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Cluster Development Policies and Firms' Performance

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Motivation and objective

- **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.**

Literature

Impact evaluations of cluster programs at firm level are scarce in the literature.

- ***CDP in Brazil*** (Figal Garone et al., 2015): Evidence of a **positive direct effect of the program on employment growth, value of exports and likelihood of exporting**. They also find different effects in the short and medium and long term (*Fixed effect Regression Model*).
- ***CDP in France*** (Martin et al., 2011): The program **did not have a robust impact on firms' employment, export or factor productivity**. (*Fixed effect Regression Model and Diff in Diff with matching*). They suggest that the program directed the funding to sectors-regions which were in decline.

Literature

Impact evaluations of cluster programs at firm level are scarce in the literature.

- ***CDP in Japan*** (Nishimura and Okamuro, 2011) : Participating in the program alone does not have an effect on R&D productivity (variable of interest). **Only those that also collaborated with partners outside the cluster** (e.g universities) **showed higher R&D productivity** (*Instrumental Variables*)
- ***CDP in Germany*** (Falck et al. 2010) : Weak 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** (*triple difference regression strategy*)

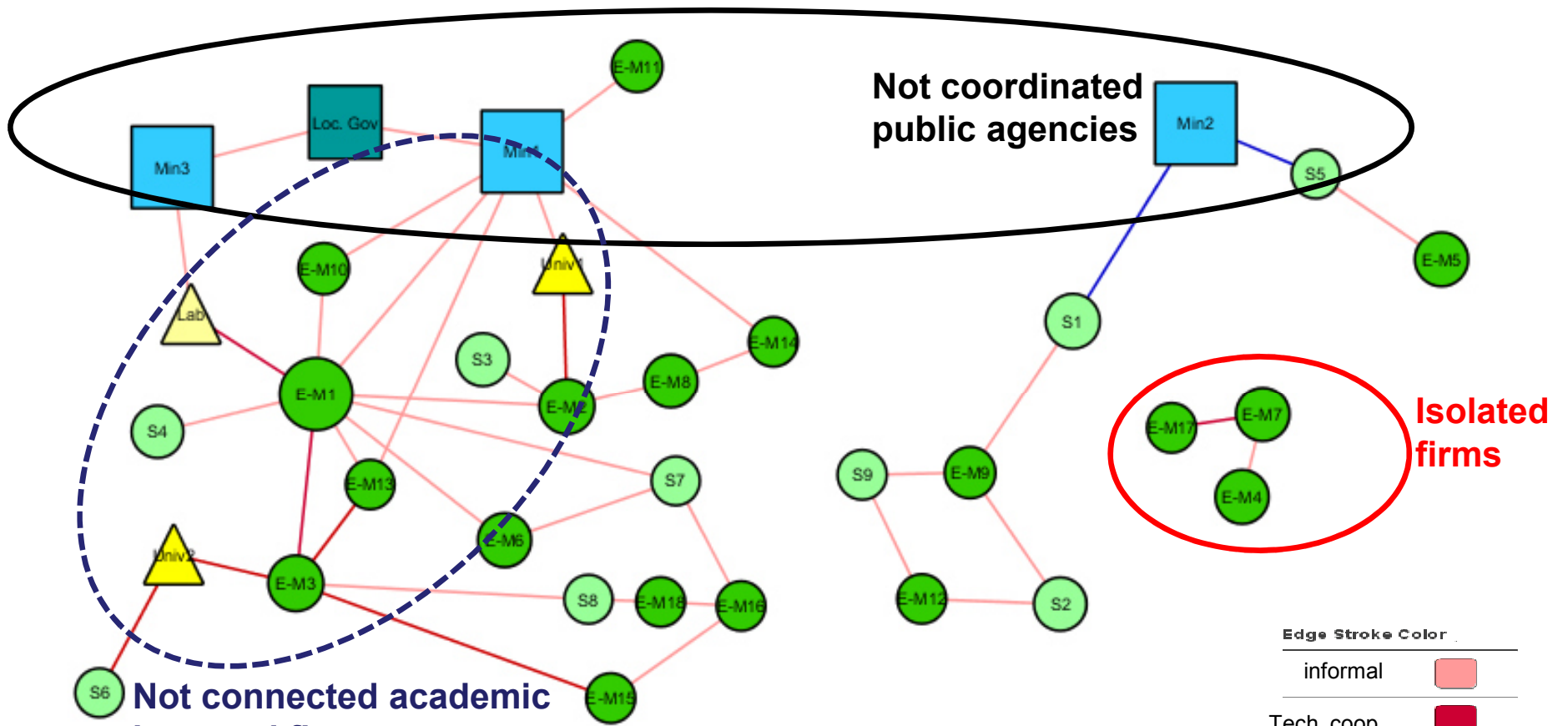
Main findings: impacts on exports and sales

1. The evidence shows that the program had a **very strong and significant effect on exports and propensity to export**
2. **This effect is very robust** across samples and econometric specifications
3. There is a **very weak evidence of an impact on sales**

Cluster development programs

- **CDPs are designed to enhance firms' competitiveness** under certain preexistent opportunities: opportunities for labor pooling, low knowledge diffusion, uncoordinated institutional arrangements, etc.
- They are intended to **create a set of incentives to mitigate coordination failures and to take advantage of economies of agglomeration** (Marshall, 1920; Arrow, 1962; Romer, 1986; Glaeser et al., 1992)

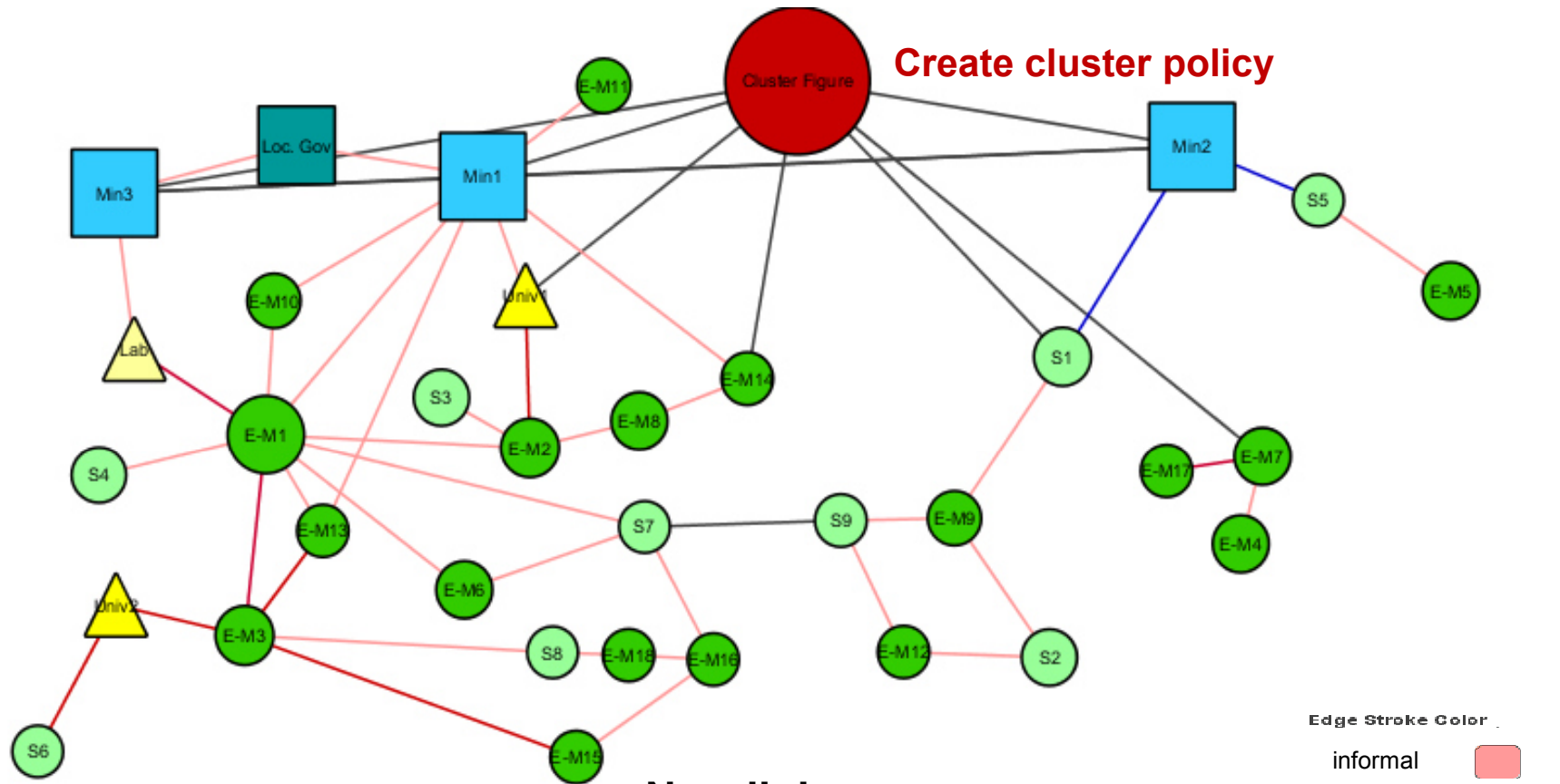
Cluster development programs



Node Shape	
○	Firms
□	Gov. Agency
△	Institutions

Edge Stroke Color	
informal	Light Red
Tech. coop	Dark Red
R&D	Red
financial	Blue

Cluster development programs



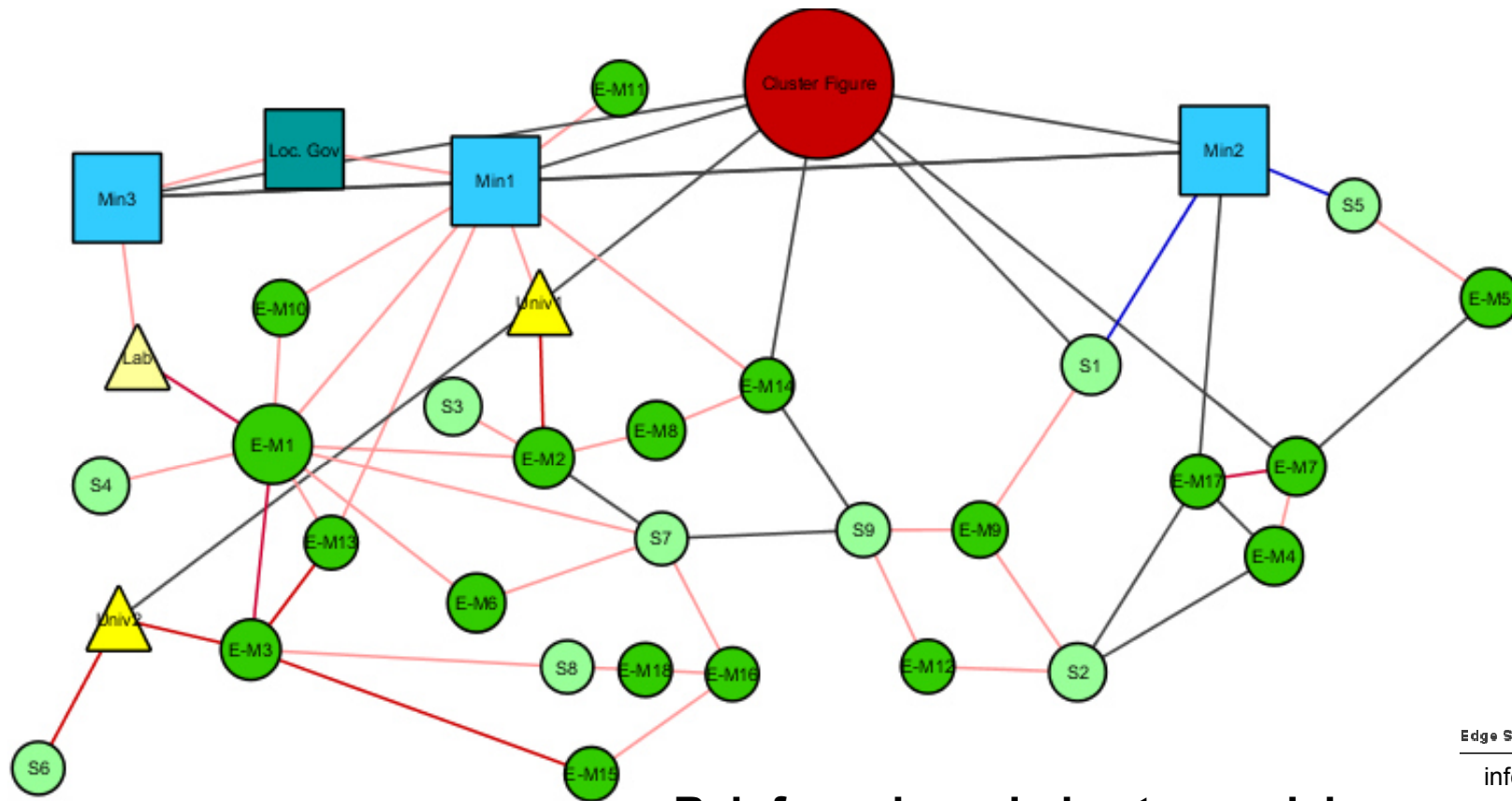
Create cluster policy

-New links
-Strategic cluster vision

Node Shape	tipo
○	Firms
□	Gov. Agency
△	Institutions

Edge Stroke Color	
informal	pink
Tech. coop	dark red
R&D	red
financial	blue

Cluster development programs



- Reinforce knowledge transmission
- Create public and club goods
- Consolidate the cluster

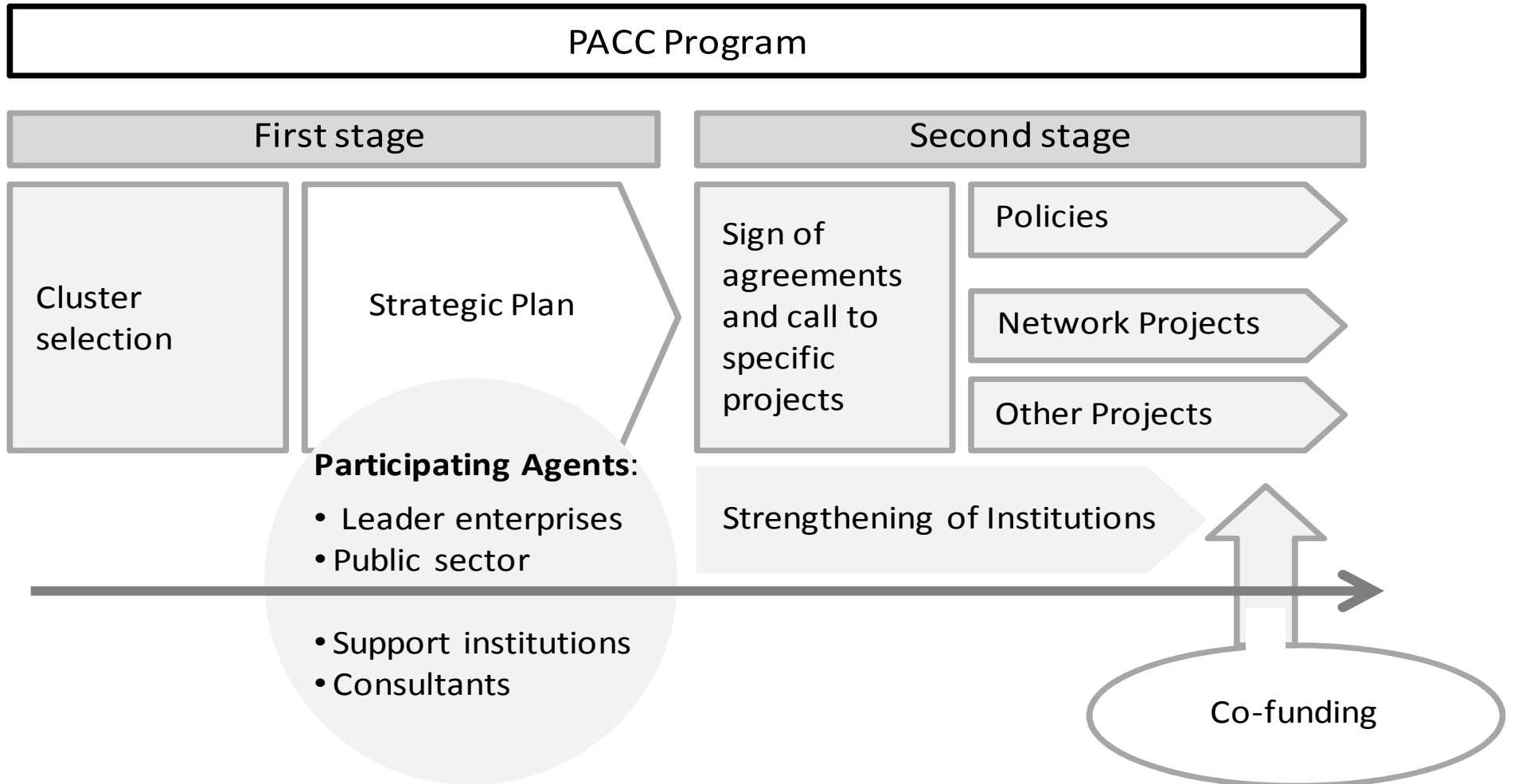
Node Shape	tipo
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PACC Intervention

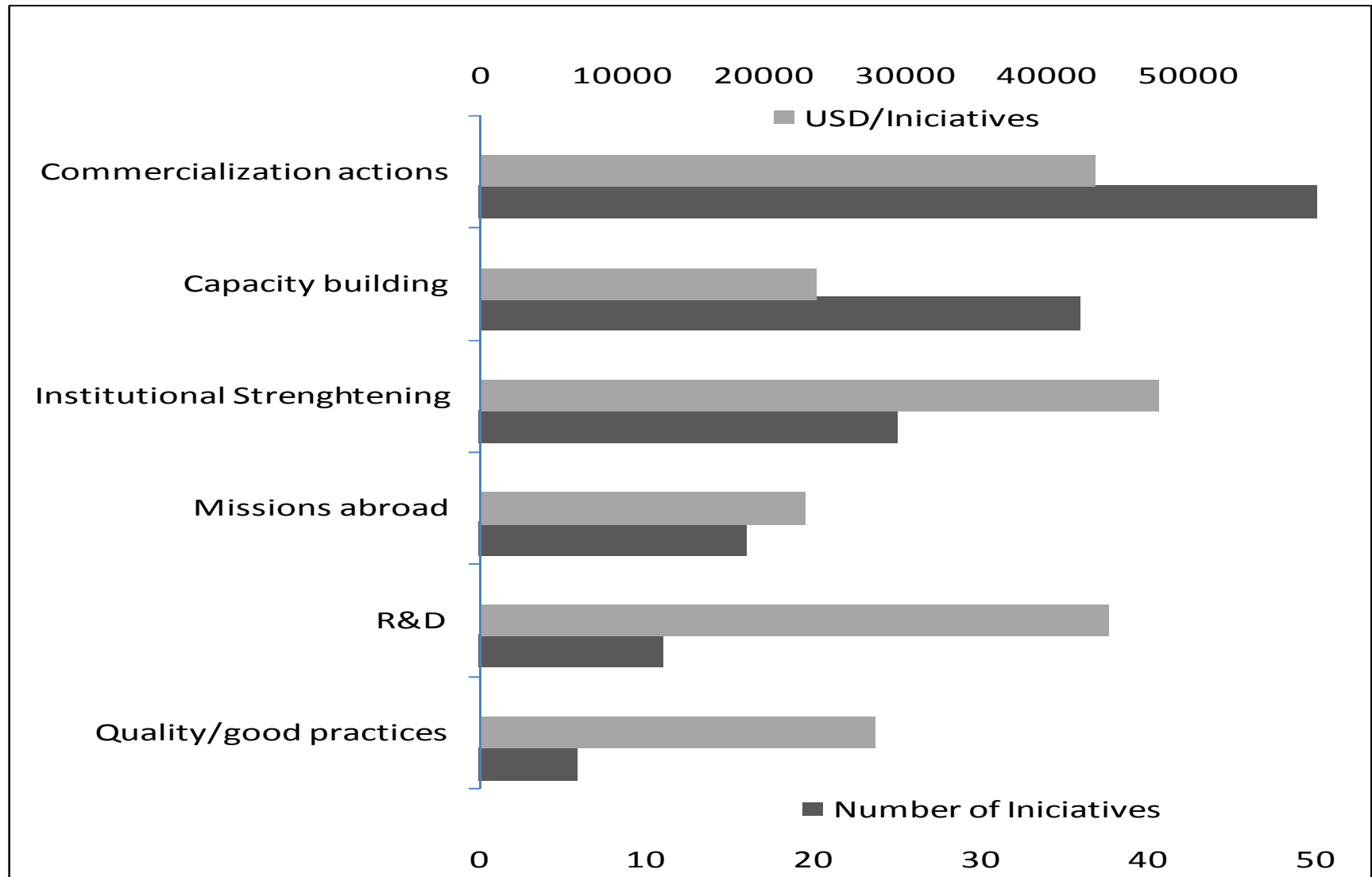
- PACC intervention **started in 2006 and finished in 2014.**
- Since its inception the **PACC supported 21 clusters.**
- The **program implementation** (and budget) was divided into 3 components:
 - Development of a **strategic plan** for the cluster
 - **Matching grants for selected projects**
 - **Strengthening of the cluster supporting institutions**

PACC Intervention



Source: Lecciones aprendidas 2006-2009/ PACC Uruguay

PACC Intervention (heavy weight on exports)



Data and Empirical Strategy

Data

Three sources of information

1. **Program administrative information** containing a list of participating companies and clusters, the number and the date of the projects in which each company participated (see [table](#))
2. Annual operating income (**Sales**) for the period **2005-2012** from DGI (see [table](#))
3. Annual **Exports of goods** for the period **2004-2014** from Institute Uruguay XXI (see [table](#))

Data and Empirical Strategy

Clusters included in the impact analysis (of sales and exports), time period covered and treatment status by cluster

Cluster	Time period covered by DGI database (sales)											Included in the analysis of:	
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	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

(*) all firms are excluded if we restrict the sample to those with positive sales every year between 2005 and 2012

Data and Empirical Strategy

Empirical Strategy

- **Assumption: participation** in the program **depends on both observable characteristics** of firms **and persistent unobserved factors** over time
- Average effect of the program can be identified by a **difference-in-differences (DID) regression**:

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

- where D is 1 when the firm is a beneficiary of the program and 0 otherwise, X is a vector of control variables not affected by the program, δ are time effects, u_i is the heterogeneity correlated with the other observed regressors, and e is an error independent of the remaining regressors

Data and Empirical Strategy

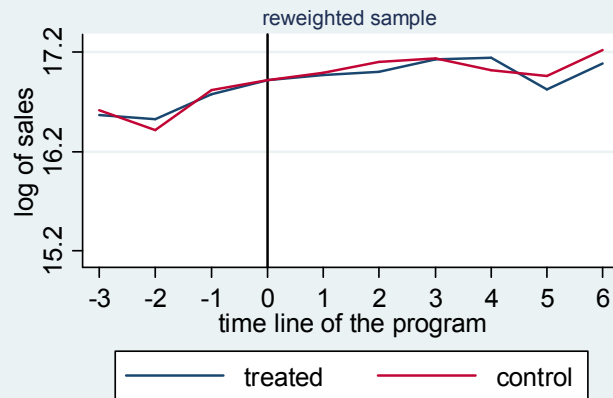
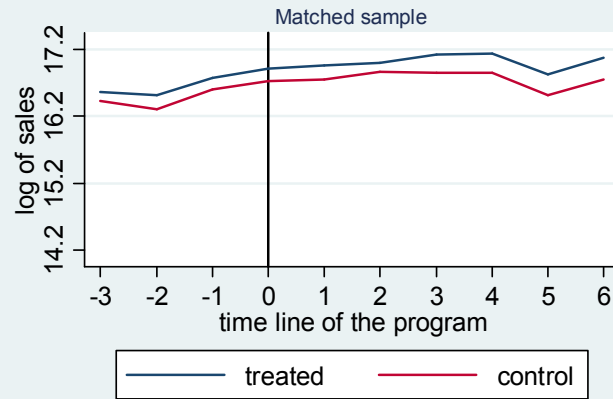
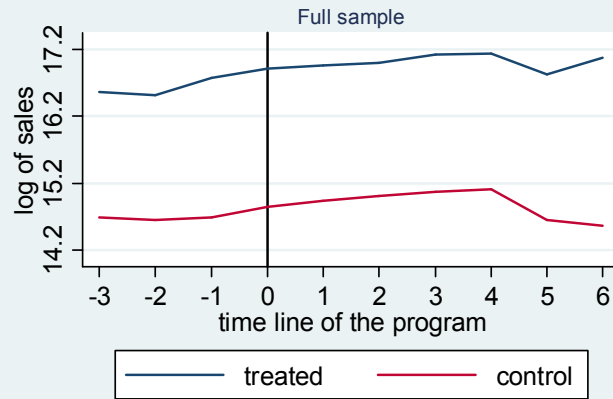
Empirical Strategy

- **β is a consistent estimator of the Average Treatment Effect if trend in the outcome variable in the absence of treatment is the same between treatment and the control group**
- Only the possibility of an **informal test** to the validity of this assumption: **comparing trend before the PACC**
- **Two alternatives** to reinforce the validity of our identification assumption :
 1. **Restrict to matched sample** based on observable pre-treatment variables (Nearest Neighbor Matching based on PS)
 2. **Reweight the sample** in such a way that the control group **matches the covariate moments of the treatment group** (**entropy balancing**, Hainmueller, 2012)

Results

Sales trends before and after the intervention

Mean log of sales per year for each group during the timeline of the program

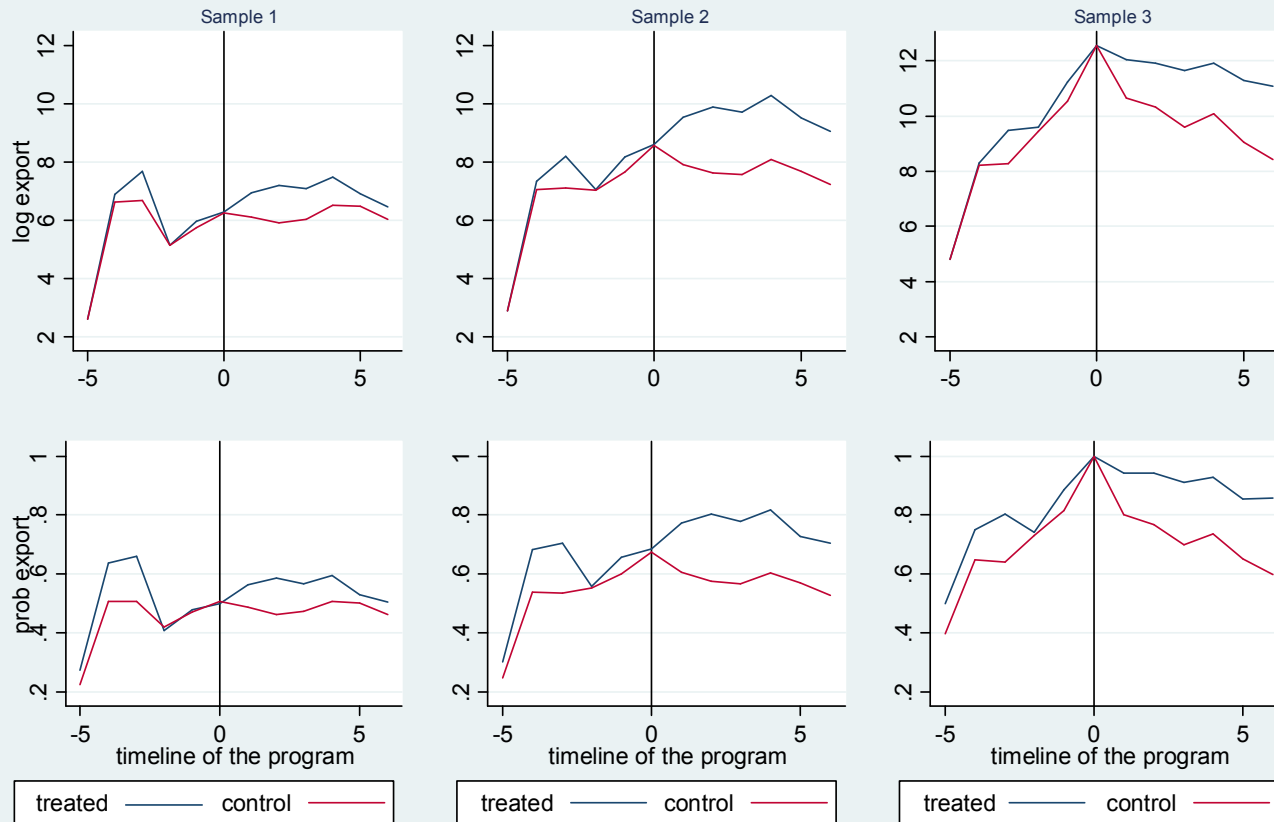


Sample 1: all firms

Results

Exports and propensity to export trends before and after the intervention

Mean log of export & Propensity to export per year for each group during the timeline of the program
 Reweighted sample



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

Results

Estimation of the Average Treatment Effects on (log of) sales

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
	(1)	(2)	1 neighbor		5 neighbor		(7)	(8)
			(3)	(4)	(5)	(6)		
Sample 1: firms with positive sales in all the years	-0.049 (0.085)	-0.053 (0.109)	0.015 (0.115)	0.018 (0.152)	0.02 (0.085)	-0.009 (0.114)	-0.028 (0.095)	-0.01 (0.097)
Sample 2: All firms	0.781* (0.369)	0.498 (0.436)	2.209*** (0.461)	2.850*** (0.623)	1.864*** (0.354)	2.014*** (0.398)	1.138** (0.386)	1.515*** (0.442)
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

Dependent variable: export in natural logarithm

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

Results

Estimation of the Average Treatment Effects on (log of) export

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
	(1)	(2)	1 neighbor		5 neighbors		(7)	(8)
			(3)	(4)	(5)	(6)		
Sample 1: All firms	0.973 (0.506)	0.946*** (0.215)	1.830*** (0.435)	2.563** (0.641)	2.000*** (0.482)	2.298*** (0.519)	0.437* (0.183)	0.750** (0.254)
Sample 2: Firms that export at least one year between 2004-14	1.389 (0.718)	1.359** (0.359)	2.570*** (0.445)	3.697*** (0.385)	2.653** (0.695)	3.109** (0.774)	1.301*** (0.221)	1.825*** (0.291)
Sample 3: Firms that export the year before de PACC	1.720*** (0.130)	2.423*** (0.310)	1.091 (0.656)	3.046** (0.866)	1.465*** (0.235)	2.026*** (0.361)	1.384*** (0.177)	2.037*** (0.288)
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

Dependent variable: export in natural logarithm

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

Results

Estimation of the dynamic Average Treatment effects on (log of) export Sample 3: Firms that export the year before de PACC

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
	(1)	(2)	1 neighbor		5 neighbors		(7)	(8)
β_1	1.428*** (0.353)	1.449** (0.440)	1.121** (0.339)	2.254** (0.578)	1.219** (0.335)	1.007 (0.545)	1.343** (0.345)	1.195** (0.410)
β_2	1.263* (0.526)	2.037** (0.519)	0.911** (0.348)	3.044** (1.162)	1.053* (0.484)	1.323* (0.577)	0.989 (0.509)	1.321 (0.802)
β_3	1.934** (0.514)	2.795*** (0.364)	1.285 (0.771)	3.283** (0.885)	1.637** (0.460)	2.529*** (0.478)	1.727*** (0.405)	2.256** (0.663)
β_4	2.504*** (0.283)	2.696*** (0.577)	1.786* (0.797)	3.283* (1.307)	2.199*** (0.258)	2.092*** (0.462)	2.066*** (0.251)	1.971** (0.617)
β_5	2.323*** (0.317)	2.889*** (0.621)	1.368 (1.141)	4.132** (1.078)	1.974*** (0.316)	2.726*** (0.639)	1.780*** (0.403)	2.707** (0.719)
β_6	2.214*** (0.233)	3.196*** (0.370)	1.088 (1.257)	3.517** (1.186)	2.047** (0.523)	2.829*** (0.225)	1.696** (0.441)	3.121*** (0.256)
β_7	0.468 (0.747)	2.687*** (0.476)	-0.529 (1.374)	2.32 (2.174)	0.191 (0.448)	2.250*** (0.496)	-0.266 (0.606)	2.311*** (0.535)
β_8	-0.536 (0.741)	1.312 (0.756)	-2.211 (1.724)	0.764 (2.347)	-0.759 (0.722)	1.466 (0.764)	-1.383 (1.011)	1.53 (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.

Results

Estimation of the Average Treatment Effects on propensity to export

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
	(1)	(2)	1 neighbor		5 neighbors		(7)	(8)
			(3)	(4)	(5)	(6)		
Sample 1: All firms	0.084* (0.034)	0.085*** (0.015)	0.165*** (0.038)	0.224*** (0.045)	0.176*** (0.043)	0.195*** (0.038)	0.044** (0.016)	0.068* (0.027)
Sample 2: Firms that export at least one year between 2004-14	0.115* (0.051)	0.117*** (0.023)	0.216*** (0.039)	0.297*** (0.033)	0.223** (0.059)	0.252*** (0.056)	0.116*** (0.020)	0.159*** (0.020)
Sample 3: Firms that export the year before de PACC	0.152*** (0.017)	0.221*** (0.025)	0.085 (0.045)	0.246*** (0.060)	0.121*** (0.017)	0.167*** (0.027)	0.119*** (0.015)	0.185*** (0.023)
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

Dependent variable: propensity to export (1=export, 0=no export)

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

Results

Estimation of the dynamic Average Treatment effects on propensity to export Sample 3: Firms that export the year before de PACC

	Full sample		Matched sample (nearest neighbor)				Reweighted sample	
	(1)	(2)	1 neighbor		5 neighbors		(7)	(8)
β_1	0.112** (0.032)	0.130** (0.034)	0.083** (0.031)	0.180** (0.058)	0.090** (0.032)	0.083* (0.041)	0.110*** (0.027)	0.112** (0.033)
β_2	0.109* (0.048)	0.197*** (0.039)	0.076** (0.027)	0.266** (0.098)	0.090* (0.040)	0.121* (0.048)	0.086* (0.042)	0.134* (0.063)
β_3	0.170** (0.059)	0.262*** (0.032)	0.101 (0.066)	0.287*** (0.070)	0.135** (0.047)	0.225*** (0.048)	0.152** (0.044)	0.217** (0.060)
β_4	0.216*** (0.037)	0.243*** (0.051)	0.139** (0.049)	0.246* (0.101)	0.179*** (0.018)	0.165*** (0.030)	0.172*** (0.023)	0.180** (0.047)
β_5	0.187*** (0.034)	0.234*** (0.054)	0.086 (0.084)	0.295** (0.077)	0.144*** (0.028)	0.194** (0.054)	0.133** (0.034)	0.217** (0.062)
β_6	0.209*** (0.018)	0.288*** (0.033)	0.095 (0.091)	0.292** (0.089)	0.182*** (0.044)	0.238*** (0.020)	0.161** (0.041)	0.277*** (0.018)
β_7	0.084 (0.067)	0.263*** (0.037)	-0.019 (0.094)	0.216 (0.151)	0.047 (0.040)	0.193*** (0.033)	0.014 (0.043)	0.211*** (0.037)
β_8	0.006 (0.049)	0.145** (0.046)	-0.158 (0.117)	0.071 (0.160)	-0.031 (0.047)	0.123* (0.056)	-0.07 (0.069)	0.151* (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.

Conclusions

1. The evidence shows that the program had a **very strong and significant effect on exports and propensity to export**
2. **This effect is very robust** across samples and econometric specifications
3. **Timing is important** when assessing the impact of this kind of programs.
4. The evidence suggests that the **maximum effect** of the program can be found **in the fourth or fifth year after the intervention**
5. There is a **very weak evidence of an impact on sales**
6. **Future research** should explore **heterogeneities across sectors** and include **attention to externalities**.



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Data and Empirical Strategy

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
Foothware & 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

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Data and Empirical Strategy

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

Cluster/Sector	All firms			Restricted sample (positive sales in all year)		
	Trated	Control	Total	Trated	Control	Total
Food	24	3,464	3,488	23	1,091	1,114
Blubberies	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

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Data and Empirical Strategy

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	
	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
Foothware & Leather Goods	32		20		12	
Food	24	775	22	775	18	232
Viticulture	12		12		12	
Total	142	1,668	104	1668	70	719

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Results

Pre-treatment trends equality test on (log of) export

Sample 3: Firms that export the year before de PACC

	Full sample (1)	Matched sample (nearest neighbor)		Reweighted sample (4)
		1 neighbor (2)	5 neighbors (3)	
Treatment since 1 year before the PACC	-0.676 (0.406)	-0.333 (0.754)	-0.816 (0.559)	-0.544 (0.379)
Treatment since 2 years before the PACC	0.181 (0.666)	0.557 (0.693)	0.769 (0.702)	0.884 (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

Dependent variable: export in natural logarithm

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

Results

Pre-treatment trends equality test on propensity to export Sample 3: Firms that export the year before de PACC

	Full sample (1)	Matched sample (nearest neighbor)		Reweighted sample (4)
		1 neighbor (2)	5 neighbors (3)	
Treatment since 1 year before the PACC	-0.067 (0.040)	-0.006 (0.062)	-0.049 (0.050)	-0.029 (0.024)
Treatment since 2 years before the PACC	-0.008 (0.059)	-0.001 (0.078)	0.043 (0.068)	0.057 (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

Dependent variable: propensity to export (1=export, 0=no export)

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