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Victoria Castillo
Alessandro Maffioli
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Innovation Policy and Employment: Evidence from an Impact Evaluation in Argentina[1]

Victoria Castillo[2], Alessandro Maffioli[3], Sofía Rojo[4], and Rodolfo Stucchi[5]

Abstract

This paper presents the evaluation of the Enterprise Restructuring Support Program (PRE) in Argentina. The aim of the program was to increase the competitiveness of small and medium-sized enterprises (SME) by cofinancing technical assistance that can be classified as either support for process innovation or support for product innovation. Although these types of programs do not primarily aim to create jobs, they are implemented assuming that they do, or at least that they do not destroy jobs. This paper tests this assumption. It compares the impact of each type of support on employment and the type of employment measured by the wages paid by firms to their employees. To control for self-selection into the program, propensity score matching and difference in differences were combined. The study found that by supporting both process and product innovation-related activities, the program was able to create more and better jobs. The effect on wages was also found to be higher when supporting product innovation activities.

Keywords: innovation, employment, wages, policy evaluation, SMEs, Argentina
JEL codes: D2, J23, L8, O31, O33.

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[2] Ministry of Labor, Employment, and Social Security, Buenos Aires, Argentina.
[3] Office of Strategic Planning and Development Effectiveness, Inter-American Development Bank, Washington DC, USA.
[4] Ministry of Labor Employment, and Social Security, Buenos Aires, Argentina.
[5] Office of Strategic Planning and Development Effectiveness, Inter-American Development Bank, Washington DC, USA.

1. Introduction

The effect of innovation on employment is not straightforward. For a long time, innovation has been seen as a potential threat to employment, in particular when technological change may have led to the substitution of labor for capital. Over time, the discussion of this relationship has become much more sophisticated, taking into account how different types of innovations under different market conditions may have different effects on employment and employment composition. For instance, process innovation can lead to a substitution of labor for capital, but it can also increase productivity, lower prices, and increase demand, leading therefore to higher employment. Similarly, product innovation usually creates more demand, but it can also increase market power for innovators, raising prices and lowering demand.

The empirical evidence seems to support the hypothesis that innovation has an overall positive effect on employment, but that different effects should be expected from different types of innovation. Many studies have found that process innovation indeed tends to destroy jobs, but that it also creates jobs in greater proportion. Therefore, the net effect of innovation should result in higher employment (see, for example, Pianta, 2006; and Harrison et al., 2008), though at the aggregate level the increase in employment due to innovation could still be offset by the decreasing employment among noninnovators.

Innovation can also affect the skill composition of the labor force. New products and new processes may require specific skills that are not always readily available in the firm. This may lead to changes in the skill composition—either through training or through hiring of more skilled workers—which are likely to be revealed by in a increase in the average wage paid by innovating firms. Empirical evidence of these effects has been discussed, for example, in Berman et al., 1994; Bresnahan et al., 2002; Caroli and Van Reenen, 2001; and Greenan, 2003.

In Latin America, several studies aimed at addressing questions related to the effect of different types of innovation on the quantity of employment and the skill composition have been conducted applying the structural model in Harrison et al., 2008. These studies are Benavente and Lauterbach, 2008; and Alvarez et al., 2011 for Chile; de Elejalde et al., 2011 for Argentina; Monge et al., 2011 for Costa Rica; and Aboal et al., 2011 for Uruguay.

Less explored are the effects of innovation policy on employment and employment composition. Usually the main objective of policy instruments aimed at fostering firm-level innovation is increasing firms' productivity (or, more generally, their competitiveness).

However, this objective is almost always viewed as not contrasting, or even complementary, with generating employment and improving the skills of the firms' labor force. This is particularly true in developing countries and for programs aimed at fostering innovation in SMEs. These programs are often justified not only on the basis of their potential contribution to growth through productivity, but also by their potential beneficial effects on employment through the creation of new and better jobs. Although the literature on the effect on innovation programs in developing countries has been growing recently, very few studies have considered the effect of these policies on employment, even less on employment composition.

Hall and Maffioli (2008) discuss the results of an impact evaluation of technology development funds in Latin American, showing relevant positive results on employment generation in Brazil. Lopez Acevedo and Tan (2010) show evidence of some impact on employment generation in Mexico and Colombia and positive effects on wages in Chile. Although these studies provide some evidence of the potential positive effects of innovation policies on the labor markets of developing countries, none of them had specifically focused on exploring this topic or much less on analyzing the relationship between the types of innovation promoted by the policy instrument and the effect on employment.

This paper aims to contribute to the literature by evaluating the impact of the Enterprise Restructuring Support Program (Programa de Apoyo a la Reestructuracion Empresarial, or PRE) on employment and wages. The purpose of this program was to improve the competitiveness of Argentine SMEs by cofinancing up to 50 percent of technical assistance services. The program was demand-driven, and the assistance that firms received was provided by the private sector; firms interested in participating in the program needed to present a productive development plan detailing the technical assistance they would need and the consulting firm or independent professional that would provide that assistance. Although the program was open to any type of technical assistance, most of the firms requested (and received) support for innovation-related activities, which we classified into either support for product innovation or support for process innovation. Since these types of support can have different effects on innovation and wages, this paper evaluates the impact of each type of support separately, and aims to answer three questions: Did the firms that received support for process innovation increase employment or wages because of the program? Did the firms that received support for product innovation

increase employment or wages because of the program? Which type of support had a larger impact on employment and wages?

The PRE Program can be seen as an extension program. Thus, another contribution of the paper is to propose a rigorous measure of the impact of a manufacturing extension program. Most of the literature on extension programs deals with agricultural extension programs. Moreover, many of the studies lack a control group, and therefore suffer from selection bias, and/or failure to incorporate information about the characteristics of the services provided. This paper addresses these methodological problems.

The rest of the paper is organized as follows. Section 2 describes the program. Section 3 presents the identification strategy. Section 4 describes the dataset. Section 5 presents the empirical results. Finally, section 6 concludes.

2. The Program

The PRE was designed at the end of the 1990s in a particularly complex context for Argentine SMEs.[6] The increase in competition resulting from the trade liberalization policies implemented at the beginning of the 1990s threatened low-productivity firms and prompted SMEs to make changes to increase their competitiveness. In this context, the objective of the program was to increase the competitiveness of SMEs.

The main justification for the program was the existence of market failures related to information, indivisibilities, and non-convexities. On the one hand, SMEs did not employ up-to-date technology because they did not seem to be aware of the importance and availability of private or public support services. On the other hand, there was no market for consulting and technical assistance for SMEs. This lack of services reflected market failures related to indivisibilities and non-convexities that appeared because the fixed cost of providing consulting and technical assistance services does not significantly decrease with the size of the clients, although the revenues do.

The program aimed at increasing the competitiveness of Argentine SMEs through three components. The first promoted the use of existing public and private support programs by providing information about the programs and their eligibility requirements. The second

[6] The program was partially financed with a loan from the Inter-American Development Bank.

component was designed to develop a market for customized professional services for SMEs. Finally, the third component offered direct support to SMEs by cofinancing up to 50 percent of the investment in professional services and technical assistance. With a budget of US$154 million, the program cofinanced technical assistance services to 1,200 firms between 1999 and 2007.

During the eight years in which the program was implemented, the Argentine economy faced one of the most severe economic and institutional crises of its history. In that context, the program faced two reorganizations that led to different management stages. Although each management stage differed in terms of the program's administrative processes, the main characteristics of the program did not change. The program was always demand-driven, there was no list of services, and beneficiaries chose the independent professional or consulting firm that offered them the technical assistance that they needed. Similarly, the type of assistance cofinanced by the program did not change significantly across stages. Like other policies designed in the 1990s, the program was horizontal, that is, it did not establish eligibility requirements by sector or geographic region. The few eligibility requirements were related to size, age, and tax compliance: firms needed to be SMEs according to Argentine law, they needed to be least two years old, and they needed to be in good standing with both the fiscal and social security authorities.

A total of 1015 firms were beneficiaries at some point between 1999 and 2007 and were active in 1998.[7] A large majority of these firms requested support for process innovation; specifically, 749 firms received support for process innovation and only 167 firms received support for product innovation. In accordance with Harrison et al. (2008), we maintain that firms introducing a new product might need to change their production process. Therefore, if a firm asked for both product and process innovation support, we consider it to be asking for product innovation support. On the other hand, those firms that were classified as process innovators asked for support to change their production process without changing their products. Most of the firms that received support for innovation activities also asked for support for noninnovation activities. Only 99 firms received support for noninnovation-related activities only. Since the aim

[7] We consider firms that were active in 1998 because of our estimation strategy requires that all the firms are at the moment in which we estimate the propensity score and we estimate the propensity score the year before the beneficiaries receive support.

herein is to compare process and product innovation support, these firms were not considered in the evaluation. Another reason for not considering these firms is that the small number of beneficiaries in this category can affect the power of the test.

3. Identification Strategy

This study aims to evaluate the impact of the different technical assistance services that the firms received when they participated in the program. As will be discussed in detail in Section 4, a large panel of firms was consulted, in which it is possible to identify participants—before and after their participation in the program—as well as non-participants. This information allows us to identify the effect of the program on employment and wages using propensity score matching (PSM) and differences in differences (DID). We are interested in comparing different types of support and therefore we extend the standard identification strategy to consider several treatments.

Treatment can take three values, that is, T= j with j=(0,1,2). Treatment variable takes value zero when the firm receives no treatment. It takes value 1 when the firm receives support for product innovation. Finally, it takes value 2 when the firm receives support for process innovation. Let

$$0 < \pi_j(x) \equiv P(T=j|x) < 1 \qquad \text{for all j, x} \qquad (1)$$

be the propensity score. Note that $\pi_0(x) = 1 - \pi_j(x)$. To estimate π_j we use a multinomial logit model using j=0 as the omitted category. We estimate this model with the information before 1999 (the first year in which firms received support). By doing this, we do not include variables that can be affected by the program. The variables we include in x for the estimation of the propensity score are: employment in 1998; average wages in 1998; a dummy variable that takes value one if the firm exported in 1998; the ratio value of exports to employment in 1998; the proportion of women in 1998; the average growth in employment between 1996 and 1998; the average growth in wages between 1996 and 1998; the age of the firm; industry dummies; type of society dummies; and region dummies.

When there is more than one treatment there are many parameters of interest (Lee, 2005). For example, it is possible to do pair-wise comparisons or comparisons with the control. If we condition on two groups j and 0 (comparisons with the control group) and we define

$$\pi_{j|j0} = \frac{\pi_j(x)}{\pi_j(x) + \pi_0(x)}, \qquad (2)$$

then we have Tj+T0=1 and we can use $\pi_{j|j0(x)}$ for propensity score matching. After defining the propensity score in this way it is possible to apply a standard PSM and DID procedure. Therefore, after computing (2) for each treatment j, it is possible to apply matching to find non-participant firms with similar probability of receiving treatment j and to define a common support, CS_j, for each treatment j. Then, the impact of treatment j can be obtained by the estimate of δ_j in the following equation

$$y_{it} = \delta\, T_{j,i,t-1} + \alpha_j\, x_{it} + \mu_t + \mu_i + \varepsilon_{j,it}, \qquad i \in CS_j,\ j=(0,1,2) \qquad (3)$$

where y_{it} is the outcome variable (log of the number of employees and log of the average wage). $T_{j,i,t}$ is a variable that takes value one after firm i receives support j, we consider lagged values of the treatment variable because we do not expect a contemporaneous effect of the policy. x_{it} is a set of control variables; we include age and age squared as control variables. μ_t is a set of year dummies that capture all the time varying unobservable factors that affect all the firms in the same way. We will also consider another model that relaxes this assumption by interacting these year dummies with industry dummies. μ_i captures time invariant unobserved firm characteristics that can affect the decision of firm i to participate in the program or its performance. To control for these time-invariant firm characteristics, we estimate equation (3) by fixed effects. Finally, $\varepsilon_{j,it}$ is an error term that is not correlated with explanatory variables.

The set of year dummies plays an important role in the analysis herein. The period we consider showed important economic and institutional changes, and these variables aim at controlling for those changes. After a long recession that began in 1998, Argentina suffered a severe crisis in 2001. As a consequence of the crisis, there was a large devaluation of the Argentine peso and the government defaulted on its debt. In 2002, GDP contracted by 10.8 percent. A period of growth began in 2003 and lasted until the end of the program in 2007. An inflationary process accompanied the recovery. In terms of the current study, controlling for these factors is important because the recovery implied an increase in employment, and the inflationary process implied an increase in nominal wages. As far as these factors affect beneficiaries and non-beneficiaries, the set of dummy variables controls for their influence in employment and real wages.

4. Description of the Dataset

We used data from two different sources: (i) the administrative records of the program, and (ii) a dataset called BADE (Dataset for the Dynamic Analysis of Employment) that was constructed by OEDE (Observatory of Employment and Entrepreneurial Dynamics) at the Ministry of Labor, Employment, and Social Security in Argentina. These sources were produced by different institutions, at different moments in time, and with different objectives. This heterogeneity required a laborious process of consolidation of the data.

The program's administrative records provide detailed information about the main characteristics of the technical assistance, that is, the year in which it was offered, the amount cofinanced (ANR), the duration in months of the technical assistance, the type of firm that offered the services, and the type of service received by the firm.

The dataset constructed at OEDE includes data from administrative records of several public institutions; it contains information from the National Administration of Social Security (ANSES), the Federal Tax Administration (AFIP), and the National Customs Administration. The dataset is a panel of firms that includes all the firms declaring employment in Argentina after 1996. It covers the manufacturing, service, and primary sectors and has firm-level information including age of the firm, location, industry, number of employees, average wages, and value of exports. In 2008, the dataset included around 6 million workers and 570,000 firms.

The datasets were linked using the tax ID number of each firm. We were able to identify almost all of the beneficiaries of the program in BADE. Only 2 percent of the beneficiaries did not declare social security data and therefore did not appear in BADE.

The dataset has three important advantages. First, the large number of firms being considered increases the probability of finding non-participant firms with the same characteristics as participants. Second, the panel structure of the dataset allows us to control for time-invariant unobservables that may have determined the participation in each service of the program and the performance of firms. Finally, the availability of several years of information prior to program initiation allows us to provide some evidence in favor of the main assumption of the DID method, that is, that the trends of the outcome variables for controls and treated firms would have been identical in the absence of treatment.

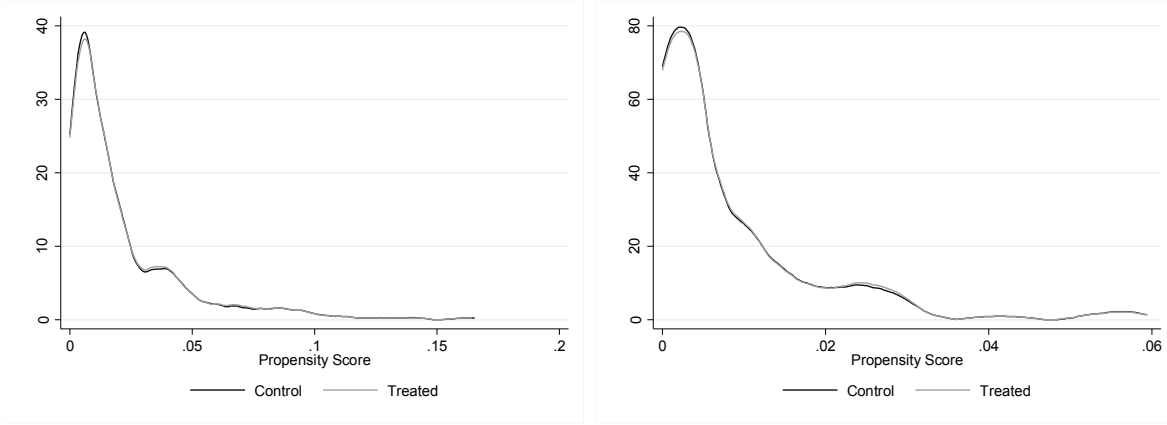
5. Empirical Results

We estimate equation (1) using a multinomial logit model for the categories: received support for process innovation, received support for product innovation, and not treated (omitted category). Table A1 in the Appendix shows the results of the estimation. As in the binary case, the coefficients are not the marginal effect. However, in this case, they do not even provide the sign of the marginal effect and therefore they are difficult to interpret and it is better to concentrate on the propensity score obtained according to equation (2).

We apply nearest neighbor matching with one neighbor to find, for each beneficiary, a non-beneficiary with a value similar to the propensity score. Figure 1 compares the distribution of the propensity score for the group of matched firms in the common support. Panel (a) shows the comparison between firms that received support for process innovation and non-beneficiaries, and Panel (b) the comparison between firms that received support for product innovation and non-beneficiaries. In both cases, the distribution of the propensity score for beneficiaries is equal to the distribution for non-beneficiaries showing that the matching was successful in finding firms with similar propensity scores.

Figure 1: Propensity Score Distributions on the Common Support

(a) Process innovation **(b) Product innovation**



Source: Authors' elaboration.

Our empirical strategy requires that in the absence of the program, both beneficiaries and non-beneficiaries have the same trend in employment and wages. This is a counterfactual that cannot be tested. However, it is possible to assume (and test) that if before receiving treatment beneficiaries and non-beneficiaries had the same trend in employment and wages, without treatment they would have the same trend in these variables. In this way, testing for this identification assumption requires testing the equality of trends in employment and wages between beneficiaries and non-beneficiaries in the period without program. Given that we included the trend of employment and wages between 1996 and 1998 in the estimation of the propensity score, we can test if after matching with the propensity score those trends are equal between beneficiaries and non-beneficiaries.

Table 1 shows the balance test for the treatment "support for process innovation." It is not possible to reject the hypothesis that after matching, treated and control firms had the same trend in employment and wages before the beginning of the program.

This table shows not only that the trend in outcome variables is balanced, but also that every characteristic we observe is balanced between beneficiaries and non-beneficiaries. Moreover, Table 1 also shows an overall test of balance. The pseudo R-square of a probit model for participation in support for process innovation activities vis-à-vis not participating in the program is 0.23 in the full sample. This means that the observables included in the model can explain the participation in support for process innovation activities. The likelihood ratio test rejects the null hypothesis that the model cannot explain participation with a p-value of zero. On the other hand, when we estimate the same model in the sample of matched firms, the pseudo R-square is 0.01 and the test cannot reject the null hypothesis that the model does not explain participation. This finding allow us to conclude with confidence that treated and control firms were similar enough in the period without program—even in their growth in employment and wages—and that any difference we find after the program can be attributed to participation in the program.

Table 1: Balance Test, Support for Process Innovation

		Mean			% reduct	t-test	
Variable	**Sample**	**Treated**	**Control**	**% bias**	**|bias|**	**T**	**p>|t|**
Wages (in log)	Unmatched	6.281	5.948	68.10		18.47	0.000
	Matched	6.289	6.298	-1.90	97.10	-0.32	0.746
Number of employees (in logs)	Unmatched	2.887	0.834	158.20		44.27	0.000
	Matched	3.002	3.020	-1.40	99.10	-0.29	0.775
Number of employees squares (square of logs)	Unmatched	10.109	2.287	124.70		47.27	0.000
	Matched	10.485	10.491	-0.10	99.90	-0.01	0.989
Age	Unmatched	14.232	8.014	49.40		16.13	0.000
	Matched	15.041	14.749	2.30	95.30	0.38	0.705
Age squared	Unmatched	407.970	175.270	34.30		11.64	0.000
	Matched	434.330	426.370	1.20	96.60	0.18	0.854
Workers experience	Unmatched	8.699	5.835	35.60		10.01	0.000
	Matched	9.040	8.700	4.20	88.10	0.77	0.443
Workers experience squared	Unmatched	145.520	93.653	22.30		6.06	0.000
	Matched	151.300	143.460	3.40	84.90	0.63	0.529
Proportion of women	Unmatched	0.214	0.256	-13.50		-3.08	0.002
	Matched	0.212	0.205	2.40	82.40	0.60	0.550
Average growth in employment 1996–1998	Unmatched	0.222	0.112	26.10		6.19	0.000
	Matched	0.220	0.255	-8.40	67.70	-1.59	0.113
Average growth of wages 1996–1998	Unmatched	0.016	-0.004	14.70		3.42	0.001
	Matched	0.016	0.018	-1.50	89.60	-0.25	0.802
Dummy exported in 1998	Unmatched	0.254	0.012	75.90		58.86	0.000
	Matched	0.268	0.242	8.10	89.40	1.10	0.271
The owner of the firm is one person	Unmatched	0.093	0.572	-117.80		-26.45	0.000
	Matched	0.084	0.087	-0.70	99.40	-0.19	0.849
Incorporated company	Unmatched	0.856	0.226	163.10		41.21	0.000
	Matched	0.866	0.862	1.10	99.30	0.23	0.816
Other societies	Unmatched	0.043	0.112	-26.10		-6.01	0.000
	Matched	0.041	0.044	-1.10	95.90	-0.26	0.792
Located in Gran Buenos Aires	Unmatched	0.463	0.409	11.00		3.03	0.002
	Matched	0.463	0.442	4.30	60.80	0.80	0.422
Located in center	Unmatched	0.401	0.380	4.20		1.15	0.251
	Matched	0.397	0.403	-1.20	72.00	-0.22	0.828
Located in Cuyo	Unmatched	0.045	0.059	-6.00		-1.55	0.122
	Matched	0.047	0.046	0.60	89.30	0.13	0.899
Located in northeast	Unmatched	0.008	0.049	-24.70		-5.18	0.000
	Matched	0.009	0.003	3.50	86.00	1.42	0.156
Located in northwest	Unmatched	0.059	0.054	2.20		0.62	0.533
	Matched	0.058	0.083	-10.50	-371.90	-1.77	0.076
Located in Patagonia	Unmatched	0.024	0.050	-13.80		-3.26	0.001
	Matched	0.026	0.024	0.80	94.50	0.17	0.864
Agriculture, hunting, and forestry	Unmatched	0.027	0.140	-41.80		-8.92	0.000
	Matched	0.028	0.031	-1.10	97.50	-0.31	0.754
Fishing	Unmatched	0.003	0.001	4.80		2.01	0.045
	Matched	0.003	0.003	0.00	100.00	0.00	1.000
Mining and quarrying	Unmatched	0.009	0.002	9.90		4.60	0.000
	Matched	0.010	0.011	-1.90	80.80	-0.26	0.795
Manufacturing: food and beverages	Unmatched	0.053	0.029	12.30		3.99	0.000
	Matched	0.057	0.058	-0.70	94.20	-0.11	0.909
Manufacturing: textiles	Unmatched	0.035	0.018	10.20		3.35	0.001
	Matched	0.036	0.044	-5.30	48.00	-0.82	0.414
Manufacturing: wood and paper	Unmatched	0.045	0.018	15.80		5.69	0.000
	Matched	0.047	0.058	-6.50	58.70	-0.96	0.340
Manufacturing: chemical and plastic products	Unmatched	0.097	0.011	38.90		22.58	0.000

	Matched	0.095	0.090	2.60	93.40	0.37	0.713
Manufacturing: metals	Unmatched	0.107	0.022	34.80		15.52	0.000
	Matched	0.111	0.098	5.30	84.80	0.78	0.433
Manufacturing: machinery and equipment	Unmatched	0.069	0.006	33.40		21.30	0.000
	Matched	0.070	0.054	8.30	75.10	1.22	0.224
Manufacturing: electrical machinery and electronics	Unmatched	0.041	0.004	25.50		16.60	0.000
	Matched	0.041	0.036	3.90	84.80	0.55	0.579
Manufacturing: automobiles and motors	Unmatched	0.064	0.004	33.50		25.32	0.000
	Matched	0.067	0.060	4.00	88.10	0.55	0.584
Manufacturing: furniture	Unmatched	0.025	0.008	13.10		5.04	0.000
	Matched	0.027	0.030	-2.20	83.20	-0.32	0.749
Electricity, gas, and water supply	Unmatched	0.004	0.001	5.00		1.89	0.058
	Matched	0.004	0.009	-8.20	-64.50	-1.00	0.316
Construction	Unmatched	0.053	0.041	5.90		1.73	0.084
	Matched	0.056	0.053	1.30	77.20	0.24	0.814
Wholesale and retail trade	Unmatched	0.187	0.260	-17.60		-4.55	0.000
	Matched	0.179	0.201	-5.10	70.70	-1.02	0.308
Hotels and restaurants	Unmatched	0.009	0.042	-20.90		-4.49	0.000
	Matched	0.010	0.001	5.40	74.20	2.13	0.033
Transport, storage and communications	Unmatched	0.035	0.093	-24.00		-5.49	0.000
	Matched	0.030	0.040	-4.10	82.90	-1.02	0.309
Financial intermediation	Unmatched	0.003	0.005	-4.20		-0.99	0.322
	Matched	0.003	0.004	-2.30	45.90	-0.45	0.654
Real estate, renting, and business activities	Unmatched	0.073	0.156	-26.20		-6.25	0.000
	Matched	0.070	0.067	0.90	96.60	0.21	0.833
Education	Unmatched	0.004	0.015	-11.50		-2.50	0.012
	Matched	0.004	0.001	2.90	74.50	1.00	0.317
Health and social work	Unmatched	0.040	0.042	-1.10		-0.30	0.767
	Matched	0.040	0.036	2.20	-96.00	0.42	0.675
Other community, social and personal service activities	Unmatched	0.015	0.080	-31.00		-6.57	0.000
	Matched	0.011	0.014	-1.40	95.60	-0.47	0.635
Sample	Pseudo R2	LR chi2	p>chi2				
Unmatched	0.230	2333.89	0.000				
Matched	0.013	25.64	0.962				

Source: Authors' elaboration.

Table 2 shows the same balance tests for the treatment "support for product innovation." As in the previous case, the matching algorithm is successful and it allows us to work with a sample of firms that did not receive support for product innovation and which, before the beginning of the program, had the same observable characteristics as those firms that received the support—including the trend in employment and wages before the program was applied.

A related result in Table 2 that shows that the matching was successful is the capacity of selecting control firms by industry. Even when no eligibility conditions were imposed in terms of industry, there are no beneficiaries from some industries—for example, fishing or mining—and the matching algorithm did not select any control firm from those industries.

Table 2: Balance Test, Support for Product Innovation

		Mean			% reduct	t-test	
Variable	**Sample**	**Treated**	**Control**	**% bias**	**|bias|**	**t**	**p>|t|**
Wages (in log)	Unmatched	6.175	5.948	46.10		5.97	0.000
	Matched	6.190	6.265	-15.20	67.00	-1.24	0.214
Number of employees (in logs)	Unmatched	2.813	0.834	155.70		20.21	0.000
	Matched	2.923	2.849	5.80	96.30	0.57	0.568
Number of employees squared (square of logs)	Unmatched	9.540	2.287	122.80		20.79	0.000
	Matched	9.855	9.455	6.80	94.50	0.50	0.616
Age	Unmatched	13.084	8.014	42.10		6.22	0.000
	Matched	13.711	13.038	5.60	86.70	0.43	0.665
Age squared	Unmatched	349.320	175.270	28.40		4.12	0.000
	Matched	366.740	372.970	-1.00	96.40	-0.07	0.941
Workers experience	Unmatched	7.524	5.835	22.70		2.82	0.005
	Matched	7.855	7.349	6.80	70.00	0.62	0.534
Workers experience squared	Unmatched	107.340	93.653	6.60		0.76	0.446
	Matched	112.060	108.450	1.80	73.60	0.17	0.869
Proportion of women	Unmatched	0.250	0.256	-1.60		-0.18	0.854
	Matched	0.246	0.246	0.10	95.80	0.01	0.994
Average growth in employment 1996–1998	Unmatched	0.190	0.112	19.90		2.08	0.037
	Matched	0.190	0.190	0.00	99.90	0.00	0.998
Average growth of wages 1996–1998	Unmatched	0.011	-0.004	11.10		1.21	0.226
	Matched	0.011	0.024	-9.00	19.00	-0.93	0.354
Dummy exported in 1998	Unmatched	0.293	0.012	84.50		32.65	0.000
	Matched	0.302	0.283	5.70	93.30	0.37	0.713
The owner of the firm is one person	Unmatched	0.108	0.572	-112.30		-12.12	0.000
	Matched	0.094	0.075	4.60	95.90	0.60	0.548
Incorporated company	Unmatched	0.826	0.226	150.30		18.55	0.000
	Matched	0.843	0.855	-3.10	97.90	-0.31	0.755
Other societies	Unmatched	0.066	0.112	-16.20		-1.89	0.059
	Matched	0.063	0.069	-2.20	86.40	-0.23	0.822
Located in Gran Buenos Aires	Unmatched	0.473	0.409	13.00		1.69	0.091
	Matched	0.478	0.472	1.30	90.20	0.11	0.911
Located in center	Unmatched	0.401	0.380	4.30		0.56	0.576
	Matched	0.390	0.358	6.40	-49.60	0.58	0.564
Located in Cuyo	Unmatched	0.084	0.059	9.80		1.38	0.167
	Matched	0.088	0.120	-12.20	-25.10	-0.92	0.359
Located in northeast	Unmatched	0.012	0.049	-21.50		-2.21	0.027
	Matched	0.013	0.019	-3.70	82.90	-0.45	0.653
Located in northwest	Unmatched	0.024	0.054	-15.40		-1.70	0.089
	Matched	0.025	0.025	0.00	100.00	0.00	1.000
Located in Patagonia	Unmatched	0.006	0.050	-26.90		-2.61	0.009
	Matched	0.006	0.006	0.00	100.00	0.00	1.000
Agriculture, hunting, and forestry	Unmatched	0.042	0.140	-34.50		-3.65	0.000
	Matched	0.044	0.044	0.00	100.00	0.00	1.000
Fishing	Unmatched	0.000	0.001	-3.80		-0.34	0.730
	Matched	0.000	0.000	0.00	100.00	.	.
Mining and quarrying	Unmatched	0.000	0.002	-6.20		-0.57	0.569
	Matched	0.000	0.000	0.00	100.00	.	.
Manufacturing: food and beverages	Unmatched	0.090	0.029	25.90		4.69	0.000
	Matched	0.094	0.050	18.70	27.70	1.52	0.130
Manufacturing: textiles	Unmatched	0.036	0.018	10.90		1.70	0.089
	Matched	0.038	0.019	11.60	-6.90	1.01	0.312
Manufacturing: wood and paper	Unmatched	0.048	0.018	16.90		2.94	0.003
	Matched	0.050	0.082	-17.70	-4.50	-1.13	0.260
Manufacturing: chemical and plastic products	Unmatched	0.120	0.011	45.00		13.47	0.000

	Matched	0.120	0.113	2.60	94.20	0.17	0.862
Manufacturing: metals	Unmatched	0.066	0.022	21.20		3.78	0.000
	Matched	0.069	0.082	-6.10	71.00	-0.42	0.672
Manufacturing: machinery and equipment	Unmatched	0.156	0.006	56.70		23.94	0.000
	Matched	0.151	0.145	2.40	95.80	0.16	0.875
Manufacturing: electrical machinery and electronics	Unmatched	0.048	0.004	28.00		9.25	0.000
	Matched	0.050	0.069	-12.00	57.20	-0.71	0.479
Manufacturing: automobiles and motors	Unmatched	0.018	0.004	13.20		2.79	0.005
	Matched	0.019	0.031	-12.00	9.10	-0.71	0.475
Manufacturing: furniture	Unmatched	0.060	0.008	28.50		7.25	0.000
	Matched	0.063	0.082	-10.50	63.30	-0.65	0.518
Electricity, gas, and water supply	Unmatched	0.000	0.001	-5.30		-0.49	0.628
	Matched	0.000	0.000	0.00	100.00	.	.
Construction	Unmatched	0.030	0.041	-5.90		-0.71	0.475
	Matched	0.025	0.019	3.40	42.60	0.38	0.703
Wholesale and retail trade	Unmatched	0.126	0.260	-34.40		-3.95	0.000
	Matched	0.120	0.088	8.10	76.50	0.92	0.359
Hotels and restaurants	Unmatched	0.006	0.042	-23.90		-2.34	0.020
	Matched	0.006	0.006	0.00	100.00	0.00	1.000
Transport, storage, and communications	Unmatched	0.012	0.093	-36.90		-3.60	0.000
	Matched	0.013	0.006	2.90	92.20	0.58	0.563
Financial intermediation	Unmatched	0.000	0.005	-10.30		-0.94	0.345
	Matched	0.000	0.000	0.00	100.00	.	.
Real estate, renting and business activities	Unmatched	0.108	0.156	-14.40		-1.73	0.084
	Matched	0.107	0.107	0.00	100.00	0.00	1.000
Education	Unmatched	0.006	0.015	-9.00		-0.97	0.332
	Matched	0.000	0.000	0.00	100.00	.	.
Health and social work	Unmatched	0.018	0.042	-14.20		-1.56	0.119
	Matched	0.019	0.031	-7.40	48.20	-0.71	0.475
Other community, social, and personal service activities	Unmatched	0.012	0.080	-32.80		-3.23	0.001
	Matched	0.013	0.025	-6.10	81.40	-0.82	0.411
Sample	Pseudo R2	LR chi2	p>chi2				
Unmatched	0.221	610.31	0.000				
Matched	0.042	18.45	0.986				

Source: Authors' elaboration.

Tables 1 and 2 allow us to focus our main objective, the impact of each type of support on firms' performance. As expected in this type of program, the program was effective in improving firms' competitiveness as measured by their survival and exporting probability. We consider linear probability models, that is, we estimate equation (3) for each type of support considering two binary dependent variables; a dummy for survival and a dummy for exporters. These linear probability models allow us to control for unobserved time invariant firm characteristics that can affect the decision of participating in the program and the performance in terms of survival and exports. Table 3 shows the results of the estimation. Both process and product innovation support increased the exporting and survival probabilities. However, the impact of product innovation support is higher. This result is consistent with the fact that firms

with new or upgraded products can compete more efficiently both in the local and the international markets.

Table 3: The Impact of the Program on Exporting and Survival Probabilities

	Support for process innovation				Support for product innovation			
	All firms	Common support	All firms	Common support	All firms	Common support	All firms	Common support
	[1a]	[2a]	[3a]	[4a]	[1b]	[2b]	[3b]	[4b]
Dependent variable: dummy exports in period t								
PRE t-1	0.0481***	0.0298***	0.0482***	0.0293***	0.0738***	0.0590***	0.0739***	0.0582***
	[0.00714]	[0.00844]	[0.00714]	[0.00843]	[0.0165]	[0.0202]	[0.0165]	[0.0202]
Age			0.00114***	0.00613***			0.00112***	0.00674*
			[4.31e-05]	[0.00157]			[4.28e-05]	[0.00374]
Age squared			-2.07e-06**	-4.95e-05**			-2.12e-06**	-0.000122**
			[9.59e-07]	[2.51e-05]			[9.53e-07]	[6.00e-05]
R-squared	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02
Dependent variable: survives in period t								
PRE t-1	0.0335***	0.0061	0.0288***	0.00659*	0.0354***	0.0214**	0.0326***	0.0218**
	[0.00323]	[0.00393]	[0.00322]	[0.00393]	[0.00702]	[0.00996]	[0.00701]	[0.00995]
Age			-0.0144***	-0.00744***			-0.0144***	-0.00884***
			[5.34e-05]	[0.000640]			[5.35e-05]	[0.00139]
Age squared			0.000113***	5.30e-05***			0.000113***	6.33e-05***
			[1.01e-06]	[9.97e-06]			[1.02e-06]	[1.98e-05]
R-squared	0.05	0.03	0.06	0.03	0.05	0.03	0.06	0.04
Number of Obs.	2,535,028	12,966	2,535,028	12,966	2,529,388	2,871	2,529,388	2,871
Number of firms	355,204	1,400	355,204	1,400	354,661	318	354,661	318

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' elaboration.

Innovation support programs have the objective of increasing firms' productivity—or more generally, their competitiveness—and they are applied with the implicit assumption that they also create more and better jobs, or at least that they do not destroy employment. Given the debate in terms of the relationship between innovation and employment, we now focus our attention on the impact of each type of innovation support on employment and employment quality measured by real wages. Table 4 shows the estimates of equation (3) for two dependent variables: the log of the number of employees and the log of wages.

The impact of the support for innovation on employment is quantitatively large and highly significant. The support for process innovation increased employment by 22 percent, and the support for product innovation increased employment by 19 percent. The impact is quantitatively important even if we consider that the program aimed at supporting SMEs and we translate it in terms of the number of employees. The average number of employees of

beneficiaries and non-beneficiaries in the matched sample in 1998 was close to 40, of which 20 percent represents approximately 8 workers per firm.

Table 4: The Impact of the Program on Employment and Wages

	Support for process innovation				Support for product innovation			
	All firms [1a]	Common support [2a]	All firms [3a]	Common support [4a]	All firms [1b]	Common support [2b]	All firms [3b]	Common support [4b]
Dependent variable: log (number of employees)								
PRE t-1	0.230***	0.227***	0.239***	0.223***	0.118***	0.195***	0.123***	0.192***
	[0.0143]	[0.0177]	[0.0143]	[0.0176]	[0.0319]	[0.0399]	[0.0318]	[0.0398]
Age	-	-	0.00398***	0.0234***			0.00388***	0.0109
			[0.000215]	[0.00378]			[0.000215]	[0.00774]
Age squared	-	-	-0.000208***	-0.000422***			-0.000208***	-0.000381***
			[3.76e-06]	[4.92e-05]			[3.77e-06]	[0.000109]
R-squared	0.03	0.07	0.03	0.08	0.03	0.06	0.03	0.07
Dependent variable: log (wages)								
PRE t-1	0.0359***	0.0210***	0.0425***	0.0195***	0.0419***	0.0452***	0.0459***	0.0437***
	[0.00576]	[0.00725]	[0.00572]	[0.00723]	[0.0129]	[0.0158]	[0.0128]	[0.0157]
Age			0.134***	0.137***			0.134***	0.139***
			[0.000125]	[0.00155]			[0.000125]	[0.00307]
Age squared			-0.000159***	-0.000167***			-0.000159***	-0.000238***
			[2.12e-06]	[2.03e-05]			[2.13e-06]	[4.19e-05]
R-squared	0.78	0.83	0.78	0.83	0.78	0.82	0.78	0.83
Number of Obs.	2,535,028	12,966	2,535,028	12,966	2,529,388	2,871	2,529,388	2,871
Number of firms	355,204	1,400	355,204	1,400	354,661	318	354,661	318

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' elaboration.

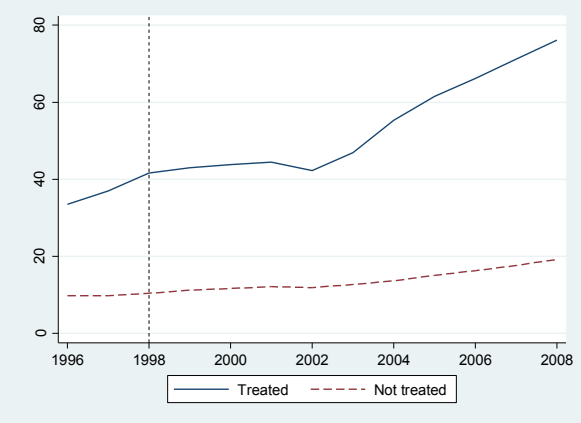
The effect of the support received for each type of innovation activity on employment is evident in Figure 2, which shows the evolution of the average number of employees for non-beneficiaries and beneficiaries both for process (Panel a) and product (Panel b) innovation. The first part of each panel shows the evolution in the full sample and the second part shows the comparison for those firms in the matched sample. The first conclusion that can be derived from this figure is that beneficiaries were different from non-beneficiaries even before the program started and it is necessary to find a proper control group. In the common support (matched sample), the story is completely different. Before the first beneficiaries received support, non-beneficiaries were similar to beneficiaries—another way of stating that the matching is successful—and after the beneficiaries received the support, there is a gap between beneficiaries and non-beneficiaries. This figure shows that beneficiaries were not as affected by the recession

as non-beneficiaries and that they created more jobs than non-beneficiaries during the period of economic expansion.

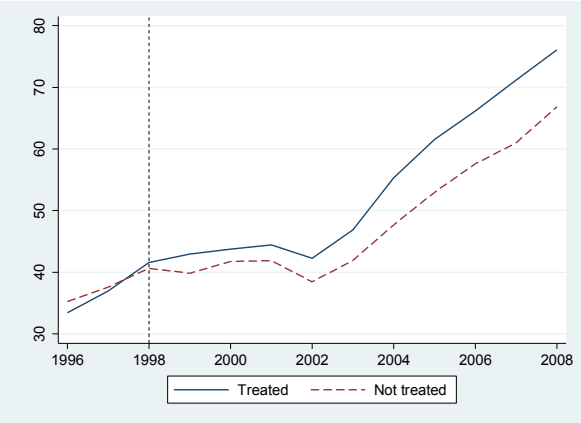
Figure 2: Number of Employees

(a) Support for process innovation

(a.1) All firms

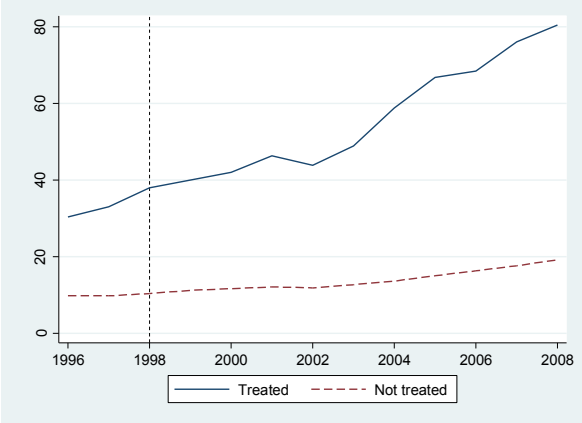


(a.2) Common support

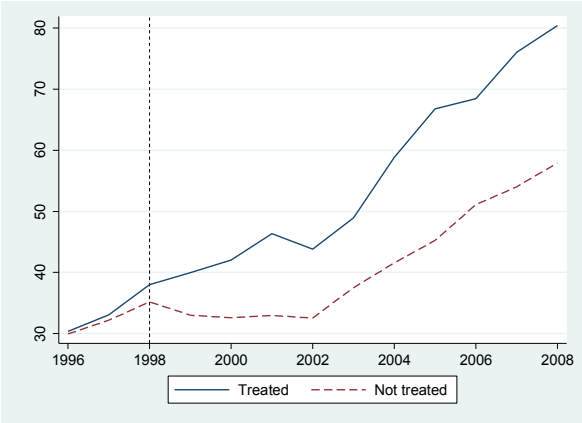


(b) Support for product innovation

(b.1) All firms



(b.2) Common support



Source: Authors' elaboration.

Table 4 also shows that the program created better jobs. Although the impact of each type of support on real wages is lower than the effect on the number of employees, it is also quantitatively significant. The support for process innovation increased real wages by 2 percent, and the support for product innovation increased real wages by 4.4 percent. It is interesting to note that the impact of product innovation support on real wages is more than twice as large as

the effect of process innovation support. This finding is similar to the findings in Table 3 for the survival and exporting probabilities.

6. Conclusions

This paper evaluates the impact of the Argentine SME support program PRE on employment and wages. The program's aim is to improve firms' competitiveness by supporting process and product innovation-related activities. Although these types of programs do not directly aim to increase employment, they assume that the policy will also create employment or at least will not destroy employment. There is some debate on the effect of innovation on employment and almost no evidence on the effect of innovation policies on employment. Therefore the main contribution of the paper is in showing that this assumption was correct. The program-supported innovation activities improved the competitiveness of the firms and led them to create more and better jobs.

The impact of the program on employment was considerable. The impact of the support for process innovation on employment was 22 percent, and the impact of the support for product innovation was 19 percent. Before the program, beneficiary firms had an average of 40 employees; the impact of the program represents approximately 8 workers per firm.

Although the impact of the program on real wages was lower than the impact on employment, it was also quantitatively important. The impact of the support for process innovation increased real wages by 2 percent and the support for product innovation increased real wages by 4.5 percent.

The impact of the support for product innovation activities on real wages, exporting, and survival probability was larger than the impact of the support for process innovation. This is related to the fact that firms with new products are able to compete more efficiently in local and foreign markets.

Our findings are based on quasi-experimental techniques that allowed us to control for self-selection of firms into each type of support activity and, therefore, to identify their causal effect. We applied DID on a common support of beneficiary and non-beneficiary firms for each type of innovation support. With this technique, we also controlled for the unobservable time-constant firm characteristics that could simultaneously affect firms' propensity to participate in the program and their performance. In order to reinforce the credibility of our DID approach, we

included the pre-program trends of outcome variables in the estimation of the propensity score and we restricted the analysis to a common support of firms with equal trends in the outcome variables before the program's commencement.

Our analysis is limited to the estimation of the program's effectiveness. A cost-effectiveness analysis would require a detailed estimation of the program's costs and is beyond the scope of this study. It is also worth noting that in the presence of spillovers, our estimates could be underestimating the effect of the program because the firms we are considering as controls could have received benefits in terms of spillovers. The study of spillovers would require identifying the mechanism through which the spillovers take place and is also beyond the scope of this paper. An area for further research would be to estimate its impact on the supply of consultancy services for SMEs.

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Table A1: The Probability of Participating in Each Activity. Multinomial Logistic Regression

	Support for product innovation			Support for process innovation		
	Coef.	**Std. Err.**		**Coef.**	**Std. Err.**	
Wages (in logs)	-0.132	0.179		0.118	0.084	
Number of employees (in logs)	1.959	0.285	***	1.675	0.126	***
Number of employees (square of logs)	-0.236	0.045	***	-0.191	0.019	***
Age	0.038	0.027		0.024	0.014	*
Age squared	0.000	0.000		0.000	0.000	
Workers experience	-0.029	0.057		-0.014	0.026	
Workers experience squared	-0.002	0.002		-0.001	0.001	
Proportion of women	0.827	0.363	**	-0.081	0.195	
Average growth in employment 1996-1998	-0.080	0.224		0.165	0.095	*
Average growth in wages 1996	0.347	0.631		0.550	0.275	**
Dummy exported in 1998	0.664	0.232	***	0.706	0.120	***
The owner of the firm is one person	16.965	1.677	***	0.719	0.458	
Incorporated company	18.297	1.703	***	2.137	0.442	***
Other societies	17.572	1.704	***	0.977	0.476	**
Located in Gran Buenos Aires	1.265	1.010		0.003	0.247	
Located in center	1.896	1.011	*	0.669	0.248	***
Located in Cuyo	1.802	1.038	*	0.052	0.297	
Located in northeast	0.802	1.229		-0.904	0.475	*
Located in northwest	1.108	1.121		0.653	0.287	**
Agriculture, hunting, and forestry	0.217	0.816		-0.126	0.434	
Fishing	-30.322	9633255.000	(a)	0.784	0.806	
Mining and quarrying	-29.800	5637620.000	(a)	1.485	0.535	***
Manufacturing: food and beverages	1.325	0.763	*	0.946	0.403	**
Manufacturing: textiles	0.579	0.823		0.883	0.421	**
Manufacturing: wood and paper	1.373	0.801	*	1.334	0.410	***
Manufacturing: chemical and plastic products	1.944	0.763	**	1.702	0.396	***
Manufacturing: metals	1.375	0.787	*	1.779	0.392	***
Manufacturing: machinery and equipment	2.805	0.763	***	1.938	0.406	***
Manufacturing: electrical machinery and electronics	2.394	0.812	***	2.157	0.422	***
Manufacturing: automobiles and motors	1.230	0.933		2.320	0.406	***
Manufacturing: furniture	2.342	0.789	***	1.565	0.439	***
Electricity, gas, and water supply	-28.405	5433679.000	(a)	1.519	0.691	**
Construction	-0.158	0.885		0.710	0.408	*
Wholesale and retail trade	0.220	0.748		0.773	0.378	**
Hotels and restaurants	-1.151	1.226		-0.435	0.527	
Transport, storage and communications	-0.640	1.008		0.164	0.429	
Financial intermediation	-29.628	3374209.000	(a)	-0.292	0.800	
Real estate, renting, and business activities	1.130	0.750		0.893	0.391	**
Education	-30.063	1947634.000	(a)	-0.876	0.685	
Health and social work	-0.386	0.925		0.898	0.418	**
Constant	-29.791	.		-12.048	0.781	***
Number of observations					355363	
LR chi2 (df) (p-value)					2928.99	(82) (0.0000)
Log likelihood					-4992.9967	
Pseudo R2					0.2268	

Source: Authors' elaboration.