

Public Support to Firm's Innovation: The Chilean FONTEC Experience

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Abstract

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1 Introduction

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2 Conceptual Antecedents and Empiric Evidence

2.1. **Market Failures: Technology**

The need of providing financial support to private investment in innovation projects has been quite extensively debated within the economic literature. Nowadays, it is theoretically acknowledged and empirically documented³ that there are many market failures that lead the private sector to under-invest in innovation. Market failures arise for four main sets of reasons: (i) investments in innovation are limited by the “incomplete appropriability” problem; (ii) asymmetric information and moral hazard limit the possibility to obtain funding from financial intermediaries; (iii) “network faults” exist when the cost of being associated to networks does not take into account the value contributed by the new member, which in many cases frustrates its incorporation; (iv) in general the assets that are generated in R&D projects are intangible, reason for which they do not represent a certain guarantee for the commercial bank, being outside the possibility of this type of financing.

On the other hand, the asymmetric information can cause coordination problems, being able to take them to the duplication of efforts, in the measurement that two companies embark separately in a project that could have benefit for both and whose costs could assume altogether; the diffusion in this scene also gets stuck.

As first described by Nelson (1959) and Arrow (1962), to the extent that knowledge can not be kept secret, the returns from investing in the production of science and technology cannot be fully appropriated by the investor; the private returns associated with an investment in S&T are therefore much lower than the social ones. Furthermore, the non-rival and cumulative character of knowledge intensifies the difficulty to compensate for the non appropriable profits, causing a greater sub-optimality in the allocation of resources, which is increased as well due to the high component of uncertainty and to the indivisibilities that entail knowledge investments. On the basis of this argument, it is expected that, even considering the existence of intellectual property rights legislation, in the absence of policy intervention the social rate of return on R&D expenditure would exceed the private one, thus the level of investment in R&D would be too low from a social point of view. Griliches (1992) and Hall (1996) present evidence in this direction, highlighting the presence of important spillovers in knowledge generation activities.⁴

³ See, for example, Levin et al. (1987), Mansfield et al. (1981) and Martin and Scott (2001).

⁴ Jaffe (1998) distinguishes between three types of spillovers generated by R&D activities: i) the knowledge generated by one agent could be used by another agent without any compensation (knowledge spillovers); ii) the availability of a new product or process in the

Hall (2002) is the appropriate reference for studying the financial market failures that may lead to underinvestment in innovation activities. This work draws upon Arrow (1962) which claims for the existence of an additional gap between the private rate of return and the cost of capital when the innovator and the financier of that innovation are two different entities. The main argument lies in the fact that “some innovations will fail to be provided purely because the cost of external capital is too high, even when they would pass the private returns hurdle if funds were available at a ‘normal’ interest rate” (Hall, p. 3).⁵ Financial market failures have been a key rationale for R&D public funding. Some econometric evidence shows that small and new R&D intensive firms often receive the most significant impacts of funding, and they are precisely the most affected by financial constraints.⁶ However, the argument may not be so relevant for large and established firms which are less likely to be financially constrained.

Some additional qualifications have been made in relation to the underinvestment argument. On the one hand, Martin and Scott (2000) emphasize that the forces leading to underinvestment differ from sector to sector; depending on the particular sources of innovation failures. Mani (2004), in turn, posits that their relevance also differs from developed to developing countries. On the other hand, as the works by Mansfield *et al.* (1981) and Levin *et al.* (1987) document, the high cost of imitating some innovations could mitigate the appropriability problem in some cases, especially when patent laws fulfill their theoretical role⁷. The possibility of underinvestment in R&D has been considered also by the literature dealing with the rent seekers’ behavior. As the games developed by Fundenberg and Tirole (1987) or Anderson *et al.* (1997) illustrate, the competition between firms seeking for a competitive advantage could lead to that phenomenon.

Finally, some evolutionary scholars (Nelson and Winter 1982, Dosi 1988, Dosi and Nelson 1994, Metcalfe 1994, Cimoli and Dosi 1995) attempted to overcome what they define as “the market failure approach” by proposing a new innovation policy framework (Teubal 1999). These scholars point out the need of addressing “failures” connected to the dynamic, collective, uncertain and discontinuous nature of the innovation process. This implies that in their perspective the public intervention is not only justified in the conventional cases of the market failure, such as basic scientific knowledge as a public

market with prices that do not fully reflect its improved properties could benefit the clients of the firm (market spillovers) and iii) the commercial or economic value of a new technology may strongly depend on a related group of technologies (network spillovers). Klette *et al.* (2000) develop a framework to test econometrically the presence of these different forms of spillovers.

⁵ Therefore the model assumes that the Modigliani-Miller theorem fails in the case of the R&D investments, since the cost of internal and external resources is assumed to be different. According to Hall (2000), three different reasons can justify this assumption: 1) asymmetric information between the inventor and the investor; 2) moral hazard on the side of the inventor arising from the separation between ownership and management; 3) different impact of taxes on external with respect to internal source of funding.

⁶ See for example Klette and Moen (1999), Hall (2002) and Duguet (2003).

⁷ Patents would be efficient when knowledge can be easily codified and innovations cannot be circumvented (Mansfield *et al.*, 1981).

good⁸ or moral hazard and adverse selection in the innovation processes, but also in cases of “non-market failure”, such as the lack of linkages within the National Innovation System (NIS) and the reduced absorption capacity of the agents within the system.⁹

2.2. The Program: FONTEC¹⁰

FONTEC program is a Chilean National Fund for Technological and Productive Development. FONTEC aims at supporting the introduction and adoption of products and process innovation by Chilean firms.

The fund is aimed at promoting and financing innovation projects that involve private firms and at supporting the development of commercial applications of scientific and technological findings. It was established in 1991 and in the first ten years of activity it supported more than 1,700 projects, for an overall value of around US\$250 million, 38% of which was financed through the program. There were 6,000 participating firms, 85% of which were SMEs, in particular medium firms. From a geographical point of view, between 1991 and 2001, 54% of its funds were granted in the Metropolitan Region, 10% in the Bío Bío Region (VIII) and 6% in the Valparaíso Region (Monsalves 2002). Finally, in terms of sectors, 41% of funds were granted to manufacturing firms, 21% to agricultural, 8% to fish industry and 8% to ICT.

The co-financing procedure is certainly one of the most important results achieved by the program: while in 1992 the resources contributed by firms were around 43% of the overall value of the projects, between 1997 and 2001 the share of private investment was steadily around 65% of the total value of projects.

The FONTEC objectives were defined as: “(i) to promote R&D, scientific technical services and other activities that contribute to technological development and thereby help enhance the ability of private business to compete and increase their output; (ii) to expand the national technology supply and use of technology either generated or adapted in Chile; and (iii) to promote interaction and cooperation between the country’s R&D centers and its businesses and to encourage them to undertake joint project”.

Operatively, FONTEC is divided into five financing lines:

⁸ These are goods which cannot practically be withheld from one individual consumer without withholding them from all (the ‘non-excludability criterion’) and for which the marginal cost of an additional person consuming them, once they have been produced, is zero (the ‘non-rivalrous consumption’ criterion).

⁹ This implies first a great emphasis on the systemic dimension and on the creation of linkages quite clearly aims at boosting the adoption of “non-market failure” measure, such as networking policies. Second, the emphasis on “excellence” is related to a view of the invention and innovation processes as cumulative and path-dependent phenomena. Third, training as to be intended not only as a way to increase the capacity of producing new knowledge, but also as an instrument to increase the absorption capacity of the agents of the NIS, such as institutions and firms.

¹⁰ “Fondo Nacional de Desarrollo Tecnológico y Productivo”.

Line 1 - *Technological innovation*: it finances projects aimed at developing new products and improving production processes. It covers the development of prototypes and market testing. The FONTEC subsidy cannot exceed 50% of the total costs.

Line 2 - *Technological infrastructure*: it finances investment in physical infrastructure, installation, equipment and also the training of firm staff involved in the development of this infrastructure. The co-financing limit ranges between 20% and 30%, depending on whether the investment is submitted by a single firm or a group of firms.

Line 3 - *Group transfer*: it supports projects submitted by a group of at least five firms and it covers the cost of technological missions abroad, training and technical assistance held by international highly specialised experts. The co-financing limit is fixed at 45% for technological missions and 50% for specialised consultants. In any case the amount of funds granted by FONTEC cannot be higher than US\$100,000.

Line 4 - *Transfer organisation and centres*: it finances projects submitted by groups of at least five firms with the aim of setting up a technology transfer centre in order to study, develop, diffuse and adapt technology. The maximum subsidy is equal to 50% of the investment and cannot be higher than US\$400,000.

Line 5 - *Pre-investment studies*: it supports evaluations and studies of potential technological investment. The maximum financing cannot exceed 50% of the overall cost or US\$15,000.

Table 1 – Projects, beneficiaries and funds by line of financing 1991-2003

	n. projects	n. firms*	Total value ⁺	FONTEC ⁺	Line / Total	Firms ⁺
Line1	1,784	1,315	125,209,730	47,358,675	79.39%	77,851,055
Line2	41	51	7,354,659	1,800,655	3.02%	5,554,004
Individual	36	--	4,853,947	1,248,219	2.09%	3,605,728
Group	5	--	2,500,712	552,436	0.93%	1,948,276
Line3	508	4,067	15,861,481	6,614,126	11.09%	9,247,355
Missions	460	--	14,180,374	6,002,502	10.06%	8,177,872
Consultants	48	--	1,681,107	611,624	1.03%	1,069,483
Line4	10	132	2,966,954	1,426,991	2.39%	1,539,963
Line5	69	41	953,586	404,360	0.68%	549,226
Special Calls	47	--	5,671,393	2,051,432	3.44%	3,619,961
Education ICT	21	--	2,536,000	819,499	1.37%	1,716,501
Clean Production	26	--	3,135,393	1,231,933	2.07%	1,903,460
Total	2,459	5,606	158,017,803	59,656,239	100.00%	98,361,564

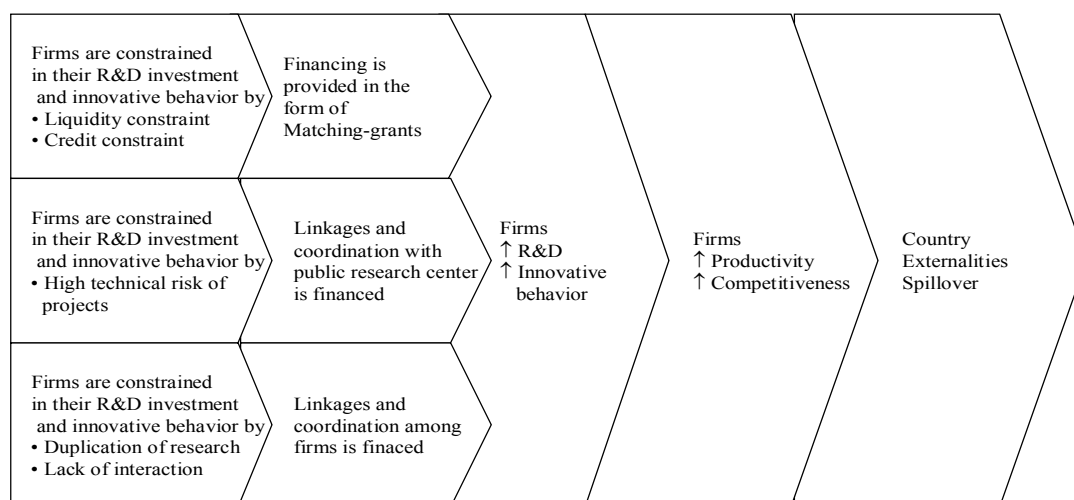
* Information available up to 2001

⁺ Thousands of Chilean Pesos

Source: OVE elaboration on the basis of CORFO and Dini and Stumpo (2002)

From the synthetic representation provided by Figure 1, it is clear that since its original design FONTEC has been conceived as a complex instrument aimed at tackling different constraints that could hamper the innovation activities of the Chilean firms.

Figure 1 – The FONTEC Rationale



Source: OVE's elaboration

The FONTEC operational structure includes an executive director and three main departments: (i) the Operations Department, which manages the selection and evaluation process, contract negotiations with clients, and the follow-up of project execution; (ii) the Legal Department, which is mainly involved with drafting of contracts and assessment of guarantees; (iii) the Administration Department handles the disbursements and other administrative matters. The central staff of FONTEC is about 25, most of whom are engineers. In addition to this, FONTEC is also supported by some external organisations under contract, The applications for financing are evaluated by a committee composed of two representatives from CORFO, two from the Ministry of Economy, one from the Ministry of Treasury and three representatives from private sector association.

Next appears a theoretician analysis on how FONTEC Program solves the market failures discussed in section 2.1.

Lines 1, 2 and 5 focus on the financial constraints that potential innovative firms might face in undertaking in the different stages of the innovation activity. Credit and liquidity constraints are probably the most diffused market failures that hamper the development of innovation projects. The high asymmetry of information between the lender and the borrower on the technical contents of the innovation projects limits the possibility to obtain funding from financial intermediaries. In such a context, a potential solution is the provision of low cost public financial resources either through subsidies or soft credit lines.

As already pointed out, lines 1 and 2 were originally designed as targeted credit lines. Line 1, in particular, adopted a “shared risk and benefits” logic: if the project was successful then the loan would have been fully repaid by the company, with interest and with a surcharge on the loan amount, depending on what results the project evaluation says can be expected. If the project failed to produce the expected results, the firm would have been entitled to a subsidy

equivalent to 50% of FONTEC's contribution, in other words, up to 40% of the total value of the project.

Between 1993 and 1994 the Chilean Government modified both Line 1 and Line 2, transforming the loans into subsidies and dropping "shared risk and benefits" benefit logic.¹¹ Therefore, since then both line 1 and 2 adopted a matching-grant mechanism, which should allow reducing the administrative cost of the provision of public funds and mobilizing private resource for innovation. However, the substitution of credit with subsidies and the removal of the "shared risk and benefits" could have increased the risk of incurring in opportunistic behavior and potential adverse selection of beneficiaries.¹²

Lines 3 and 4 aim at taking advantage of the potential benefit of joint ventures and alliances in developing innovations. The rationale of this type of intervention is twofold: first it aims at reducing the typical duplication problem of the private investment in R&D, which often emerges when cooperation between firms is not allowed or supported. In fact, although cooperation could degenerate into collusion and, thus, reduce the social welfare by increasing prices above marginal costs, it could also significantly mitigate the negative effect of both free-riding on other firms' R&D and duplication of research effort.

In order to solve out this dilemma, scholars and policy makers proposed solutions such as R&D cooperatives and Research Joint Venture (RJVs), where firms are allowed and encouraged to coordinate their R&D investment in a first stage and then put into the condition of engaging in Cournot or Bertrand competition in a second stage.¹³ Secondly, the promotion of research agreements aims at fostering interactive learning process among beneficiaries.

An increasing attention has recently been devoted to the potential social benefit of networking and interactive learning. Firms could benefit of the connections with each other not only because they lack resources, as the resource-based view states, but because of the need to explore and benefit of other firms' knowledge bases.¹⁴

¹¹ Two reasons were the basis of this request: first, CORFO was going through a deep reform process that implied the closing of all the first tier credit line; secondly, the use of the credit, even targeted credit, generated many difficulties in differentiating between innovation and investment projects.

¹² A more detailed discussion about the potential opportunistic behavior of beneficiaries or crowding out effect is provided in the next section.

¹³ On this specific topic see d'Aspremont and Jacquemin 1988; Martin and Scott 2000; Martin 2003.

¹⁴ According to the "network of learning" (Powell, Koput, Smith-Doerr 1996) and to the "interactive learning" approaches (Lundvall 1988 and 1992, Morgan 1996), networks facilitate organizational learning and act as a locus of innovation. Thus, "organizational learning is both a function of access to new knowledge and the capabilities of utilizing and building on such knowledge." (Powell, Koput and Smith-Doerr 1996: 118).

In addition, line 4 also aims at supporting generation of public or semi-public good needed to carry out innovation projects. In this case firms the program deal with the constraints that might be generated by the lack of technical capability or infrastructure that have the nature of public or semi-public good (such as highly specialized laboratory and equipment).

The specific mechanism of delivering funds reveals other important features of the FONTEC rationale. As we have already mentioned, since 1993 FONTEC have been funding its beneficiaries through matching-grants awarded on the basis of a project selection mechanism. The subsidies could have been awarded through alternative mechanism, such as fiscal exemption, which do not provide for the selection of the projects by a public agent and rest on the assumption that the firms are in the best position to select which projects should be financed.¹⁵

The direct selection of innovation projects by a specialized public agent has three justifications. Firstly, the public agent acts as a screener, conveying the technical knowledge and know-how that the financial markets lack or are not willing to develop. This process could contribute to reducing the asymmetry of information between the financial sector and the innovative firm and allow filling the knowledge gap between borrower and lender.

Secondly, as the public agent has the possibility and the authority of performing a monitoring or supervisory role that diminishes the risk of moral hazard by the firm. Third, the public agent aim at selecting those projects that being profitable for the firm have the highest social returns. Under these assumptions, the agency selects projects that hardly would have been otherwise financed, either for the relevant asymmetries of information or for high social externalities.

Therefore, the benefit of this process should be reflected in increasing investments in R&D or in changes in innovative behaviour that are in turn conducive of productivity increases at the firm level (which eventually generate externalities and spill over effects on the overall economy).

2.3. FONTEC Expected Impact

After reviewing the literature, the rationale of the FONTEC program, and having identified the expected and unexpected outcomes of these

¹⁵ Under another modality of financing, the government does not make use of the S&T agent. This might be a choice when attempting to avoid the budgetary costs of establishing an S&T agency, when technical expertise for project assessment is lacking in the country, or as a safeguard against the always latent possibility of adverse selection. Funds are channelled in a sort of more direct way, for instance, using the scheme of fiscal incentives. In this case, the provision of funds is usually made in the form of tax exceptions on the basis of predefined qualifying expenditure categories, which are almost checked only on an accounting basis. Thus, government involvement is minimal in the sense that it does not perform any assessment on the quality or relevance of the projects, nor it distinguishes –at least explicitly, since tax exceptions are deemed to favour larger firms- sectors or specific areas of financing.

interventions, a set of relevant evaluative questions for the instrument was defined.

(i) Does the public financing crowded out private resources? The evaluation will address the impact of the program on the beneficiaries' own financial resources devoted to R&D and innovation activities, as a test for the potential crowding out effect of the public financing.

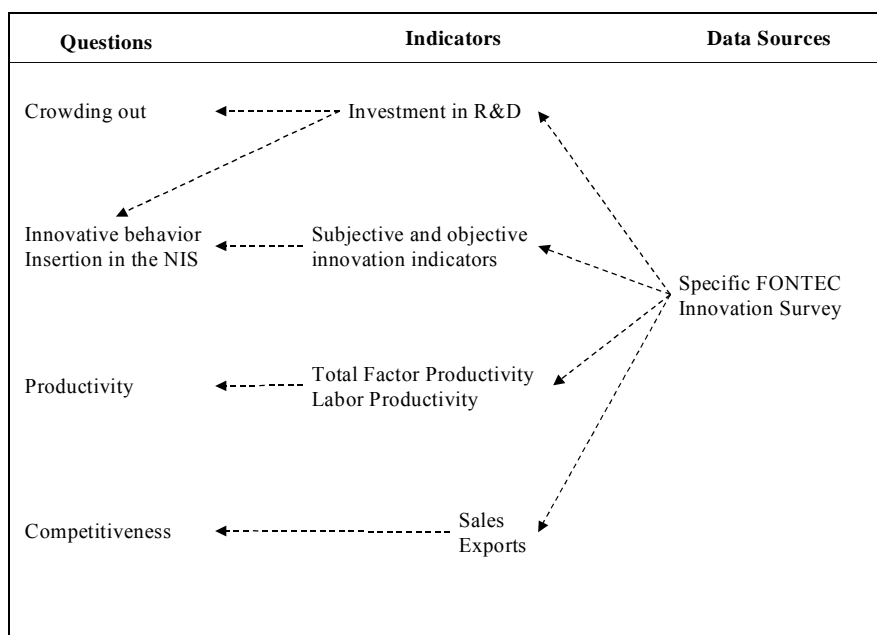
(ii) What is the impact of the project on the innovative behavior of beneficiaries? What is the impact on the insertion of beneficiaries in the NIS? The evaluation will assess the effectiveness of the public financing in inducing a change in the behavior of the beneficiaries and increasing their capability of developing process and product innovations and allowing them to be more connected to the NIS.

(iii) What is the impact on productivity of beneficiaries? If a significant product or process innovation occurred, in the medium-run firms should also increase their productivity.

(iv) What is the impact on competitiveness of beneficiaries? An innovative and efficient firm is expected to be able to improve its competitiveness both on domestic and foreign market.

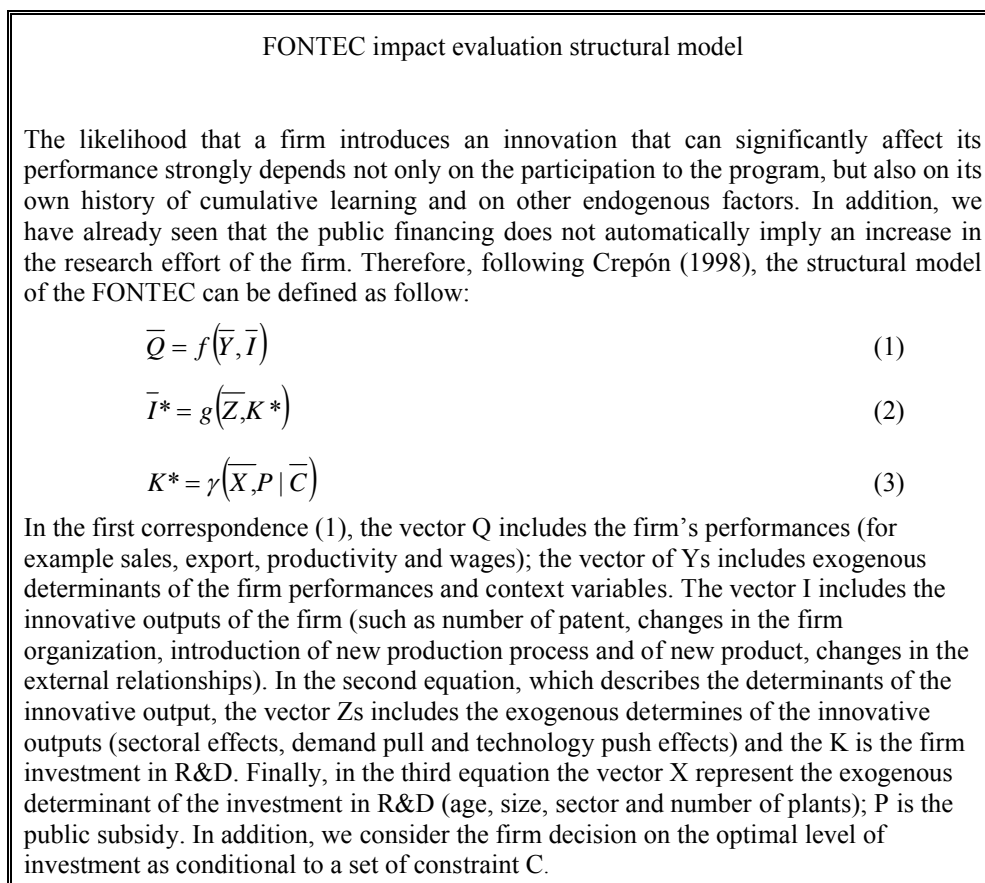
Unfortunately, the lack of an evaluation design that include a collection data system for tracking outcomes of interest that are presented in figure 2 for beneficiaries and, ideally, of non-beneficiaries as well, required to carry out a process of missing data filling using alternative sources to track past performance of the FONTEC program.

Figure 2 – FONTEC Research Questions, Indicators and Data Sources



Source: OVE elaboration

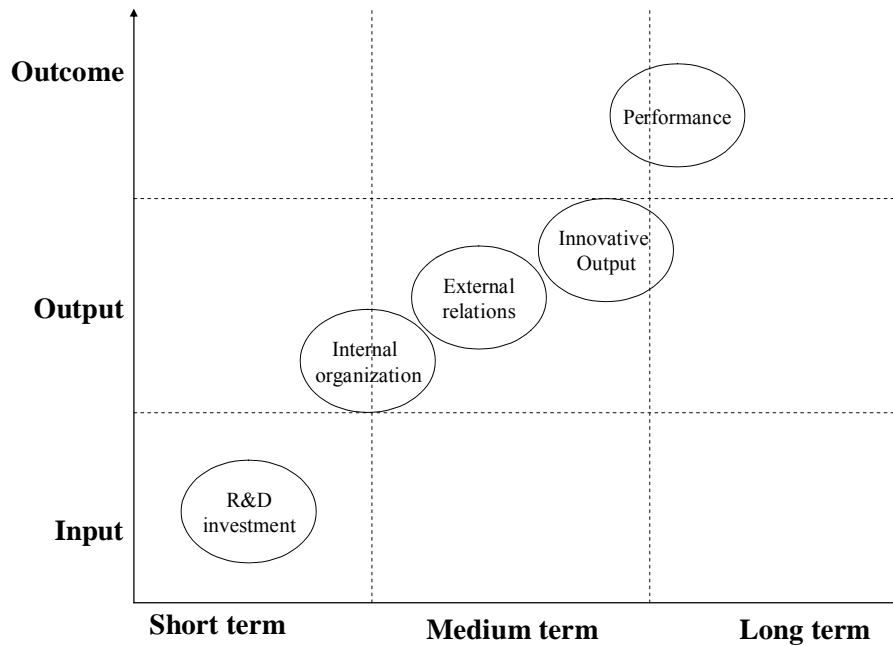
In order to assess the impact of the FONTEC program on its beneficiaries we make reference to a simple structural model inspired by the work of Crepón of the relationship between firms' investment in R&D, productivity and competitiveness. Needless to say, the aim of the evaluation is not to estimate the entire model. We use this synthetic representation of the causality chain that lead from the provision of the subsidy to the R&D investment, then to the innovative outputs and finally to the performance outcomes. Figure 3 summarizes the temporal sequence of events that are involved in the assessment of the impact of the FONTEC.



On the basis of this framework, the impact evaluation of the FONTEC is performed on four levels of outcomes (data permitting), all in comparison with the "witness" of non-beneficiary group:

- (i) Input additionality: the impact on the firms' investment in R&D.
- (ii) Behavioural additionality: the capability of the program of inducing changes in the internal and external organization of the firms;
- (iii) Innovative outputs: the impact on the development of new products and patents;
- (iv) Performances: the impact on firms' productivity and competitiveness -as measured by change in sales, employment, productivity and a share of sales exported

Figure 3: Evaluation Model



Source: OVE elaboration

2.4. Previous Evidence

The FONTEC program has already been evaluated. Although the previous evaluations concluded with an overall positive judgment of the program, the evidence that they cited was quite mixed. The first evaluation (Gerens, 1996) concluded that in the first five years of operation the program had generated an outstanding social return. In fact, just taking into account the fifteen “most promising” projects among the 377 financed by the FONTEC and assuming that all the other had generated a neutral social impact, the overall program social internal rate of return was equal to 15%.¹⁶

In addition, the evaluation pointed out that the highest rates of return were quite surprisingly achieved in the low risk and soft innovation projects. Although the evaluation provided a quite complete economic and financial analysis of the fifteen cases, these should be interpreted with caution. In particular, two basic assumptions of the evaluation methodology are worth mentioning: first, in order to approximate a sort of counterfactual scenario, the evaluation assumed that the projects financed by the FONTEC would have been executed in any way by the beneficiaries, but with a delay within two and four years. Second, the social benefit of the evaluation is calculated on the basis of a projected diffusion of the innovation throughout the entire Chilean economy. However, the main weakness of the approach is due to the complete lack of attribution of the estimated outcome to the program participation.

¹⁶ This result is consistent with those attributed by Dini and Stumpo (2002) to another evaluation carried out in 1995 by INVERTEC. This preliminary study estimated that for each CH\$1 invested, FONTEC’s project it generated a fiscal income increase of CH\$8.

A second evaluation of the program was conducted in 1998 (ILADES). This study took into consideration the same period (1991-1995), but adopted a different methodology. In addition to a group of firms that were financed by the program, this evaluation considers a group of firms that did not participate to the program.

Unfortunately, not only the two samples were quite small (28 beneficiaries and 10 non-beneficiaries), but also the evaluators faced many problems in collecting quantitative information. Therefore, the study ended up focusing on some comparative qualitative statement about the characteristic of the beneficiaries firms. The evaluation concluded that the FONTEC projects were concentrated on adaptation of the existing product and on process innovation aimed at improving the efficiency of the existing production. Finally, the study concluded that US\$1 of financing generated an incremental investment of US\$0.88.

In 2004 the University of Chile carried out an impact evaluation of FONTEC (University of Chile 2004). This last evaluation was based on a specific survey including both a group of beneficiary firms and a group of non-beneficiaries.

The main conclusions of this evaluation are that the program had a positive and significant impact on firms' growth, both in terms of sales and employment, but not on other outcomes such as productivity and investment. In addition, the evaluation point out that the program was effective in inducing incremental innovation of existing products and a higher insertion of the beneficiaries into the NIS. However, it also points out the lack of evidence of significant impacts in terms of development of new products.

Finally, a brief cost benefit analysis based on the potential fiscal revenues deriving from the increased sales shows that the program generates an overall positive fiscal benefit.

3 Methodology - Empirical Model

3.1. Description of the Data and Definition of Indicators

In 2004 the University of Chile coordinated the collection of a survey aimed at generate a database to be used for the program impact evaluation. The survey focused on the firms financed by the line 1 between 1999 and 2002. The total sample included a group of 319 treated firms representative of the sectoral and geographical distributions of the universe of beneficiaries and an equal sample of non-treated firms. At the end of the survey 219 beneficiaries and 220 non-beneficiaries were successfully interviewed. However, as shown by table 2, only a sub-sample of the interviewed firms provided all the required information. In particular in many cases the survey failed in collecting the information about the firms' economic and financial evolution.¹⁷

Table 2 – FONTEC Survey

	Total Survey	Innovation Questions	Economic and Financial Questions
FONTEC	219	219 (100%)	131 (60%)
Control Group	220	220 (100%)	106 (48%)
Total	439	439 (100%)	236 (54%)

Source: OVE's elaboration

The FONTEC Evaluation Survey is composed of six sections:

- a. **Identification:** it includes information about the firm juridical structure, location and sector.
- b. **Economic and financial performances:** it includes data on: sales, employment, salaries, investment in R&D, investment in physical capital and export in the period 1998-2002.
- c. **Business management and innovation:** it includes a series of questions about the management changes and technological innovation developed by the firm and the innovation undertaken in the period 1998-2002.
- d. **Relationship with the FONTEC program (only beneficiaries):** it includes question about the motivation of applying to the program and a "customer-satisfaction" evaluation of the program services.
- e. **Characteristics of the project developed through the program (only beneficiaries).**
- f. **Value attributed to the project undertaken with FONTEC (only beneficiaries).**

Before proceeding with the analysis, a brief explanation of the some of the indicators that will be adopted is probably needed. When we deal with the analysis of the behavioral changes occurred within the firm we adopt some indicators calculated combining two kind of information collected in the survey: first the firms, both treated and control, were asked if they had

¹⁷ According to the University of Chile the total rate of response is acceptable when compared with other experience in the USA and Latin America.

introduced some changes in terms of production process, management of human resources and internal/external organization of the firm. Then they were asked to rank the relevance of the innovation introduced according to the potential impact on their competitiveness, as a way to give a metric form to the different changes.

In order to make this information more comparable, we develop an indicator that, using the relevance rating, transforms a potential dummy variable (whether the specific changes occurred or not) into continuous variables that range between 0 and 1:

$$GE_{kj} = \frac{1}{4n_{kj}} \sum_{i=1}^{n_{kj}} GRADE_{ij} \quad (5)$$

where GE stands for Grade Evaluation, and GRADE_{ij} is the relevance (between 0 and 4) attributed by firm j to the potential change i and n_{kj} is the number of potential changes in the area k that are applicable to the firm j.¹⁸ The index ranges from 0 when the firm reported a zero evaluation to all the potential changes, and 1 when the firm reported an evaluation of 4 to all the potential changes.

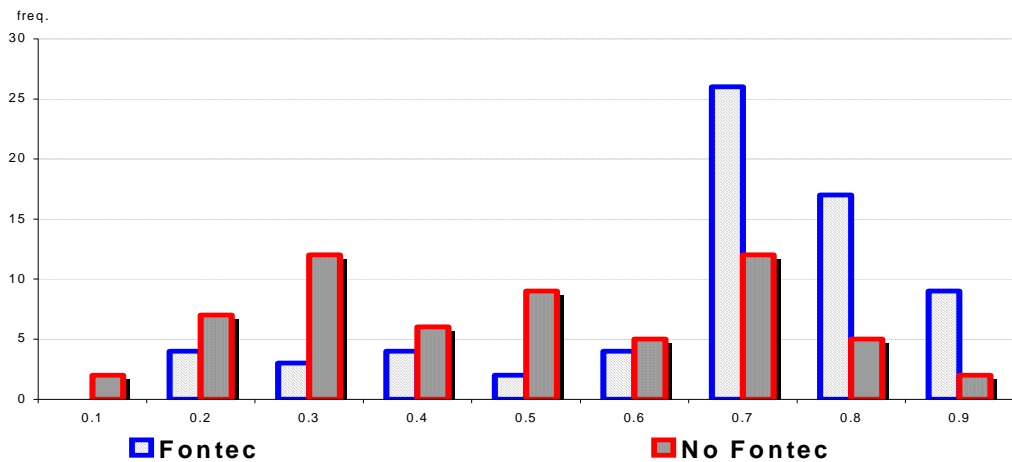
3.2. Estimation Methodology

In order to evaluate impact of the program, a standard comparison strategy between treated and non-treated firms was performed. The first stage under this framework was to make firms comparable between both groups. The sampling strategy aimed to have comparable firms on most of their observables variables reported in standard records like productive sector, geographical location and size. The propensity score matching is a procedure that aims to generate sub samples of firms that are similar in several other dimensions based on information raised directly from the field work including those used for the sampling process, in order to make firms comparable just before they participate in the program.

Following the standard literature a Logit Model was performed where the binary dependant variable reflects the firm's participation in the program. Initial level of sales, productive experience, geographical area, and productive sector, among others were used as a vector of independent variables. Once done, a comparison between both distributions of firms is reported in order to analyze differences in their chances to participate in the program. This is done in order to obtain a sub sample of firms that are comparable just before the program started. The Figure 4 sketches these distributions for both groups of firms.

¹⁸ For example, the area "process innovation" includes 13 potential changes, of which just *n* may be applicable to firm *j*). This means that we exclude the changes that are NA.

Figure 4 – Propensity Score Common Support



Source: OVE's elaboration

The results show that despite the fact that both distributions are not quite similar, the common support is wide. That is every firm from both group have a positive chance - some of them higher than others, to participate in the program. Secondly, treated firms have a larger probability to participate in the program compared to those belonging to the control group. This result show that a discretionary or selective process from the program administration may be in place. Although the evidence in this line is very weak since the common support covers most of the range of the dependent variable. Finally, these mismatches may respond to the high level of volatility observed in the independent variables mostly related with the low number of observations included in both samples.

However, the characteristics of dataset imposes proceed in the estimation of the program impact with some cautions. When there are limited degree of freedom, high heterogeneity of the interviewed firms and the presence of outliers the mean values are very sensitive to the estimation method. In such a context it is highly commendable to work with value close to the median, which are less sensitive to the outliers. In the following sections, the impact of the program is often not statistically significant. As already discussed, these results could be due not only to the actual lack of impact, but also to the limitations of the available databases. However, as suggested by Neyman (1966) in a context of limited observation the requirements in terms of interval of confidences can be partially relaxed.

The impact of the program will be estimated in double difference (Before/After and Treated/Non-Treated) on a group of beneficiaries and non-beneficiaries matched on the basis of their ex-ante probability of participating to the program. This procedure, know as Difference-in-Difference (DID) with Propensity Score Matching (PSM), by combining two impact evaluation strategy allows controlling for two potential source of bias that affect the quality of the counterfactual: the PSM controls for the potential selection on observables and the difference-in-differences estimation removes any non-

observable time-invariant differences among the individual firms of the two groups.¹⁹

4 Results

4.1. Input additionality: testing for crowding-in/crowding-out effects

In this section we analyze to what extent the resources provided by FONTEC to the treated firms have been additional to other source of financing, either internal or external. This is one of the most explored impacts of this kind of program and it has been defined by the literature as the crowding in/out effect. The public financing is expected to produce a multiplier effect on the resources that the beneficiaries invest in R&D. In fact, by providing the opportunity of overcoming liquidity and credit constraints, these programs should allow the beneficiary firms to undertake projects at the margin of their portfolio and, eventually, to generate the technical condition for undertaking additional innovation projects.

For this purpose, we calculated the evolution of the R&D investment of treated firm and we compared it with the investment of group of non-treated firms. In this particular case we compare the performances before the participation (1998) with the average investment in that include the three years of participation (1999-2001) and one year after (2002). This is due to the fact that the crowding in effect (or, at least not crowding out effect) is expected to occur simultaneously or in the close proximity of the subsidies disbursement. We use two specification of the outcome variable: (i) the level investment in R&D; and (ii) the R&D intensity, that is the ratio between R&D investment and the total sales.

Table 3 – FONTEC impact on R&D investment

	Level ⁺	% of sales
Naïve		
BA	2,955,111	0.91
Impact		
DID (mean)	2,597,263	0.77
DID with Kernel PSM (mean)		
Bandwith 0.04	5,215,081*	0.79
Bandwith 0.08	4,973,204*	0.74
Bandwith 0.16	5,057,793*	0.71
Bandwith 0.24	4,994,074*	0.74*

⁺ Chilean Pesos

* Significant 10%

BA = Before After estimator (only treated firms)

DID = Difference In Difference estimator (treated and non-treated)

PSM = Difference In Difference estimator with Propensity Score Matching

Source: OVE's elaboration on the basis FONTEC Database

¹⁹ See Blundell & Costas-Diaz (2002)

All the estimators have the expected positive sign. The kernel estimators calculated in terms of pesos invested in R&D are always statistical significant, while they are significant only in one case when calculated in terms of R&D intensity. The magnitude of the program impact increases significantly when the performances of the treated firms are compared with those of the non-treated. These results seem to reasonably exclude a crowding out effects between FONTEC financing and firm resources. However, we cannot support the case of absence of substitution or, even less, of a crowding in effect.²⁰ In fact, FONTEC beneficiaries receive an average subsidy of Ch\$ 25 million, which is slightly higher than the program cumulated impact (ca CH\$20 million) during the four years taken into consideration.

These quite ambiguous results suggest exploring more in detail the program effects on R&D investments. As pointed out David et al. (2000) there is little evidence of the effectiveness of subsidies in allowing firms to undertake projects that otherwise would not have been carried out.²¹ This lack of impact could depend on a misjudgment of the real (or main) market failure that is hampering private investment in R&D. A subsidy is more likely to produce a significant increase in the firm's investment in R&D when liquidity and credit constraints are the main problems that the firm faces in undertaking such activities. Nevertheless, if the firm's main difficulties are more related to technical capabilities or risk aversion, the provision of subsidies is much less likely to produce a significant increase in R&D investments and could result into a substitution of private resources.²²

In the case of FONTEC, some qualitative information collected from the 219 interviewed beneficiaries can provide some additional elements to the evaluation of this effect. In particular, the program beneficiaries were asked to grade a set of potential reasons for applying to the program. Table 4 quite clearly shows that for the majority of the beneficiaries the program is an important complementary source of financing (50%), probably connected to being a helpful signal of the quality of the project to other source of financing (28%). Quite lower (30%) is the percentage of firms that ranked the impossibility of receiving financing from the private sector as a highly relevant reason for applying to the program. Therefore, a partial substitution effect can be due to this complementary and signaling function attributed to the program participation

²⁰ This is quite different from the results obtained by Benavente (2002) from the analysis of the Chilean Innovation Surveys(1995-1998) support can provide some additional evidence, for the author identifies a crowding in effect of the public financing on the Chilean manufacturing firms of US\$1.3 for US\$1 received. However, this study considers all public sources available and not only the FONTEC program.

²¹ More recent studies confirm the mixed evidence on the effectiveness of public subsidies in increasing private R&D: Gonzalez Jaumardreu Pazó (2004) show that in Spain subsidies go to firms that would have performed the project in any case. Lach (2002) finds that subsidies increase private investment in R&D only when a narrow definition of R&D is adopted. See also Sanguinetti (2005) and Binelli and Maffioli (2006).

²² A displacement effect could occur when the resources released through the program were not needed and give an incentive to dismiss expensive or unprofitable projects and shift money either to other activities or to the direct benefit of company's shareholders.

Table 4 – Reason for applying to FONTEC

Complementary source of financing	50.2%
Fundamental source of financing (project rejected by the private sector)	30.6%
Signal of the quality of the project outside the firm	27.9%
Share the risk of be copied by the competitors (appropriability)	26.5%
Signal of the quality of the project inside the firm	23.3%
A way to get involved into the network of public support to innovation	21.9%

Source: OVE's elaboration on the basis FONTEC Database

As noted by Lach (2002), the firm investment in R&D could be partially or totally displaced even when the beneficiaries effectively need the funds to undertake the financed project. In fact, if the firm lacks enough skilled human resources or faces other constraints that make very costly to implement other projects together with the financed one, it can decide to dismiss some of the non-financed projects in order to fulfill the commitment with the public agency, thus reducing its overall level of R&D expenditures.

The analysis of the role of the financed project within the work plan of the beneficiaries can indeed help to clarify the FONTEC effect.²³ Analyzing the data provided by the survey conducted among the beneficiaries, it results that for the 56% of the treated firms the project financed by FONTEC was a strategic component of their research work program, while for the 9% of the treated firms the project was in the portfolio but not strategic. Only the 4% of the treated firms declare that the project was not in their work plan.²⁴ These figures lead to two considerations: first, many beneficiaries would have undertaken the project financed by FONTEC even without the program, or at least would have seek alternative source of financing. This does not necessarily mean that the FONTEC resources crowded out other sources, but can at least explain the limited multiplier effect. Second, given that the majority of the beneficiaries appear to have quite carefully planned the supported project, it is quite unlikely that the commitment with FONTEC could have generated a sudden shortage of skilled human resources to be dedicated to other R&D projects. Nevertheless, when asked to identify the main difficulties faced during the execution of the FONTEC project, 67% of the beneficiaries point out the lack of skilled labor force. This means that some sort of underestimation of the human resources required to carry out the FONTEC project could have displaced other R&D activities originally included in the firm work plan.

Another useful way of evaluating the occurrence of a potential crowding out effect could be provided by the analysis of the impact of the program on investment in physical capital. Participation in the program did not have any positive impact on investment physical capital. Actually the treated firms underperformed the non-treated in terms of investment in machinery. This result seem quite consistent with the hypothesis that the limited lack of impact

²³ In this case, the information was collected just on the treated group, since none specific innovation projects could have been identified as a counterfactual of the financed ones.

²⁴ The other 31% of the beneficiaries didn't clearly identify weather the project was in their working plan.

on R&D intensity is more due to a temporary adjustment in the investment decisions rather than to some sort of resource displacement.

4.2. Evaluation of the behavioral additionality of the program

According some recent assessments of S&T programs, as long as the impact is formulated in terms of input and output measures, the firm is largely treated as a black box (OECD 2005). The aim of this section is to complement the previous analysis at input level analysis and the next section about the impact on the outcomes with an evaluation of the program impact on the firm capabilities to generate a competitive advantage and to modify their strategies. For this purpose, we evaluate the impact of the participation in the FONTEC program on some intermediate outcome of the innovative process. In particular we aim at identifying the internal dynamic that that might have been put in place as a consequence of having received the FONTEC's support. In particular, we analyze the firm behavior at two levels: (i) process innovation and organizational changes; and (ii) access to external resources.

a) Process and organizational innovation

Proceeding with our attempt to open the black boxes of the effect of the FONTEC on the strategic behavior of the beneficiary firms, we now consider another fundamental component of the innovation effort: process and organizational innovations. For this purpose we consider a set of three indicators: (i) number of new production process adopted by the firm; (ii) relevance of the process innovation adopted by the firm; and (iii) relevance of the changes in human resource management adopted by the firm.

With reference to the first indicator, the number of new production process adopted by the firm, table 5 shows that the FONTEC has a positive and significant impact on the treated firms. Compared to the control group, the beneficiaries adopted on average 0.33 process more.

Table 5 – Process and Organizational Innovations

	Number of new process	Relevance of the process introduced	Relevance of Training and HR innovation
Naïve			
Mean treated	1.50	0.42	0.46
Impact			
T-NT	0.41	-0.07	-0.06
Kernel PSM (mean)			
Bandwith 0.04	0.28	-0.03	-0.09*
Bandwith 0.08	0.40	-0.03	-0.07*
Bandwith 0.16	0.46*	-0.02	-0.06
Bandwith 0.24	0.48*	-0.03	-0.06

* Significant 10%

BA = Before After estimator (only treated firms)

DID = Difference In Difference estimator (treated and non-treated)

PSM = Difference In Difference estimator with Propensity Score Matching

Source: OVE's elaboration on the basis FONTEC Database

With reference to the second indicator, which summarizes the firm's self-evaluation of the relevance of the changes introduced in the production process, the program does not show any significant impact. In order to explore more in detail what occurred within the firm, we also analyze the components of this indicator: the treated firms seem to be more dynamic than the control group only in terms of internalizing new components of production process, which is confirmed also by the fact that they outsource less than the control group. On the other hand, the treated firms are significantly less dynamic in adopting ICT, quality and safety control, and management systems.

The results are even more worrying when the changes in the management of human resources are taken into account. In this case the impact of the program is negative and significant in all the specifications. The disaggregate analysis of the indicators components confirms that the treated firms underperformed the control group in all the options and that the average scores are significantly different both in training activities and in the adoption of incentive.

b) Improved access to external resources

One of the most significant expected behavioral outcomes, at least in an evolutionary perspective, is the improvement of the firm insertion in the National Innovation System (NIS). In order to evaluate the impact of the program on this fundamental aspect of the learning process, both the treated and the control firms were asked to estimate the relevance of improvements achieved in using external source of knowledge.

In this case the impact of the program is unambiguously positive and significant in almost all the specifications (Table 6). In addition, the analysis of the disaggregated indices allow noticing that this positive impact mainly due to the significantly increased capacity of the treated firms of interacting with both public institutions and, even more importantly, with academic institutions, while the program seems to reduce the relevance of the competitors as a source of innovation.

Table 6 – Access to External Resources

	Improved Access to External Source of Knowledge	Improved Access to External Source of Financing
Naïve		
Mean treated	0.43	0.34
Impact		
T-NT	0.01	0.03
Kernel PSM (mean)		
Bandwith 0.04	0.05	0.09
Bandwith 0.08	0.08	0.12*
Bandwith 0.16	0.10*	0.13*
Bandwith 0.24	0.10*	0.13*

* Significant 10%

BA = Before After estimator (only treated firms)

DID = Difference In Difference estimator (treated and non-treated)

PSM = Difference In Difference estimator with Propensity Score Matching

Source: OVE's elaboration on the basis FONTEC Database

When the improvements in the access to external source of financing are taken into consideration, the impact of the program is again strongly positive. More in detail, the treated firms improved significantly their capability of defining, budgeting and presenting innovation projects and their knowledge of potential external source of financing.

4.3. Impact on innovative output

According to Nelson (1991) the development of new product is probably one of the most important dynamic capabilities of the firm. In order to evaluate how the participation to the FONTEC program could have affected this capability, we calculate the impact of the program on two innovative output indicators: (i) the number of new products manufactured by the firm during the period under analysis; and (ii) number of patents registered by the firm during the period under analysis.

Table 7 shows the results of the program impact the number of new products introduced during the period of the analysis. According to this first basic indicator, the program has no positive impact on the beneficiary capability of developing production innovation. This poor performance is quite consistent with the results of previous evaluations (GERENS 1996, ILADES 1998 and Universidad de Chile 2004), which concluded that the program was more focused on process innovations and incremental improvement of existing products. Nevertheless, there is no structural reason that explains why the program should have taken such approach. In particular, the *line 1* specifically aims at fostering the development of new products and at financing prototypes and marketing tests.

Table 7 – Impact on Innovative Output

	Number of New Products	Number of Patents
Naïve		
Mean treated	3.11	1.50
Impact		
T-NT	-0.52	0.41
Kernel PSM (mean)		
Bandwith 0.04	-1.45	0.16
Bandwith 0.08	-1.45	0.15
Bandwith 0.16	-1.45	0.14
Bandwith 0.24	-1.51	0.14

* Significant 10%
 BA = Before After estimator (only treated firms)
 DID = Difference In Difference estimator (treated and non-treated)
 PSM = Difference In Difference estimator with Propensity Score Matching

Source: OVE's elaboration on the basis FONTEC Database

Another important piece of information is provided by number of products that have been patented by the firms. The patenting process implies a much more formalized research process and, therefore, is likely to be connected to a more complex innovation activity. In addition, patents are usually associated to the

so-called “radical innovation”, in contrast with incremental innovation (Griliches 1990). In fact, a firm has the incentive to apply for a patent when the developed product is an absolute novelty, at least at national level. In this case the treatment effect is more encouraging, having the program a positive, but not significant on the beneficiaries in almost all the adopted specifications (Table 5).

In conclusion, the analysis of the FONTEC impact on firms’ innovation capabilities at product level lead to some mixed considerations: although the program confirms its relatively ineffectiveness in supporting the creation and adoption of new products in the short run, it also seems to have a certain role in fostering the patenting activities of the beneficiaries. This could mean not only that the program is focused on process innovation and on the incremental improvement of existing products, but also that it finances the development of new products that require a higher research effort by the firm and, thus, that more frequently lead to the patenting of the innovation.

4.4. Impact on performances: sales, employment export and productivity

In this last section we analyze the impact of the program on firms’ productivity and competitiveness. For this purpose we take into consideration four indicators: (i) sales; (ii) employment; (iii) labor productivity; and (iv) exports as percentage of sales.²⁵

Table 8 – Impact on Innovative Output

	Sales		Employment		Productivity	% Export
	Level ⁺	Δ%	Level	Δ%		
Naïve						
BA	123,000	37	7.4	9.3	0.1	1.6
Impact						
DID (mean)	83,200	10.72	12.06	16.73	-0.20	-0.28
DID Kernel PSM (mean)						
Bandwidth 0.04	62,200	13.75	8*	10.90*	-0.15	2.60*
Bandwidth 0.08	47,500	11.47	7*	11.96*	-0.20	2.72*
Bandwidth 0.16	50,000	13.61	7*	12.61*	-0.24	2.70*
Bandwidth 0.24	59,400	16.20	7*	13.23*	-0.24*	2.67*

⁺ Thousand of Chilean Pesos

* Significant 10%

BA = Before After estimator (only treated firms)

DID = Difference In Difference estimator (treated and non-treated)

PSM = Difference In Difference estimator with Propensity Score Matching

Source: OVE’s elaboration on the basis FONTEC Database

The estimations of the impact on both sales and employment show the expected sign, although the average impact on sales is not statistically

²⁵ It is worth noting that in this evaluation this effect is measured only one year after the participation to the program. As we pointed out, the effect on performance are more likely to occur in the medium/long run. Therefore the results included in this section should be considered with taking into account of this potential lag.

significant. This is reflected also by the results in terms of labor productivity. In the period taken into consideration, labor productivity has increased, but more for the control group than for the beneficiaries. However, it is worth mentioning that this results depends more on the significant contraction of employment of the non treated firms (-4.7%), rather than to a faster efficiency growth. Taking into account the peculiar situation of the Chilean economy in the years 2001-2002, the results can also be interpreted as a better performance of the beneficiaries firms that were able to growth both in terms of employment and sales. In this direction, the results in terms of export appear consistent with the hypothesis of positive impact of the program on firms' competitiveness.

5 Conclusion

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7 Appendix : Impact Evaluation Annexes

Fontec evaluation statistical annex

Table A1 – Participation Model

Logistic regression		Number of obs = 156				
Log Likelihood = -94.013066		LR chi2(4) = 26.98				
		Prob > chi2 = 0.0000				
		Pseudo R2 = 0.1255				

fontec	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	

exp	-.0932519	.0361754	-2.58	0.010	-.1641543	-.0223495
exp2	.0010479	.00047	2.23	0.026	.0001267	.0019691
g2	-1.506646	.3812858	-3.95	0.000	-2.253953	-.7593401
vtas_98	-1.01e-11	8.81e-12	-1.15	0.251	-2.74e-11	7.16e-12
_cons	2.120756	.5708484	3.72	0.000	1.001913	3.239598

Table A2 – Impact on R&D (%)

ATT variable did2 (I + D as % of Sales)						
		Impact	Bias	std error	Confidence Interval 90% #	
Nearest Neighborhood	2 neighbors	0.83*	-0.03	0.43	0.03	1.37
	3 neighbors	0.78	0.01	0.43	-0.10	1.35
	4 neighbors	0.70	0.09	0.42	-0.30	1.19
Kernel &	Bandwidth 0.04	0.79	0.01	0.43	-0.09	1.35
	Bandwidth 0.08	0.74	0.06	0.41	-0.15	1.26
	Bandwidth 0.16	0.71	0.07	0.40	-0.13	1.22
	Bandwidth 0.24	0.74*	0.06	0.39	0.01	1.28

& The default Bandwidth in STATA 9 is 0.08

Confidence interval was obtained with Bootstrap at 500 iterations

* Significant at 10%

Table A3 – Impact on R&D (Level)

ATT variable did2 (I + D level change)						
		Impact	Bias	std error	Confidence Interval 90% #	
Nearest Neighborhood	2 neighbors	4,297,078	689,066	2,726,289	-3,139,621	7,382,203
	3 neighbors	5,231,854	-164,683	2,649,898	-640,809	8,702,775
	4 neighbors	4,199,675	875,073	2,517,153	-3,255,255	6,588,216
Kernel &	Bandwidth 0.04	5,215,081*	108,196	2,390,273	652,196	8,513,696
	Bandwidth 0.08	4,973,204*	333,656	2,248,480	325,678	7,651,067
	Bandwidth 0.16	5,057,793*	327,817	2,102,918	579,341	7,910,691
	Bandwidth 0.24	4,994,074*	384,306	2,068,907	451,774	7,749,726

& The default Bandwidth in STATA 9 is 0.08

Confidence interval was obtained with Bootstrap at 500 iterations

* Significant at 10%

Table A4 – Impact on Process

ATT número de proceso productivos nuevos generados por el proyecto						
		Impact	Bias	std error	Confidence Interval 90% #	
Nearest Neighborhood	2 neighbors	0.12	0.13	0.37	-0.79	0.75
	3 neighbors	0.30	-0.04	0.36	-0.38	0.97
	4 neighbors	0.28	0.00	0.35	-0.50	0.94
Kernel &	Bandwith 0.04	0.28	-0.03	0.35	-0.39	0.91
	Bandwith 0.08	0.40	-0.09	0.31	-0.12	1.01
	Bandwith 0.16	0.46*	-0.09	0.29	0.01	1.02
	Bandwith 0.24	0.48*	-0.09	0.27	0.06	1.03

& The default Bandwith in STATA 9 is 0.08

Confidence interval was obtained with Bootstrap at 500 iterations

* Significant at 10%

Table A5 – Relevance of Processes

ATT variable i0001						
		Impact	Bias	std error	Confidence Interval 90% #	
Nearest Neighborhood	2 neighbors	-0.04	0.00	0.07	-0.19	0.08
	3 neighbors	-0.02	-0.02	0.07	-0.14	0.11
	4 neighbors	-0.03	-0.01	0.07	-0.14	0.10
Kernel &	Bandwith 0.04	-0.03	-0.01	0.07	-0.16	0.10
	Bandwith 0.08	-0.03	-0.01	0.06	-0.15	0.08
	Bandwith 0.16	-0.02	-0.02	0.06	-0.12	0.09
	Bandwith 0.24	-0.03	-0.01	0.06	-0.13	0.09

& The default Bandwith in STATA 9 is 0.08

Confidence interval was obtained with Bootstrap at 500 iterations

* Significant at 10%

Table A6 – Relevance of Training

ATT variable i0002						
		Impact	Bias	std error	Confidence Interval 90% #	
Nearest Neighborhood	2 neighbors	-0.08*	0.01	0.05	-0.23	0.00
	3 neighbors	-0.08	0.00	0.05	-0.18	0.01
	4 neighbors	-0.08*	0.00	0.05	-0.18	0.00
Kernel &	Bandwith 0.04	-0.09*	0.01	0.05	-0.22	0.00
	Bandwith 0.08	-0.07*	0.00	0.04	-0.17	0.00
	Bandwith 0.16	-0.06	-0.01	0.04	-0.14	0.02
	Bandwith 0.24	-0.06	-0.01	0.04	-0.15	0.02

& The default Bandwith in STATA 9 is 0.08

Confidence interval was obtained with Bootstrap at 500 iterations

* Significant at 10%

Table A7 – Improved Access to Eternal Knowledge

ATT variable i0004						
		Impact	Bias	std error	Confidence Interval 90% #	
Nearest Neighborhood	2 neighbors	0.07	0.00	0.07	-0.06	0.20
	3 neighbors	0.05	0.02	0.06	-0.10	0.15
	4 neighbors	0.07	0.01	0.06	-0.06	0.19
Kernel &	Bandwith 0.04	0.05	0.03	0.06	-0.11	0.14
	Bandwith 0.08	0.08	0.01	0.06	-0.05	0.18
	Bandwith 0.16	0.10*	-0.01	0.05	0.01	0.21
	Bandwith 0.24	0.10*	-0.01	0.05	0.01	0.23

& The default Bandwith in STATA 9 is 0.08

Confidence interval was obtained with Bootstrap at 500 iterations

* Significant at 10%

Table A8 – Improved Access to Eternal Source of Financing

ATT variable i0005						
		Impact	Bias	std error	Confidence Interval 90% #	
Nearest Neighborhood	2 neighbors	0.08	0.02	0.07	-0.06	0.20
	3 neighbors	0.09	0.01	0.07	-0.06	0.22
	4 neighbors	0.08	0.02	0.07	-0.07	0.20
Kernel &	Bandwith 0.04	0.09	0.02	0.07	-0.05	0.21
	Bandwith 0.08	0.12*	-0.01	0.07	0.00	0.25
	Bandwith 0.16	0.13*	-0.02	0.06	0.02	0.27
	Bandwith 0.24	0.13*	-0.02	0.06	0.03	0.28

& The default Bandwith in STATA 9 is 0.08

Confidence interval was obtained with Bootstrap at 500 iterations

* Significant at 10%

Table A9 – Impact on New Products

ATT número de nuevos productos fabricados por la empresa						
		Impact	Bias	std error	Confidence Interval 90% #	
Nearest Neighborhood	2 neighbors	-0.47	-1.13	1.85	-3.04	2.73
	3 neighbors	-1.55	-0.16	1.87	-6.49	1.20
	4 neighbors	-1.72	-0.04	1.87	-7.09	0.97
Kernel &	Bandwith 0.04	-1.45	-0.04	1.52	-5.16	1.11
	Bandwith 0.08	-1.45	-0.03	1.48	-4.61	1.05
	Bandwith 0.16	-1.45	-0.14	1.50	-4.47	1.24
	Bandwith 0.24	-1.51	-0.13	1.51	-4.82	1.14

& The default Bandwith in STATA 9 is 0.08

Confidence interval was obtained with Bootstrap at 500 iterations

* Significant at 10%

Table A10 – Impact on Patents

ATT número de patentes desarrolladas por la empresa						
		Impact	Bias	std error	Confidence Interval 90% #	
Nearest Neighborhood	2 neighbors	0.17	-0.07	0.25	-0.34	0.65
	3 neighbors	0.09	0.01	0.24	-0.46	0.53
	4 neighbors	0.13	-0.02	0.23	-0.36	0.57
Kernel &	Bandwith 0.04	0.16	-0.07	0.24	-0.29	0.65
	Bandwith 0.08	0.15	-0.04	0.22	-0.29	0.62
	Bandwith 0.16	0.14	-0.01	0.20	-0.23	0.60
	Bandwith 0.24	0.14	-0.01	0.20	-0.20	0.60

& The default Bandwith in STATA 9 is 0.08

Confidence interval was obtained with Bootstrap at 500 iterations

* Significant at 10%

Table A11 – Impact on Sales (%)

ATT variable dpvtas (en %)						
		Impact	Bias	std error	Confidence Interval 90% #	
Nearest Neighborhood	2 neighbors	16.17	1.03	12.41	-9.44	31.60
	3 neighbors	11.57	4.80	12.25	-14.21	26.79
	4 neighbors	13.84	1.87	11.90	-10.64	29.56
Kernel &	Bandwith 0.04	13.75	0.70	12.09	-8.66	30.57
	Bandwith 0.08	11.47	1.60	11.57	-12.07	27.36
	Bandwith 0.16	13.61	0.45	11.38	-7.23	29.92
	Bandwith 0.24	16.20	-0.46	10.97	-2.92	31.48

& The default Bandwith in STATA 9 is 0.08

Confidence interval was obtained with Bootstrap at 500 iterations

* Significant at 10%

Table A12 – Impact on Sales (Level)

ATT variable dvtas (\$)						
		Impact	Bias	std error	Confidence Interval 90% #	
Nearest Neighborhood	2 neighbors	71,700,000	-11,700,000	60,300,000	-16,900,000	166,000,000
	3 neighbors	79,000,000	-23,500,000	60,300,000	-2,262,882	180,000,000
	4 neighbors	59,100,000	-7,622,904	61,900,000	-38,400,000	153,000,000
Kernel &	Bandwith 0.04	62,200,000	-9,508,021	58,100,000	-25,800,000	164,000,000
	Bandwith 0.08	47,500,000	5,541,509	56,200,000	-46,100,000	140,000,000
	Bandwith 0.16	50,000,000	2,494,266	56,400,000	-37,500,000	149,000,000
	Bandwith 0.24	59,400,000	-3,334,663	56,000,000	-27,400,000	163,000,000

& The default Bandwith in STATA 9 is 0.08

Confidence interval was obtained with Bootstrap at 500 iterations

* Significant at 10%

Table A13 – Impact on Employment (%)

ATT variable dpper (en %)						
		Impact	Bias	std error	Confidence Interval 90% #	
Nearest Neighborhood	2 neighbors	10.82	-0.22	8.56	-0.32	28.57
	3 neighbors	12.27*	-1.72	8.31	2.17	35.55
	4 neighbors	12.47*	-1.49	8.36	2.17	33.92
Kernel &	Bandwith 0.04	10.90*	-1.79	7.11	0.47	23.94
	Bandwith 0.08	11.96*	-1.69	6.74	1.71	25.21
	Bandwith 0.16	12.61*	-1.82	6.64	4.11	29.08
	Bandwith 0.24	13.23*	-1.83	6.63	4.37	28.68

& The default Bandwith in STATA 9 is 0.08

Confidence interval was obtained with Bootstrap at 500 iterations

* Significant at 10%

Table A14 – Impact on Employment (Level)

ATT variable dper (people)						
		Impact	Bias	std error	Confidence Interval 90% #	
Nearest Neighborhood	2 neighbors	9*	-1	8	1	28
	3 neighbors	8*	1	8	0	27
	4 neighbors	9*	-1	8	1	30
Kernel &	Bandwith 0.04	8*	0	6	0	21
	Bandwith 0.08	7*	0	6	1	21
	Bandwith 0.16	7*	1	6	0	18
	Bandwith 0.24	7*	0	5	1	17

& The default Bandwith in STATA 9 is 0.08

Confidence interval was obtained with Bootstrap at 500 iterations

* Significant at 10%

Table A15 – Impact on Productivity

ATT Indice dpme						
		Impact	Bias	std error	Confidence Interval 90% #	
Nearest Neighborhood	2 neighbors	-0.21	0.00	0.31	-1.36	0.02
	3 neighbors	-0.22	-0.01	0.33	-1.26	0.01
	4 neighbors	-0.64*	0.40	0.31	-1.82	-0.43
Kernel &	Bandwith 0.04	-0.15	-0.01	0.22	-0.79	0.04
	Bandwith 0.08	-0.20	0.01	0.22	-0.82	0.02
	Bandwith 0.16	-0.24	0.02	0.22	-0.76	0.02
	Bandwith 0.24	-0.24*	0.03	0.21	-0.77	0.00

& The default Bandwith in STATA 9 is 0.08

Confidence interval was obtained with Bootstrap at 500 iterations

* Significant at 10%

Table C16 – Impact on Export

ATT Indice dexpo						
		Impact	Bias	std error	Confidence Interval 90% #	
Nearest Neighborhood	2 neighbors	2.78*	0.01	1.52	0.63	5.71
	3 neighbors	2.79*	0.00	1.52	0.60	5.71
	4 neighbors	2.79*	0.01	1.52	0.60	5.69
Kernel &	Bandwith 0.04	2.60*	0.14	1.60	0.12	5.44
	Bandwith 0.08	2.72*	0.06	1.53	0.46	5.67
	Bandwith 0.16	2.70*	0.05	1.51	0.49	5.52
	Bandwith 0.24	2.67*	0.07	1.51	0.40	5.46

& The default Bandwith in STATA 9 is 0.08

Confidence interval was obtained with Bootstrap at 500 iterations

* Significant at 10%