mean of (log) sales of treated (blue) and control (red) firms. In the case of the control firms is a weighted average based on multivariate reweighting method proposed by Hainmueller (2012). The horizontal axis indicates the years of exposure to the program which is specific for each sector, where 0 is the year of the start of PACC and the negative numbers (in absolute terms) indicate the number of years before the program.
(2) Each of the three columns of graphs correspond to the following specific samples: Sample 1: all firms; Sample 2: firms that export in at least one year btw 2004-2014; Sample 3: firms that exported the year before the start of the program.