

# The impact of public funding for research and development on business performance in Mexico

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## Abstract

This study evaluates the impact of financial incentives for corporate innovation on the performance of Mexican companies. It also analyses the priorities underlying the incentive programmes by constructing a profile of the types of firm that are the main recipients of this kind of support. Propensity score matching – in this case, matching based on the probability of receiving such support – of data from the 2017 Research and Technological Development Survey (ESIDET) is used for this purpose. When corporate and governments funds are both taken into account, the results indicate that public funding fosters higher levels of expenditure on research and development, but when public funds are deducted from the total, the results show that these incentive programmes have had no net effect on the initial foreseen level of private research and development expenditure. The findings also indicate that government funding has a positive impact on corporate performance and in terms of human capital and that the types of firm that tend to receive this kind of support more often are in the services sector, those that are more innovative, larger and more competitive, and those that engage in the development of technological applications that are nearer to the market rather than those devoted to basic research.

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## Keywords

Research and development, technological innovations, financing, public sector, industrial enterprises, programme evaluation, statistical methodology, Mexico

## JEL classification

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## I. Introduction<sup>1,2</sup>

Governments provide incentives for corporate innovation for a number of reasons. First, innovation is considered to be a key element in international competitiveness. This is particularly important for Mexico, since its productivity growth has been flat since the 1990s. In fact, in 2021 its productivity index was lower than it had been in 1993. Another rationale for providing stimulus for corporate investment in research, development and innovation (RDI) is that market incentives for this type of investment are lacking. Market failures lead to underinvestment in this area, and the economy therefore falls short of the socially optimal level of RDI activity (Nelson, 1959; Arrow, 1962). Because of the high cost and risk levels associated with innovation, commercial lenders are reluctant to finance innovation, and companies therefore must mainly use their own funds to cover R&D costs (Hall, 2002; Spielkamp and Rammer, 2009). In addition, in the wake of the international financial crisis of 2008, RDI spending dropped sharply for two reasons. The first is that the corporate funds used to finance RDI are primarily derived from corporate profits, which dropped during that period. The second is that the supply of financing from alternative lenders shrank as a consequence of the credit crunch.

Mexico has launched numerous programmes to support corporate innovation and R&D, including programmes that provide direct financial support to business enterprises. Total R&D spending has still not exceeded 0.5% of GDP, however. Although in 2004 the government pledged to devote no less than 1.0% of GDP to this effort (SEGOB, 2004), expenditure peaked at 0.45% in 2010 and has fallen since then, slipping to 0.30% of GDP in 2020 (see table 1).

**Table 1**

Mexico: labour productivity and investment in research and development (R&D), 1993–2021

|  | 1993  | 2000  | 2005  | 2010  | 2015  | 2020              | 2021  |
|--|-------|-------|-------|-------|-------|-------------------|-------|
| Labour productivity <sup>a</sup>   | 19.80 | 20.40 | 18.80 | 18.70 | 19.80 | 19.60             | 18.90 |
| Total R&D expenditure ( <i>Percentages of GDP</i> )                          | 0.22  | 0.31  | 0.41  | 0.45  | 0.43  | 0.30              | -     |
| Public R&D budget ( <i>Percentages of GDP</i> ) <sup>b</sup>                 | -     | 0.19  | 0.22  | 0.29  | 0.32  | 0.20 <sup>c</sup> | -     |
| Corporate R&D expenditure ( <i>Percentages of GDP</i> )                      | 0.03  | 0.09  | 0.17  | 0.16  | 0.07  | 0.05              | -     |
| Corporate share of total R&D expenditure ( <i>Percentages</i> ) <sup>d</sup> | 10.40 | 29.80 | 46.90 | 35.00 | 18.60 | 2.50              | -     |

**Source:** Prepared by the authors. 1993 data: Organisation for Economic Co-operation and Development (OECD), “Main Science and Technology Indicators” and OECD.Stat.

<sup>a</sup> GDP per hour worked, in United States dollars at constant 2015 prices at purchasing power parity (PPP).

<sup>b</sup> Government budget allocations for R&D.

<sup>c</sup> Figure for 2019.

<sup>d</sup> Corporate R&D expenditure as a percentage of total gross R&D expenditure.

The public R&D budget (as a percentage of GDP) had risen almost continually from its 2000 level of 0.19% of GDP to 0.32% by 2015 but then began to decline steadily, dropping to 0.20% by 2019, which was practically as low as it had been at the start of this century. Importantly, in parallel with these downward trends, corporate innovation efforts have dwindled. Whereas corporate R&D spending had jumped from 10.4% of total gross expenditure on R&D in 1993 to 46.9% by 2005, the business sector accounts for only 21.5% of total R&D expenditure now. In 2020, companies’ R&D spending amounted to just 0.05% of GDP, which is a far cry from the 0.17% level recorded in 2005. Even with the provision of public funding, the Mexican government has not managed to boost total public and private R&D spending in order to bring about a clear-cut, stable trend towards technological change.

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<sup>2</sup> The authors are grateful to the National Institute of Statistics and Geography (INEGI) for providing them with access to Survey on Research and Technological Development (ESIDET) microdata.

An assessment of the programmes implemented to date is thus needed in order to provide input for the design of government incentives that will put public funds to good use and help to ensure that the attendant policies achieve their objectives in terms of both efficiency and effectiveness.

The main objective of such an assessment should be to conduct a cost-benefit analysis in terms of social well-being, since the net social benefits have to outweigh the net social costs in order for government action to be justified.<sup>3</sup> The problem is that such an analysis is nearly impossible to carry out. The proper role of the State can be discerned only on the basis of a large number of assumptions about the cause-and-effect relationship entailed in the interaction between public and private activities. Because of the difficulty of attributing an isolated increase in social well-being to a given technology policy, intermediate variables have to be employed in order to analyse these effects. In the case of public support for corporate RDI, these intermediate variables are the increase in private sector spending on RDI (financial additionality) and variables related to business performance and results.

According to the literature, the allocation of public funding is not random. This poses a methodological problem of selection bias when the time comes to evaluate its impact. One way to overcome this problem is to use propensity score matching (PSM) (in this case, matching on the probability of being a beneficiary) to pair each subsidized firm with an unsubsidized one (a control). Using this methodology, the variables of interest for beneficiary firms can be compared with those for firms that have not received any assistance; the difference will reflect the impact of the public policy in question (additionality). The presence of additionality will indicate that the assistance channelled through these firms has made the country more competitive and that, therefore, the policy is justified.

Few studies have been done on government support for innovation in developing countries (Zúñiga-Vicente and others, 2014; Vergara Reyes and others, 2021), and the impact of this kind of assistance in such countries therefore needs to be assessed. This is also true of Mexico, where empirical studies on the impact of innovation incentives using data at the company level are few and far between (see box 1). The studies that do exist are based on data from the twentieth century for a sample of small and medium-sized enterprises and, surprisingly, do not analyse the effect of expenditure on R&D or innovation. Clearly, then, there is a need for evaluations of technology policies, which are all the more necessary in times of international crises and upheavals during which Mexican companies have sharply dialled back their innovation efforts and are faced with a tighter credit situation when they do try to undertake such efforts.

In view of the above, the objective and principal innovative aspect of this study is, first, its effort to determine if public funding of corporate R&D work encourages innovative companies to spend more of their own funds on RDI than they would have spent in the absence of that support and, second, to weigh the effect that the support has on other corporate performance variables. It also seeks to outline the profile of the companies that have enjoyed preferential treatment by assistance agencies based on an analysis of the businesses that most often receive public support. This profile, which reflects the types of firm that are accepted into government programmes the most often, in contradistinction to those that have not been included in those programmes, can shed light on what could be regarded as the revealed priorities of those programmes.

This study is structured as follows. Following this introduction, section II describes the propensity score matching (PSM) methodology that was used. Section III focuses on the types of data and the variables used to measure the impact. Sections IV and V present the core analysis of this study regarding the impact of public funding and the revealed policy priorities based on the profiles of the most frequent corporate participants in the relevant programmes.

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<sup>3</sup> This analysis must also take into account the opportunity costs involved and the negative effects on businesses that have not received government support.

**Box 1**

## Mexico: an assessment of the impact of public support for corporate innovation

Several studies evaluate support for R&D and innovation in Mexico using propensity score matching, but most of them employ data compiled around the turn of the century and thus prior to the 2008 international financial crisis (1994–2005) (Tan and López-Acevedo, 2007; López-Acevedo and Tan, 2005 and 2010; López-Acevedo and TinajeroBravo, 2013). These studies analyse the effect of such support on employment, productivity and sales, but not —possibly owing to a lack of data— on corporate R&D spending. A few recent studies present the results of ad hoc surveys of firms in the Innovation Incentive Programme (PEI) (Dávila-Borbón, León-Balderrama and Preciado-Rodríguez, 2019; Pastor Pérez, Rodríguez Gutiérrez and Ramos Ávila, 2017; Moctezuma, López and Mungaray, 2017) and have found, overall, that this assistance has had a positive impact on innovation efforts. These studies' usefulness is limited by the fact that the number of respondent firms was quite small,<sup>a</sup> which impedes the use of econometric models and the generalization of their findings to innovating companies as a whole.

There are three studies that used unconventional methods of analysis in this field. Chávez (2020) uses a fuzzy regression discontinuity approach and finds that assistance has a positive influence on the number of staff working on innovation but finds no effect in terms of the number of patents or on the actual level of R&D expenditure in absolute terms.

Martínez-Covarrubias, Lenihan and Hart (2017) analyse the effect of assistance in terms of improvements in global value chains using the Heckman two-step selection method but find no significant impact. Meanwhile Moctezuma, López and Mungaray (2017) offer descriptive statistics on the effects of a number of different variables, including investment, external linkages, the participation of researchers and students, publication and dissemination, and competitiveness. The authors conclude that a number of projects would not have been conducted if it were not for government assistance, although others would have gone ahead anyway, which implies that some firms exhibited a crowding-out effect.

Thus, generally speaking, all these studies indicate that assistance has had a positive impact, but their widely varying natures in terms of both methodology and the variables used to measure the impact make comparisons or generalized conclusions difficult. Most surprisingly of all, only one study (Chávez, 2020) analyses the effect on R&D expenditure by the firms in question, which, internationally, is the most commonly used variable for this type of study.

**Source:** H. Tan and G. López-Acevedo, "How Well Do Small and Medium Enterprise Programs Work? Evaluating Mexico's SME Programs Using Panel Firm Data", Washington, D.C., World Bank, 2007; G. López-Acevedo and H. W. Tan, *Impact Evaluation of Small and Medium Enterprise Programs in Latin America and Caribbean*, Washington, D.C., World Bank, 2010; and *Evaluating Training Programs for Small and Medium Enterprises: Lessons from Mexico*, World Bank, 2005; G. López-Acevedo and M. Tinajero-Bravo, "Evaluating different types of enterprise support programs using panel firm data: evidence from the Mexican manufacturing sector", *Economía*, vol. 14, No. 1, 2013; C. Dávila-Borbón, J. I. León-Balderrama and J. M. Preciado-Rodríguez, "La efectividad del Programa de Estímulos a la Innovación (PEI) en Sonora. ¿Qué factores influyen en el impacto del programa Rodríguez sobre la innovación y la competitividad de las empresas?", *Estudios Sociales. Revista de Alimentación Contemporánea y Desarrollo Regional*, vol. 29, No. 53, 2019; M. D. P. Pastor Pérez, P. I. Rodríguez Gutiérrez and A. E. Ramos Ávila, "Effects of public financing for innovation: microeconomic perspective based on a study of small businesses", *Región y Sociedad*, vol. 29, No. 70, 2017; P. Moctezuma, S. López and A. Mungaray, "Innovación y desarrollo: programa de estímulos a la innovación regional en México", *Problemas del Desarrollo*, vol. 48, No. 191, 2017; E. Chávez, "The effects of public R&D subsidies on private R&D activities in Mexico", *PSE Working Paper*, No. 2019-73, *HAL Open Science*, 2020 [online] <https://shs.hal.science/halshs-02355106v3>; and J. L. Martínez-Covarrubias, H. Lenihan and M. Hart, "Public support for business innovation in Mexico: a cross-sectional analysis", *Regional Studies*, vol. 51, No. 12, 2017.

<sup>a</sup> For the study by Dávila-Borbón, León-Balderrama and Preciado-Rodríguez (2019), 39 companies were surveyed and, in the study by Pastor Pérez, Rodríguez Gutiérrez and Ramos Ávila (2017), responses were received from 10 firms.

## II. Propensity score matching as an evaluation methodology<sup>4</sup>

The additionality effect of public support can be understood as the amount by which performance indicators change as a result of government action when that change would not have occurred in the absence of that action and is thus basically the outcome of the public policy incentives that were introduced. The desired effect of the financial injection — derived from public funds — is that the firm in question will spend an additional amount on R&D (Georghiou, 1994). If a suitable evaluation method is used, the amount of additional expenditure will represent the estimated effect (the financial additionality) that has clearly been produced by the support provided and that is not attributable to other possible explanatory factors (demonstrated causality).

The allocation of subsidies is not random but instead entails two separate steps. Companies first have to decide whether they are willing to assume the cost of applying for public funding and, if they do, then government agencies will select which ones will receive the support based on their criteria and objectives. Thus, the evaluation has to take account of both the businesses' self-selection and then the selection made by the agencies in charge of the support programme. In fact, subsidized companies may differ in important ways from non-subsidized ones, and the support programme selection process must therefore be taken into consideration (Heckman, 1979; Imbens and Wooldridge, 2009).

Various econometric techniques have been developed for addressing and correcting for this selection bias, such as regression discontinuity design, the difference-in-differences technique and the instrumental variables approach (Hünernund and Czarnitzki, 2019). Given the data available for this study, however, propensity score matching appears to be the best option (Angrist, 1998; Gerfin and Lechner, 2002; Smith and Todd, 2005).

Sample matching based on the probability of a firm becoming a beneficiary makes it possible to determine, by direct means, how much a subsidized company would have invested in R&D in the counterfactual situation (without public support). Since that counterfactual is never observable, it has to be estimated in order to see what the effect of the government support measure has been. Assuming that all the important characteristics leading to selection can be observed, or, in other words, that the assumption of conditional independence is borne out (Rubin, 1977), it is possible to approximate this counterfactual situation by looking at companies that have the same, or very similar, characteristics as the subsidized ones but that have not received public funds. In order to find these matches, the subsamples of subsidized and non-subsidized firms are matched up according to the probability of receiving a subsidy. On the basis of a probit estimate, the conditional probability of a firm receiving a subsidy can be obtained:  $Pr(Sub_i = 1 | X = x)$ . Thus, subsidized firms are being compared with firms that had the same probability of receiving subsidies but did not. On the basis of this index, a nearest-neighbour matching estimate is made comparing each subsidized firm with its projected counterfactual to estimate the impact (Rosenbaum and Rubin, 1983; Dehejia and Wahba, 2002).

Accordingly, the average effect on subsidized firms is estimated as follows:

$$ATT = \frac{1}{N^T} \sum_{i=1}^{N^T} (Y_i^T - \hat{Y}_i^C) \quad (1)$$

where  $Y_i^T$  is the value of the variable of interest of subsidized companies;  $\hat{Y}_i^C$  is the counterfactual situation; and  $N^T$  is the number of firms that received public funds.

<sup>4</sup> The propensity score matching manual of Vergara Reyes and others (2021) is a good source for detailed methodological information and for information on the development of the models and the selection variables used (detailed in section IV).

Finally, in order for matching to be adequate, there must be sufficient commonality between the sample of treated firms and the potential control sample, so there must be a sufficient overlap between the sample of treated firms and the control sample in terms of the probability of receiving a subsidy. Consequently, observations of treatment-group companies for which the probability is higher than the highest level of the potential control group or lower than the lowest level of the potential control group are eliminated.

### III. Data sources, treatment variables and impact indicators

The innovation surveys conducted by many countries have provided solid databases that can be used to estimate the impact of subsidies. Econometric models are used to simulate experimental methods and compare the performance of firms that have received innovation subsidies with the performance of firms that have not. Mexico conducted its Technological Research and Development Survey (ESIDET)<sup>5</sup> in 2006, 2008, 2012, 2014 and 2017 but, since the data from the different survey years cannot be matched, this analysis will be based on the data obtained from the 2017 survey. The survey covers Mexican companies having at least 20 employees. Its sectoral coverage corresponds to the branches of industry identified by the Organisation for Economic Co-operation and Development (OECD) of the North American Industry Classification System (NAICS) (INEGI, 2013).

The survey includes questions on firms' structural features and their innovation and commercial activities. These data make it possible for the analysis to cover a wide range of variables in calculating the probability that a firm will receive a subsidy or not and in evaluating the effectiveness of this use of public funds by looking at more than just expenditures on innovation as such.

The database provides information both on companies that are innovating and on those that are not doing so. The decision was made to restrict the analysis to innovative firms, in line with the approach used in the existing literature (Czarnitzki and Licht, 2006; Czarnitzki and Lopes-Bento, 2013). After applying this criterion and eliminating the companies for which information on the variables of interest is not available, the sample ended up being composed of 2,438 observations.

The 2017 survey provides information for each year that it covers (2014, 2015 and 2016) in most cases, but there are some variables for which only aggregate data for the whole period are available. This is the case for the information on incentive programmes, which is aggregated for the three years covered by the survey, and it is therefore impossible to determine whether any given company participated in that programme in one, two or all three years. Nonetheless, information on the amount of direct support for R&D that was provided in each individual year is available, so a more accurate analysis can be undertaken by lagging the control variables in order to avoid endogeneity in the estimates. Consequently, we feel that the best option is to analyse the effect of the provision of public funds without looking at firms' participation in other types of programme.

The analysis is broken down into two main parts. In the first, the treatment involves a dichotomous variable that takes a value of 1 if companies have received public funds and a value of 0 if they have not. This variable is used to calculate the probability that a company will receive support. In the second, in order to estimate the effect that the receipt of public funds has on corporate outcomes, the approach favoured in the empirical literature<sup>6</sup> was used, and the effect is therefore measured using variables for

<sup>5</sup> National Institute of Statistics and Geography (INEGI) and National Council of Science and Technology.

<sup>6</sup> For a review of recent empirical information focusing on an analysis of subsidies, see Zúñiga-Vicente and others (2014), Dimos and Pugh (2016) and Dimos and others (2022).

innovation effort and for corporate performance. We thus use the logarithm of R&D spending<sup>7</sup> and, in addition, R&D spending as a percentage of the sales volume, in order to shield the calculations from the distorting effect that the largest firms can have on the mean.

Given the availability of information on the amount of public funds channelled into business enterprises, the analysis includes net and gross outlays. Net expenditure on R&D corresponds to R&D expenditure financed out of a company's own funds, whereas gross expenditure on R&D also includes government subsidies. In other words, when the figures for net expenditure are used, public funds are not taken into account in estimating the treatment effect.

When net R&D expenditure is used as the treatment outcome, a positive result indicates that the company used, at the least, all the additional funds that it received, and increased its spending on R&D above the level of expenditure that had initially been planned, allocating additional private funds that had not initially been intended for that purpose (full additionality). A negative result indicates that the assistance had a partial or full crowding-out effect. For the estimates based on gross R&D expenditure, a positive value signals the presence of at least partial additionality. In this case, however, it is not clear whether the increase in R&D expenditure is equal to or less than the amount of public funding received.

Using a combination of these results for the treatment effects, three mutually exclusive types of additionality effects can be identified (see table 2): (i) full additionality: the funding received prompts the company to raise its planned level of net R&D expenditure by more than the amount of public funds received; (ii) partial crowding out: the company increases its R&D expenditure from what was initially planned, but by less than the amount of public funds received; and (iii) full crowding out: the company uses the public funds received instead of the private funds initially allocated for R&D expenditure, with the level of spending remaining the same as (or lower than) it would have been before the public funds were received. In this latter case, there is no financial additionality at all, giving way to what is known in the literature as “free riding”.

**Table 2**  
Types of additionality

|  |                               | Effect of financial support on net expenditure ( $\hat{\tau}_i^{net}$ ) |                                   |
|--|-------------------------------|---|-----------------------------------|
|  |                               | $\hat{\tau}_i^{net} > 0$  | $\hat{\tau}_i^{net} \leq 0$       |
| Effect of financial assistance on gross expenditure ( $\hat{\tau}_i^{gross}$ ) | $\hat{\tau}_i^{gross} > 0$    | Full additionality  | Partial crowding out <sup>a</sup> |
|  | $\hat{\tau}_i^{gross} \leq 0$ | Impossible <sup>b</sup>   | Full crowding out                 |

**Source:** J. Heijs, A. J. Guerrero and E. Huergo, “Understanding the heterogeneous additionality of R&D subsidy programs of different government levels”, *Industry and Innovation*, vol. 29, No. 4, 2022.

<sup>a</sup> Or partial additionality effect.

<sup>b</sup> This is not observable because net expenditure will always be less than gross expenditure, and a positive value for net expenditure will therefore never occur when gross expenditure is negative.

Since the provision of public funds can influence companies' performance in various ways, in addition to their innovation effort, performance and entrepreneurial capacity variables were also included (Crespi, Tacsir and Vargas, 2016). Specifically, the logarithms of sales and export volumes are used as performance variables that can then be used to compare the positive effect of public support for R&D based on indicators of a firm's profitability and sustainability over time. Finally, the study looked at the effect of public funding on human capital, measured by the number of employees with tertiary degrees as a percentage of all employees. This indicator can be used to determine if this type of public assistance is also conducive to the presence of a more technically sophisticated and more highly specialized company workforce.

<sup>7</sup> Logarithmically transformed variables have been widely used. See, for example, Czarnitzki and Licht (2006), Neicu (2019) and Huergo and Moreno (2017).

## IV. Independent variables: company profile

As stated, because of the possibility of selection bias, a clone control group is needed. Using the PSM method, such a control group is created based on the probability of receiving these incentives, which is calculated using the variables<sup>8</sup> that will influence that likelihood. Thus far, there is no theoretical framework that would indicate what the relevant variables are (Heijs, Guerrero and Huergo, 2022; Vergara Reyes and others, 2021), although there is a large body of literature arguing for the inclusion of certain variables for the assignment of treated and control-group companies (see Zúñiga-Vicente and others, 2014; Vergara Reyes and others, 2021).

A large number of empirical studies that use PSM have tended to coalesce around the inclusion of a given group of variables in the models. In practice, there is some degree of standardization around the selected variables, but there are very few studies that offer theoretical arguments for why certain variables are appropriate for matching up treated and control-group companies. This study will therefore follow the predominant model and include the same variables as have been used in previous studies.<sup>9</sup>

Table 3 shows the results, coefficients (column 1) and marginal effects (column 2) of the estimation of the determinants of the probability of being a beneficiary using a probit model. For the estimation, all the variables were lagged one year in order to avoid problems of double causality, especially in the case of variables related to the variables of interest (expenditures on innovation or human capital).<sup>10</sup> This first step makes it possible to obtain the profile of the companies that receive support, which indicates the revealed priorities of the public agency in question. In other words, it implicitly reveals the types of company that, *ceteris paribus*, have benefited most often, whether this has been by design of the policy or not, and those that have been discriminated against. A first set of variables that reflect the implicit priorities at work are structural characteristics, such as a firm's size, sector, the length of time it has been in existence, export behaviour and ownership structure.

Company size proves to be the most noteworthy variable in this set because it plays a fundamental role as an explanatory variable for the allocation of public funds. It could be that small and medium-sized enterprises (SMEs) have greater difficulty in securing support because they have less logistical capacity for identifying possible sources of funds and for preparing the corresponding proposals. They may also have few eligible projects. Large firms, meanwhile, have access to more information and are likely to have more eligible projects. In addition, they have, in all likelihood, gone through a learning process in applying for grants, thereby creating advantages of scale with respect to the costs—in terms of both money and time—of preparing grant applications (Heijs, 2001; Aerts and Schmidt, 2008; Neicu, 2019). Furthermore, large firms tend to have better contacts with public agencies and officials involved in the allocation process. They are also more likely to innovate and apply the results to various production lines. This is an important feature, as government agencies will seek to maximize the probability of producing positive outcomes by choosing companies with greater innovation capacity (Heijs, 2001; Hud and Hussinger, 2015).

<sup>8</sup> For a description of these variables, see table A1.1 in annex A1.

<sup>9</sup> The selection of the variables used here is based on a review of 55 studies that use PSM to evaluate R&D and innovation incentives in which an indication is given of the control variables used in each and the sign of the estimated effect on the probability of obtaining government support (see Vergara Reyes and others, 2021).

<sup>10</sup> Earlier studies incorporate lagged variables or components of variables of interest in estimating the probability of receiving support (Aristei, Sterlacchini and Venturini, 2017; Afcha and Lucena, 2022).

**Table 3**  
Factors influencing the probability that firms will be involved in government research and development (R&D) incentive programmes, probit model

|                                    | Government support = 1 |       |           |       |
|------------------------------------|------------------------|-------|-----------|-------|
|                                    | (1)                    | (2)   |           |       |
|                                    | Coefficient            | S.E.  | dy/dx     | S.E.  |
| Company size                       |                        |       |           |       |
| 0<x<100                            | -0.067                 | 0.115 | -0.012    | 0.021 |
| 100<x<200                          | Reference              |       |           |       |
| 200<x<500                          | -0.337***              | 0.131 | -0.061*** | 0.024 |
| x>500                              | -0.170                 | 0.121 | -0.031    | 0.022 |
| Age (log)                          | -0.114**               | 0.045 | -0.021**  | 0.008 |
| Export activity                    | 0.274***               | 0.086 | 0.050***  | 0.016 |
| Publicly owned                     | 0.047                  | 0.135 | 0.009     | 0.025 |
| Multinational (>50%)               | -0.506***              | 0.155 | -0.092*** | 0.028 |
| Group                              | -0.138*                | 0.077 | -0.025*   | 0.014 |
| Human capital                      | 0.865***               | 0.185 | 0.158***  | 0.034 |
| Basic research                     | -0.283**               | 0.131 | -0.052**  | 0.024 |
| Applied research                   | 0.419***               | 0.105 | 0.076***  | 0.019 |
| Technological development          | 0.710***               | 0.085 | 0.130***  | 0.016 |
| Sector of activity:                |                        |       |           |       |
| - Traditional industrial producers | -0.116                 | 0.129 | -0.021    | 0.023 |
| - Traditional industrial suppliers | -0.108                 | 0.131 | -0.020    | 0.024 |
| - Specialized industrial suppliers | 0.052                  | 0.165 | 0.009     | 0.030 |
| - Scale-intensive industries       | 0.143                  | 0.127 | 0.026     | 0.023 |
| - Science-based industries         | 0.319*                 | 0.171 | 0.058*    | 0.031 |
| - High-tech services               | 0.429***               | 0.120 | 0.078***  | 0.022 |
| Year: 2014                         | -0.202***              | 0.070 | -0.037*** | 0.013 |
| Wald test                          |                        |       |           |       |
| Sector dummies $\chi^2$ (6)        | 33.18***               |       |           |       |
| LR Chi <sup>2</sup> (20)           | 321.7                  |       |           |       |
| Log-likelihood                     | -814.9                 |       |           |       |
| Pseudo R <sup>2</sup>              | 0.165                  |       |           |       |
| Observations                       | 2.438                  |       |           |       |

**Source:** Prepared by the authors, on the basis of data from the 2017 Survey on Research and Technological Development (ESIDET).

**Note:** S.E.: robust standard errors. All the variables have been lagged by one period. Marginal effects (dy/dx) have been calculated from sample means. All models include a constant term. \*\*\* p < 0.01; \*\* p < 0.05; \* p < 0.1 (significant at 1%, 5% and 10%, respectively).

Meanwhile, there are arguments for assuming that SMEs ought to apply for aid more often. Czarnitzki and Delanote (2015) point out that such support would be more important for small firms, as they are more sensitive to the negative effects of market failures,<sup>11</sup> such as the appropriability problem (Arrow, 1962) and uncertainty (Dixit and Pindyck, 1994), as well as imperfect information as reflected in its asymmetric distribution and especially in such firms' more limited access to it (Czarnitzki and Delanote, 2015). Moreover, SMEs are under many more financial constraints and are therefore more likely to need to seek financing outside the market (Heijs, 2001; Canepa and Stoneman, 2008; Czarnitzki and Delanote, 2015). In addition, there are programmes designed specifically for SMEs. However, the net effect of all these possible factors on the size-based bias in the allocation of funding is not fully defined. Most of the empirical studies find that it is more frequent for larger firms to participate than smaller ones (Almus and Czarnitzki, 2003; Czarnitzki and Lopes-Bento, 2013 and 2014; Guerzoni and

<sup>11</sup> The idea that the innovative activities of SMEs are more constrained by market failures has been empirically proven in studies by Lerner (1999), Czarnitzki and Hottenrott (2011) and Hall and Lerner (2010).

Raiteri, 2015). Other studies, however, have found that the trend in terms of size is non-linear (Czarnitzki and Licht, 2006; Huergo and Moreno, 2017; Heijs, Guerrero and Huergo, 2022). These studies indicate that, as a firm's size increases, so does its probability of participating in incentive programmes but that there is a point at which the increase in size has a diminishing effect on the likelihood of participation. They conclude that, while the largest firms are likely to participate more often than smaller firms, medium-sized firms are less likely to be in these programmes. In order to capture the effect of firm size, a variable is included that takes a value of 1 when the firm has 200 or more workers. As can be seen in table 3, this study, meanwhile, shows that large firms receive government support less frequently and that there is no difference in the frequency of participation in incentive programmes between small firms and medium-sized ones. It therefore points to the presence of positive discrimination towards smaller firms, as they, *ceteris paribus*, are more likely to participate in government incentive programmes.

The big differences existing between sectors in terms of the probability of innovating, technological opportunity and technological level reflect the heterogeneity existing in terms of both the need to apply for funding and the probability of receiving it. Accordingly, a set of dichotomous variables referring to the sector to which a company belongs has been included. Although the survey furnishes disaggregated data on the types of activity carried out, the sample is quite small, especially in certain sectors, which precludes a highly disaggregated analysis. This is why this study employs sectoral aggregation based on firms' technological behaviour in line with the proposal of Pavitt (1984) and Bogliacino and Pianta (2016). Using this approach, it becomes clear that there are two sectors in which the percentage of firms participating in such programmes is disproportionately high: science-based industries and the high-tech services sector.

Science-based industries are the ones that have benefited the most of all.<sup>12</sup> This could be due to the important role of this sector in the Mexican economy and the country's interest in attracting foreign investment, which tends to benefit this type of company more than others. Given the available data, however, it is not possible to verify this supposition. Similarly to the situation in European countries (Herrera and Bravo, 2010; Hud and Hussinger, 2015; Afcha and García Quevedo, 2016), Mexican firms in the high-tech services sector and science-based industries have benefited from positive discrimination in terms of the selection of firms for inclusion in these programmes.

A structural characteristic frequently used in such evaluations is the age of the firm, whose explanatory value in terms of the probability of being a beneficiary is ambiguous. On the one hand, more experienced (older) firms are expected to be more likely to be beneficiaries, as they are more likely to have developed closer relationships with the managers or officials responsible for administering these programmes. It is also true, however, that it may be more likely for older firms to belong to more traditional sectors, which would generally equate with a lower technological level and fewer technological opportunities and, hence, a lower participation rate (Cerulli and Poti, 2012). On the other hand, younger firms tend to be more financially constrained, and some of them, such as at least some technology-based start-ups, are highly innovative, so they may have a larger number of projects that are eligible for support and could therefore be more likely to receive such grants or incentives (Czarnitzki and Lopes-Bento, 2013). In this study, we have included the logarithmically transformed number of years that a firm has been in business. In the probit model (see table 3), the variable capturing the age effect shows that it has a negative impact leading to a lower level of participation in government incentive programmes for older firms.

Another aspect frequently included in empirical studies is export capacity, and the variable included for that characteristic takes a value of 1 if the firm has engaged in export activity (exporting probability). The effect is expected to be positive, as the international market is more competitive than

<sup>12</sup> The estimated results for each sector are interpreted in relation to the reference sector (which is excluded from the model). In this case, that is the "other sectors" category, which includes agriculture, low-tech services and construction.

the local market, which would indicate that exporting firms will have a greater capacity for converting their research into product innovations (Czarnitzki and Licht, 2006). The higher participation rate for these firms would be due, in part, to the fact that these firms will have more innovative and entrepreneurial skills, as well as more experience in preparing proposals for an eligible project. But another part of the explanation could be that many government agencies opt for a policy of picking “winners” (Wallsten, 2000; Blanes and Busom, 2004; Cantner and Kösters, 2012) and so select the most competitive firms that have demonstrated that they can perform successfully in international markets, which are much more demanding with regard to innovation. Indeed, many countries have active export promotion policies, including some that focus particularly on innovation, as is the case in Mexico.<sup>13</sup> The results presented in table 3 also show that export firms have a clearly greater likelihood of being included in incentive programmes.

Empirical evidence shows that a firm’s ownership structure is an influential factor in determining which companies receive support. For this reason, variables have been included that indicate whether firms are publicly owned, privately owned or have foreign (multinational) equity participation,<sup>14</sup> while individually owned firms are implicitly included in the analysis as a reference variable. Since positive discrimination towards local or national firms has been detected, the presence of foreign equity is expected to have a negative impact on the receipt of support. This study provides confirmation of the findings of previous empirical works (Aerts and Schmidt, 2008; Czarnitzki and Lopes-Bento, 2011; Aristei, Sterlacchini and Venturini, 2017) showing that also in Mexico the participation rate of partially foreign-owned firms, as well as firms belonging to business groups is lower. Meanwhile, publicly or partially publicly owned companies participate to the same extent as individually owned companies; it can therefore be concluded that ownership structure is an important predictor of funding allocation.

A second group of variables used in the model reflect the revealed priorities of government agencies in Mexico<sup>15</sup> with regard to the innovative activities and results achieved by different companies (see table 3). The first variable has to do with the focus of R&D. Although some programmes support only basic R&D, which is more distant from market applications, most of them are designed to support a wide range of innovative activities and would thus theoretically accept applications from all sorts of firms. However, many programmes issue a call for proposals requiring the submission of a specifically designed and planned project, which implicitly excludes incremental innovation efforts. It therefore makes sense to analyse how a firm’s chosen orientation towards innovation influences the likelihood of that firm being selected for an incentive programme. Three binary variables have therefore been included that take a value of 1 if the companies’ activities are oriented towards basic or applied research or towards the development of technology.

Theoretically, firms engaged in basic R&D research should have a greater likelihood of securing government support than companies involved in the development of technology, since basic research generates strong social gains but also entails a great deal of risk. It is therefore probable that opportunities for realizing a high level of private gain would not in themselves attract a socially desirable volume of resources (Nelson, 1959). Therefore, it is to be expected that the authorities will encourage this type of research by providing support for it. Contrary to theoretical expectations, the orientation towards basic research is found to have had a negative influence on the likelihood of receiving support. One possible explanation is that basic research is mainly carried out by CONACYT, universities or other research institutions or centres and that the number of companies carrying out such activities is relatively

<sup>13</sup> In Mexico, some programmes (e.g. the Joint Export Promotion Commission (COMPEX)) combine the promotion of exports with support for innovation.

<sup>14</sup> For the purposes of this analysis, firms are classified as multinationals if 50% or more of the equity in the firm is held by foreign entities.

<sup>15</sup> In Mexico, support is provided by federal institutions such as the State Secretariats and decentralized government agencies such as CONACYT.

small.<sup>16</sup> Meanwhile, firms oriented towards activities closer to the market (technological development) are more likely to participate in the programmes. One possible explanation for this could be that, as has been observed in other countries,<sup>17</sup> government agencies in Mexico are opting for projects that offer the prospect of a certain level of success in the short term and products that have an immediate application in the market. Moreover, the level of risk of failed projects is higher in the case of basic R&D, and the likelihood that projects closer to the market will be successful appears to be higher. This may be the reason why the State seems to prefer to support innovative companies that are more oriented towards innovations that can be applied in the short run.

Yet a company's performance is determined not only by its approach to innovation but also by the skilfulness of its managers and researchers. Firms with higher-quality human resources can therefore be expected to be more likely to turn in a strong performance in terms of innovation and to prepare successful project proposals for submission to public agencies that provide production incentives (Cerulli and Potì, 2012). A variable was therefore introduced to reflect the number of employees with tertiary degrees as a percentage of all employees working in R&D (human capital). Using the model employed in this study, it can be confirmed that the presence of more highly qualified personnel has a significant positive effect on a firm's likelihood of securing government funding.

## V. Analysis of the effect of incentives for innovation based on the propensity score matching model

Once a profile of subsidized firms has been developed, the next step is to look at the effect of that support in terms of financial additionality and corporate performance. Various matching algorithms have been used in this study to see how robust the findings are. First, matching has been used for the estimates only for firms within the same common support area,<sup>18</sup> and the re-use of control-group firms is allowed, so that a single firm not receiving support can be a control-group firm for more than one treated firm.

Table 4 presents the results for the different matching algorithms. Column (1) shows the results for the matching of beneficiary firms with a single control-group company (the one for which the probability of being a beneficiary is the closest). Column (2) shows the results for the use of the algorithm for the maximum distance between the treated and the control-group firms (caliper), which means that firms without a corresponding control-group firm with a probability of being a beneficiary of less than 0.015 are not included in the estimation. Since the matching with a single firm may be influenced by outliers for certain firms, column (3) shows the estimates obtained by matching each benefiting firm with up to five control-group firms. Finally, column (4) shows the estimates for the kernel matching algorithm, which uses all observations as controls, weighting each one on the basis of the probability of receiving support. Table 4 shows that the results are robust to the different matching algorithms, although the preferred model is matching with a control-group firm and caliper of 0.015 (column 2).

<sup>16</sup> On the basis of the Oslo Manual classification, ESIDET divides activities into three types: basic research (carried out by 9% of the firms in the sample), applied research (12.5%) and technological development (28.7%).

<sup>17</sup> See, for example, Cantner and Kösters (2012); Hottenrott and Richstein (2020); Heijs, Guerrero and Huergo (2022).

<sup>18</sup> The analysis is performed with comparable firms whose probability of becoming beneficiaries is similar. Firms with extreme values, for which the probability of becoming a beneficiary is higher than the maximum or lower than the minimum of the control group are not included in the effect estimate.

**Table 4**  
Average treatment effect on treated firms (ATET)

|                                       | (1)         |       | (2)                       |       | (3)         |       | (4)             |       |
|---------------------------------------|-------------|-------|---------------------------|-------|-------------|-------|-----------------|-------|
|                                       | NNM(1) Comm |       | NNM(1) Comm<br>cal(0.015) |       | NNM(5) Comm |       | Kernel matching |       |
|                                       | ATET        | S.E.  | ATET                      | S.E.  | ATET        | S.E.  | ATET            | S.E.  |
| Total R&D expenditure<br>(over sales) | 0.131***    | 0.043 | 0.136**                   | 0.053 | 0.147***    | 0.040 | 0.134***        | 0.043 |
| Total R&D expenditure<br>(over sales) | 0.047       | 0.040 | 0.035                     | 0.039 | 0.064**     | 0.028 | 0.046           | 0.029 |
| Total R&D expenditure (log)           | 1.006**     | 0.449 | 0.932**                   | 0.442 | 1.192***    | 0.360 | 0.991***        | 0.240 |
| Gross expenditure on R+D (log)        | 0.326       | 0.437 | 0.221                     | 0.479 | 0.511       | 0.388 | 0.329           | 0.297 |
| Human capital                         | 0.059*      | 0.033 | 0.074***                  | 0.020 | 0.060**     | 0.026 | 0.216***        | 0.011 |
| Sales (log)                           | 0.546**     | 0.248 | 0.361**                   | 0.179 | 0.543**     | 0.245 | 0.111           | 0.151 |
| Exports (log)                         | 1.341**     | 0.544 | 1.022***                  | 0.353 | 1.476***    | 0.552 | 1.269***        | 0.337 |

**Source:** Prepared by the authors, on the basis of data from the 2017 Survey on Research and Technological Development (ESIDET).

**Note:** NNM (n) = Nearest-neighbour matching with *n* control-group companies.

Comm = Estimate restricted to units within the common support area.

cal(-) = Maximum permitted distance for matching between the probability of receiving support of a treated firm and a control-group firm.

ATET: Average treatment effect on the treated.

S.E. = Bootstrap standard error estimates with 200 repetitions.

Total number of treated firms: total = 116; common support = 111; common support and caliper of 0.015 = 102.

\*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$  (significant at 1%, 5% and %, respectively).

Table 4 shows that the effect of government funding for R&D on private innovation effort (total R&D expenditure in absolute values and as a percentage of sales) is positive and statistically significant. The result indicates that companies participating in incentive programmes exhibit a greater innovation effort than counterfactual non-participating companies. Firms receiving R&D funds spend around 13 percentage points more on R&D (as a percentage of sales) than non-participating firms. These results line up with the findings of earlier studies (Crespi, Tacsir and Vargas, 2016; Fernández-Sastre and Montalvo-Quizhpi, 2019; Huergo and Moreno, 2017) and confirm the presence of partial additionality. However, the net variables (private expenditure less the funds received) show no statistically significant effect in either absolute terms or as a percentage of sales. These results are also in line with those of previous studies (Busom, 2000; Hottenrott, Lopes-Bento and Veugelers, 2017; Neicu, 2019; Heijis, Guerrero and Huergo, 2022) and indicate that the presence of a partial crowding-out effect, i.e. that some of the companies may not be using the funds properly, cannot be ruled out.

With regard to the performance and entrepreneurial capacity variables, table 4 shows that support has had a positive effect on all three indicators. Firms receiving government funds have a higher percentage of staff with tertiary studies (7 percentage points). In terms of performance, the results indicate that, although the effect is positive for sales and exports, the main effect is on exports.

To check that the matching was statistically correct, the means of the control variables were compared. This test makes it possible to analyse the similarity between the control group and the treated group used to estimate the effect of receiving support by looking at the mean values for each of the variables of the estimation of the probability of being a beneficiary. The means test (see table A1.2 in annex A1) shows that, after matching the means of these variables for the treated group and the control group, they are statistically equal, and therefore the two groups can also be considered to be equal.

## VI. Conclusions

Although R&D and innovation are regarded as being highly important in supporting competitiveness and the economic development of a country, the severe financial constraints associated with the crisis and the difficulty of obtaining credit in the financial market represent major obstacles for investment at the company level. The role of the State in fostering R&D and innovation investment in order to correct market failures is therefore all the more important. In the case of Mexico, current financial constraints also make it imperative for such support policies to be implemented efficiently and effectively, and it is therefore essential to evaluate the performance of government bodies in correcting those market failures.

From a methodological standpoint, an assessment of the impact of incentives runs into problems of selection bias. To mitigate them, the propensity score matching method, which is a non-parametric technique, was used. This method provides two types of result. First, it identifies the revealed or implicit priorities of the government agencies that allocate this type of support by examining the profile of the firms that most frequently participate in these incentive programmes. In the case of Mexico, the firms receiving the most support are companies in the services sector, the most competitive (export) firms, those with the highest level of human capital and those more oriented towards technological development. This indicates that government bodies are channelling support into the firms that are most likely to show positive results. This profile is very similar to the profile reflected in the results of most of the previous empirical studies on this subject (Herrera and Heijts, 2007; Czarnitzki and Lopes-Bento, 2011; Busom, Corchuelo and Martínez-Ros, 2017; Sterlacchini and Venturini, 2018).

The second type of result yielded by the PSM method is the measurement of the impact of this type of support on the firms in question, which is the main purpose for using this method. In this case, it is found that the support programmes of Mexican public agencies have a positive effect on total R&D expenditure, measured both in absolute values and as a percentage of the value of sales. Specifically, in the case of firms receiving these funds, R&D expenditure as a proportion of sales is, on average, around 13 percentage points higher than that of firms not participating in incentive programmes. However, once the amount received is deducted, it turns out that the firms are not significantly increasing their spending. In other words, government incentive programmes are not prompting participating firms to increase their private innovation effort. The entire increase in R&D expenditure in the firms receiving support is financed by the government subsidy, while the firms are not increasing the amount of their own funds devoted to R&D and innovation. In table 2 this is presented as a partial crowding-out effect.

Nonetheless, the financial additionality generated by government incentives is important, as the companies that are spending more in total can devote more time, human capital and assets to innovation. As noted earlier, innovation is a high-risk activity in both technological and economic terms, and some companies therefore either do not engage in this type of activity at all or limit themselves to lower-risk projects. It is, however, clear that these types of activity should be encouraged, so that companies will strengthen their technological capabilities, which in turn will enable them to compete more successfully in the market, thereby boosting the competitiveness of the country as a whole.

The novel aspect of this study is, as explained in box 1, that it, along with the study by Chávez (2020), is one of the very few that directly assess the impact of government support for corporate RDI in Mexico. To this end, it uses a micro-level sample with individual firm data and the propensity score matching method. While there are other studies that estimate the quantitative impact of such support in financial terms, those studies are based on a sample with very few observations or use a methodology—although skilfully applied—that is atypical in this field and that produces results that are difficult to compare at the international level. Interesting future lines of research include the analysis of the types of company in which government funding for R&D and innovation has a greater or lesser impact, which would make it possible to adjust the programmes and assess which types of programme are more effective. Thus far, given the limited size of the sample, it has not been possible to analyse these aspects.

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## Annex A1

**Table A1.1**  
Variables used

| Variable                                       | Description   |
|--|---|
| Total R&D expenditure (log)                    | Total private expenditure on R&D (in logarithms)  |
| Net R&D expenditure (log)                      | Private expenditure on R&D (in logarithms), less the funding received (in logarithms)           |
| Total R&D expenditure as a percentage of sales | Total private expenditure on R&D as a percentage of sales                                       |
| Net R&D expenditure as a percentage of sales   | Private expenditure on R&D (in logarithms), less the funding received, as a percentage of sales |
| Human capital                                  | Number of employees with a postgraduate degree as a percentage of the total number of employees |
| Sales (log)                                    | Total volume of sales in period t (in logarithms)   |
| Exports (log)                                  | Total volume of exports in period t (in logarithms)   |
| Pavitt1  | = 1 Traditional industrial producers  |
| Pavitt2  | = 1 Traditional industrial suppliers  |
| Pavitt3  | = 1 Specialized industrial suppliers  |
| Pavitt4  | = 1 Scale-intensive industries  |
| Pavitt5  | = 1 Science-based industries  |
| Pavitt 6                                       | = 1 High-tech services  |
| Company size                                   |   |
| 0–100  | = 1 if the firm has between 0 and 100 employees   |
| 101–200  | = 1 if the firm has between 101 and 200 employees   |
| 201–500  | = 1 if the firm has between 201 and 500 employees   |
| Over 500                                       | = 1 if the firm has over 500 employees  |
| Age of company (log)                           | Natural logarithm of the number of years the firm has been in existence                         |
| Export activity                                | = 1 if the firm engaged in export activity  |
| Publicly owned                                 | = 1 if the firm is publicly owned   |
| Multinational                                  | = 1 if 50% or more of the equity in the firm is held by foreign entities                        |
| Group  | = 1 if the firm belongs to a corporate group  |
| Basic research                                 | = 1 if the firm channels innovation expenditure into basic research                             |
| Applied research                               | = 1 if the firm channels innovation expenditure into applied research                           |
| Technological development                      | = 1 if the firm channels innovation expenditure into technological development                  |

**Source:** Prepared by the authors.

**Table A1.2**  
Test of equality of means

| Variable                           | Before matching |         |       | After matching |         |       |
|------------------------------------|-----------------|---------|-------|----------------|---------|-------|
|                                    | Treated         | Control | p> t  | Treated        | Control | p> t  |
| Firm size                          |                 |         |       |                |         |       |
| 0<x<100                            | 0.525           | 0.476   | 0.057 | 0.402          | 0.314   | 0.190 |
| 200<x<500                          | 0.116           | 0.173   | 0.004 | 0.147          | 0.147   | 1.000 |
| x>500                              | 0.219           | 0.203   | 0.429 | 0.333          | 0.412   | 0.249 |
| Age (log)                          | 2.715           | 2.819   | 0.012 | 2.860          | 2.903   | 0.753 |
| Export activity                    | 0.451           | 0.282   | 0.000 | 0.422          | 0.422   | 1.000 |
| Publicly owned                     | 1.058           | 1.026   | 0.028 | 1.049          | 1.039   | 0.827 |
| Multinational (>50%)               | 0.111           | 0.174   | 0.001 | 0.127          | 0.206   | 0.134 |
| Group                              | 1.483           | 1.467   | 0.692 | 1.343          | 1.225   | 0.322 |
| Human capital                      | 0.183           | 0.005   | 0.000 | 0.111          | 0.110   | 0.977 |
| Basic research                     | 0.090           | 0.007   | 0.000 | 0.147          | 0.186   | 0.455 |
| Applied research                   | 0.235           | 0.009   | 0.000 | 0.284          | 0.235   | 0.427 |
| Technological development          | 0.507           | 0.018   | 0.000 | 0.608          | 0.578   | 0.671 |
| Sector of activity:                |                 |         |       |                |         |       |
| - Traditional industrial producers | 0.145           | 0.309   | 0.000 | 0.127          | 0.127   | 1.000 |
| - Traditional industrial suppliers | 0.116           | 0.222   | 0.000 | 0.108          | 0.088   | 0.640 |
| - Specialized industrial suppliers | 0.069           | 0.068   | 0.960 | 0.029          | 0.000   | 0.082 |
| - Scale-intensive industries       | 0.161           | 0.112   | 0.003 | 0.118          | 0.147   | 0.538 |
| - Science-based industries         | 0.077           | 0.032   | 0.000 | 0.078          | 0.059   | 0.582 |
| - High-tech services               | 0.269           | 0.097   | 0.000 | 0.382          | 0.422   | 0.570 |
| 2014                               | 0.409           | 0.501   | 0.000 | 0.373          | 0.412   | 0.568 |
| 2015                               | 0.591           | 0.499   | 0.000 | 0.627          | 0.588   | 0.568 |

**Source:** Prepared by the authors.

**Note:** Values refer to NNM(1) matching, imposition of common support and caliper of 0.015.