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Evaluating Different Types of Enterprise Support Programs Using Panel Firm Data: Evidence from the Mexican Manufacturing Sector

In most countries, small and medium-sized enterprises (SMEs) make up the vast majority of firms, account for a substantial share of gross domestic product, and involve the bulk of the workforce. However, SMEs often lag behind larger firms in many performance dimensions. This lag is widely believed to result from constraints that SMEs face, including decreased access to finance, weak managerial and workforce skills, an inability to exploit scale economies in production, and imperfect information about market opportunities, new technologies, and methods of organization.

In Mexico, microenterprises and SMEs make up 99 percent of firms, employ about 64 percent of the workforce, and account for more than 40 percent of GDP. Given the importance of SMEs in the economy, governments in Mexico over the past twenty years have established a wide variety of SME support programs. How effective these SME programs have been in achieving their objectives is unclear. In Mexico, impact evaluations of SME programs are rare. Most evaluations are qualitative in nature and narrow in scope, usually

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measuring beneficiary satisfaction with either support services or program coverage.

This paper evaluates SME support programs in Mexico using a panel of firm-level data for two groups of firms—a treatment group that participated in SME programs and a control group that did not. The panel data have been created by linking SME program participation information to a large panel of annual industrial surveys (1994–2005) maintained by Mexico's National Institute of Statistics and Geography.

The panel data provide an opportunity to address several issues that have plagued impact evaluations of SME programs in most countries, including Mexico. First, asking program participation questions in the firm survey allows the identification of firms that have never participated in any program and firms that have participated in different types of SME support programs such as business development services (BDS) or programs to support research and development (R&D).[1] Second, the availability of multiple years of information on the characteristics and performance of participant firms—both before and after program participation—allows us to estimate the impacts of support programs that address selection biases arising from differences between the treatment and control groups in observable attributes and in unobserved heterogeneity. Our findings suggest that program participation in certain types of BDS and R&D support programs is associated with a higher value added per worker and increases in employment and exports. The positive impact associated with firm participation is strongest and most robust in the R&D support programs, which include the Sector Promotions Program (PROSEC) of the Ministry of Economy and the Fiscal Incentives and Technological Innovation (FITI) program of the National Science and Technology Council. These programs showed positive and statistically significant impacts on firm performance, ranging from increases of 9–13 percent on sales—and, in the case of PROSEC, increases of 12 percent in value added per worker and 10 percent in production per worker. Both R&D programs increased exports between 16 and 18 percent. The results also indicate that some outcomes, such as employment and value added per worker, showed positive effects only after the third or fourth year of program participation, although the effect increases as time goes on. As for BDS programs, we estimate positive effects

1. Business development services programs typically include consulting services, training for workers, management and quality control practices, technology upgrading, market development, and export promotion.

on sales, fixed assets, and productivity measures from the National Environmental Audit Program (PNAA). We were unable to identify positive effects of this program on other outcomes or positive effects of the Comprehensive Quality and Modernization Program for Training the Industrial Workforce (CIMO-PAC).

An Overview of SME Programs in Mexico

The Mexican federal government supports the development and competitiveness of Mexican firms by improving the overall business environment and through interventions to support individual firms or groups of firms, especially SMEs. Between 2001 and 2006, the Mexican government invested the equivalent of US$13 billion in approximately 3.7 million SMEs (World Bank 2010).

Several agencies in Mexico provide SME support. The Ministry of Economy is first with regard to coverage numbers—providing benefits to more than a million firms in 2001–06—but fourth with regard to the amount of resources channeled to SMEs. The National Finance Bank's participation in the total budget of SME programs grew more than threefold from 2001 to 2006 (from 23 percent to 70 percent), and the number of firms supported grew almost ten times (from 90,000 to 877,000). Banco Mexicano de Comercio Exterior was second in the amount of resources provided—with 43 percent of the total—but fourth in the number of firms supported. The Ministry of Labor and Social Protection programs provided benefits to 6 percent of all firms but with a small budget, whereas the National Council of Science and Technology had a sizable budget but reached relatively few firms.

Almost all SME programs explicitly or implicitly require that participating firms be located in Mexican territory and be capitalized primarily—in some cases entirely—by Mexican capital. Most programs are targeted at formal sector enterprises, through the requirement that firms be legally incorporated in Mexico and registered with the tax authorities. Several programs have explicit sectoral criteria for participation (for example, manufacturing, commerce, or agriculture), while others have no sectoral preference. Most programs appear not to have merit-based criteria for participation, although a few require that firms demonstrate solvency and a minimum of one to three years of operation, criteria that are not particularly binding for most formal sector SMEs. If program eligibility requirements are easily satisfied, it follows that most programs will fund every firm or group of firms that is eligible as long as funding lasts. Few programs require regular progress reports or impact assessments as part of their formal operating procedures. This means that few incentives for systematic measurements by participating SMEs are built into the operating procedures that govern the provision of support. In general, SME evaluations do not take into account the complicated biases from unobserved firm heterogeneity and self-selection that plague efforts to measure the true impacts of program participation on firm performance.

In this paper we focus on SME programs that yielded the larger samples in our panel data of firm surveys. These programs—CIMO-PAC, the PNAA, FITI, and PROSEC—are described below. Two of these programs—CIMO-PAC and the PNAA—can be classified as BDS programs that provide support to improve firms' management and operation, while FITI and PROSEC provide support for R&D. These programs vary in objectives, program size, type and amount of support, and operating procedures. There is no information on assignment rules.

The Comprehensive Quality and Modernization Program

The Ministry of Labor and Social Protection established CIMO-PAC as a pilot program in 1988 to support SMEs. The program's stated goal is to improve SME productivity and competitiveness by increasing training levels, helping to design training plans, and expanding the availability of training. The final objective of the program is to promote increases in workers' wages.

In creating CIMO-PAC the government tried to address a particular market failure, namely, the skill shortage and underinvestment in training by SMEs. The program selection criteria specified that firms be micro-, small-, or medium-sized enterprises and that they be registered as taxpayers. The program does not directly provide training but instead subsidizes the hiring of independent instructors to design and deliver training to the SMEs. It also subsidizes the costs of producing training materials, developing training programs, and assessing workers' skills based on labor competency standards. It encourages employers to distribute training resources across a wide cross section of the firm's workforce to ensure that the benefits of training are more evenly distributed. It subsidizes as much as 50 percent of the costs of training, based on a capped cost of Mex$500 (about US$40) an hour, subject to a maximum of 200 hours. From 2001 to 2006, CIMO-PAC served approximately 1.6 million workers in approximately 227,000 firms, and its subsidies amounted to US$75 million.

The National Environmental Audit Program

The PNAA was created in 1992 under the supervision of the Federal Environmental Protection Attorney. The main objective of the PNAA is to provide incentives for firms to comply with environmental and regulatory requirements beyond those established in the legal codes. This objective is accomplished through a voluntary certification of compliance for firms that fulfill environmental quality controls.

The PNAA rationale is based on the need to reduce negative environmental externalities caused by economic processes, mainly in industry and tourism. The program offers participating firms the consultancy services of a certified environmental auditor who can advise on how to mitigate pollution and environmental risk, comply with environmental regulations, and apply best practices. Firms can obtain a clean industry or environmental quality certificate once they have addressed the recommendations of the environmental auditor.

The program targets firms that, because of their location, dimensions, and characteristics, are likely to negatively affect the environment or exceed established limits for protection, prevention, and restoration of the environment. Any firm—independent of its size—can participate in the program. Federal Environmental Protection Attorney records show that the majority of participating firms have been large because large firms usually tend to pollute on a greater scale. Other explanations suggest that large firms participate because they are easier targets for official verification and public scrutiny and also because they may be more interested in maintaining a good corporate image.

The benefits to participating firms of the certification range from complying with environmental legislation and maintaining a good corporate image to realizing economic savings from implementation of sustainable technologies and self-regulation in the use of energy and natural resources, as well as realizing fiscal benefits, in the cases of the Guadalajara and Monterrey metropolitan areas. The cost and duration of the auditing and certification process vary according to the size of the firm and the complexity of its products and services. Costs usually ranged from Mex 200,000 to 250,000 (approximately US$16,000–20,000), and the audit lasts from three to six months. Firms have to pay for the services of certified auditors and are expected to be highly involved in the process. Between 2002 and 2006, the program tripled the number of audits initiated—from 293 in 2002 to 933 in 2006—and the number of clean industry certificates issued doubled in the same period, increasing from 169 in 2002 to 338 in 2006.

Fiscal Incentives and Technological Innovation Program

The FITI program, which was started in 2001 under the National Council of Science and Technology, encouraged taxpaying individuals and firms that invested in R&D to develop new products, materials, and processes. The main objective of this program was to increase the annual investment and spending made by firms for technological innovation. The program sought to address the chronic problem of the lack of investment by Mexican firms in scientific activities and technological innovation. These problems appear to be associated with the difficulty of financing and sustaining R&D and with the limitations on internalizing all economic benefits derived from scientific discoveries and technological developments. Firms that were eligible to participate in the program had to be enrolled in the National Registry of Scientific and Technological Institutions and Firms, be up to date on their tax payments, and be involved in the development of products, materials, and high value added processes. The program did not target firm size or sector; however, large firms tend to get the larger share of program funding. For example, in 2005 large enterprises represented approximately one-third of the beneficiary firms and obtained about 80 percent of the program resources. Benefits were also highly concentrated by sector, with firms in the automobile industry receiving approximately 40 percent of the resources in the same year, followed by pharmaceutical and chemical plants, each of which received approximately 8 percent.

The program consisted of a fiscal credit of approximately 30 percent of the amount invested in specific projects that are oriented to the development of new products, materials, and processes as well as training staff in R&D. The program granted fiscal incentives in accordance with income tax law and considers only necessary expenses and investments realized in the corresponding fiscal year. The amount of the fiscal incentives authorized varied widely, but on average, incentives range from Mex 1.5 million to 2.5 million per project (US$120,000–200,000). The National Council of Science and Technology, through a special committee, evaluated all eligible projects to determine their technical suitability and relevance according to a set of standards. For example, the program excluded all technological R&D activities that would not render direct benefits for Mexico.

From 2001 to 2006, the program provided benefits to 8,701 projects and 2,620 firms and provided tax incentives of approximately US$873 million. However, because firms could apply for more than one project a year and could apply again in different years, the actual number of firms that benefit from the program is difficult to determine.

The Sector Promotions Program

The Sector Promotions Program was implemented in 2002 by the Ministry of Economy to increase the competitiveness of Mexican industrial firms in international markets, to promote openness and foreign trade, and to support the integration of productive chains. It is similar to the FITI program. The Sector Promotions Program's rationale is directly associated with the nature and evolution of the tariff structure established by the World Trade Organization and the North American Free Trade Agreement. The Mexican government recognized that the supply of non–North American inputs and machinery was critical for certain industries, both for exporting and for the domestic market. Therefore, the government decided to establish competitive conditions through preferential duties for the acquisition of these goods.

The Sector Promotions Program targets firms in a wide range of industries.[2] Any exporting firm in the targeted industries can apply for the program, regardless of size, as long as the firm requires critical inputs and machinery from non–North American countries and is current in its tax obligations. The program benefit is an ad valorem preferential tariff for inputs and machinery used for specific products, independent of whether the products are manufactured for export or for the domestic market. The program is automatically renewed each year after the benefited firm presents an annual report of the activities it carried out under the program.

The magnitude of PROSEC's benefit varies according to the specific non–North American imported good. Normal tariffs range from 3 to 13 percent ad valorem, but with the program such imports can be exempted by as much as 6 percent. Unfortunately, the information is not publicly available on the

2. These industries include electrical appliances, electronics, furniture, toys and sports, footwear, mining and metallurgy, capital goods, photography, agricultural equipment, rubber and plastic, iron and steel, chemicals, pharmaceutical and medical equipment, transportation, paper and cardboard, wood, leather, auto parts and automotive equipment, textiles and apparel, chocolate and candy, coffee, and food processing.

number of projects or firms that have benefited from the program or the amount of subsidies.

Review of SME Programs

There is limited knowledge on the impact of SME programs worldwide. Storey (1998) notes the paucity of rigorous SME program impact evaluations. Batra and Mahmood (2003) conclude that most SME programs in developing countries have little or no impact on performance, are not cost effective, and do not warrant continued public support. A report by the Organization for Economic Cooperation and Development (2007) reiterates this point, calling for a concerted effort to develop global best practices in the design, implementation, and rigorous impact evaluation of enterprise support programs.

Lopez-Acevedo and Tan (2011) review rigorous impact evaluations of SME programs that have been published over the past decade. The programs fall mainly into two categories: business development services and research and development. Table 1 provides an overview of the studies reviewed and the impact these programs have shown, if any, on the different variables of interest.

The evidence that emerges for the effectiveness of BDS support programs on productivity is mixed. Although these studies generally find positive impacts of program participation on outcomes such as increased training, R&D spending, and exports, a significant number of studies that control for both unobserved firm heterogeneity and selectivity bias in program participation find no significant impact on productivity or productivity growth. On the other hand, a positive impact on employment and sales seems to be more common across studies, and two studies (Wren and Storey 2002; Jarmin 1999) also find a positive impact on firms' survival rates. Of the studies that do find a positive impact of BDS programs on productivity, Tan and Lopez-Acevedo (2005) show that participation in the CIMO program in Mexico increased productivity by 6 to 11 per cent, depending on the measure of value added that is employed in their estimations. Benavente and Crespi (2003) also find that participation in Chile's Associative Development Projects program led to an increase of between 12.4 and 14.9 percent in total factor productivity growth.

All the studies of R&D programs—for Belgium, Brazil, Argentina, Chile, and Turkey—find net improvements in R&D intensity. Very few of the R&D

TABLE 1. Review of SME Support Programs

Study	*Country*	*Type of intervention*	*Description*	*Findings*
Sarder, Ghosh, and Rosa (1997)	Bangladesh	BDS	Different finance, advisory, and business support services for SMEs	5–16 percent gains in sales, employment, and productivity; higher impacts with larger number of services used and programs providing financing
Jarmin (1998)	United States	BDS	Manufacturing extension partnership: technical assistance and technology upgrading	2–6 percent gains in value added per worker from program participation
Jarmin (1999)	United States	BDS	Manufacturing extension partnership: technical assistance and technology upgrading	3–16 percent gains in labor productivity with DID[a] and selectivity correction
Revesz and Lattimore (2001)	Australia	BDS, R&D	Six programs of R&D incentives, grants, and export promotion	Impacts for export but not R&D programs: 3 percent gains in exports, no impacts on productivity
Roper and Hewitt-Dundas (2001)	Ireland and Northern Ireland	BDS	Training, grant support, and investment incentives for small businesses	10–20 percent gain in employment growth; no impacts on sales growth or profitability
Wren and Storey (2002)	United Kingdom	BDS	Enterprise initiatives programs on marketing and consulting services for SMEs	4 percent gain in medium-sized firm survival; 3–7 percent gain in sales; 2–3 percent impact on employment by firm size
Benavente and Crespi (2003)	Chile	BDS	Associative Development Projects program of network (cluster) development for SMEs	11 percent gain in total factor productivity with DID[a], 11–15 percent total factor productivity gain with matching and DID[a]
Tan and Lopez-Acevedo (2005)	Mexico	BDS	CIMO: integrated program of training and technical assistance for SMEs	Regressions with DID[a] showed positive CIMO impacts on productivity growth of 11 percent in the 1991–93 period but not in 1993–95
Mole and others (2008)	United Kingdom	BDS	Business Link: consulting and advisory services to SMEs	4–11 percent impact on employment growth; no impact on sales growth
Morris and Stevens (2009)	New Zealand	BDS	Growth Services Range: grants and advisory services for high-performing SMEs	8–20 percent impact on sales; mixed results on labor productivity with DID[a] or matching and DID[a]
Motohashi (2001)	Japan	R&D	Promotion of Creative Businesses: program of technology upgrading and assistance for SMEs	1–3 percent improvement in sales; weak impacts with selection correction

(*continued*)

TABLE 1. Review of SME Support Programs (*Continued*)

Study	*Country*	*Type of intervention*	*Description*	*Findings*
Aerts and Czarnitzki (2004)	Belgium	R&D	R&D subsidies	3 percent higher R&D intensity but no impacts on patenting outcomes
Chudnovsky and others (2006)	Argentina	R&D	Argentine Technological Fund nonreimbursable fund: matching grants for R&D and technology development	54–79 percent improvement in innovation intensity (R&D to sales); no impacts on new product sales or on labor productivity growth
De Negri, Borges, and De Nedri (2006)	Brazil	R&D	National Technological Development Support Program: subsidy program for R&D and technology development	50–90 percent gain in R&D expenditures; positive impacts on sales
Binelli and Maffioli (2007)	Argentina	R&D	FONTAR (Argentine Technology Fund): targeted credit and matching grants for technology development	0.18 percent gain in R&D intensity; 0.15 percent gain in R&D elasticity
Criscuolo and others (2007)	United Kingdom	R&D	Regional Selective Assistance: investment grants for businesses start-ups, plant expansion or modernization, and R&D in disadvantaged regions	16 percent gain for employment, 0 percent for investment using DID[a]; impacts are 2–3 times larger with instrumental variables; no impacts on labor productivity or total factor productivity
Ozcelik and Taymaz (2008)	Turkey	R&D	R&D loans and R&D grants for promoting research and technology development	Gains in overall R&D intensity of 2.6 percent and own R&D intensity of 1.9 percent for the treatment group; no change in R&D intensity of the control group

Source: Lopez-Acevedo and Tan (2011).
a. Difference in differences.

support program evaluations look beyond intermediate outcomes such as R&D spending and innovation activity. Of those that examine outcomes such as sales or productivity, De Negri, Borges, and De Negri (2006) find a positive impact of public R&D support on the growth of firms, as measured by rates of increase in net sales turnover. Motohashi (2001) finds a positive impact on sales growth of a program to provide low-interest financing or tax credit support (or both) to R&D projects but weak impacts after selection correction. Chudnovsky and others (2006) find improvement on innovation intensity but no impacts on new product sales or on productivity. These studies argue that it might take time for the benefits from these programs to translate into innovation and productivity.

Most studies do not find evidence of SME programs' crowding out private R&D investment. Some studies, such as Ozcelik and Taymaz (2008), even find evidence of crowding in. De Negri, Borges, and De Negri (2006) find that firms that received public funding for R&D projects in Brazil increased their R&D expenditure between 28 and 39 percent. Ozcelik and Taymaz (2008) estimate that supported firms in Turkey increased their R&D intensity (as measured by the ratio of R&D expenditures to output) by 1.95 to 2.56 percent, when compared with firms that received no support. Aerts and Czarnitzki (2004) find that firms in Belgium that benefited from public R&D funding showed on average an R&D intensity (ratio of R&D expenditure to turnover) of 4.7 percent, while nonbeneficiary firms showed a much smaller R&D intensity, 2.2 percent on average.

Another important aspect that should be analyzed in the studies is the mode of R&D intervention, whether as tax incentive or direct subsidy. The study by Ozcelik and Taymaz (2008) analyzed only grants and subsidized loan programs; therefore the positive impact on R&D spending that the authors show comes only from direct subsidy interventions. Similarly, Chudnovsky and others (2006) point to a positive impact from subsidies to R&D investments, while De Negri, Borges, and De Negri (2006) find a positive impact of public financing (loans) on private R&D expenditure. Binelli and Maffioli (2007), on the other hand, conclude that the positive impact they observed from public R&D support comes mainly from the provision of fiscal credit (tax incentives), with no evidence of an impact from matching grants support.

There are still other important issues in SME program design that affect firm performance that most studies do not address, for example, the type of service provider (public versus private) and dosage (intensity, duration, and frequency of the use of support services). From the studies reviewed, there is some evidence from Benavente and Crespi (2003) that BDS programs delivered by private providers may be more effective than public ones. Regarding dosage, Binelli and Maffioli (2007) show that a 1 percent increase in the amount financed through the program yields a 0.15 percent increase in privately financed R&D. All other studies reviewed use only a binary specification for program participation. The advantage of this paper over other studies is that it analyzes R&D and BDS programs and contrasts their intermediate and final effects.

Data Used in the Analysis

This paper uses the National Employment Salary, Training, and Technology Survey (ENESTYC) and the Annual Industry Survey (EIA), which are maintained by Mexico's National Institute of Statistics and Geography to create the nonexperimental panel data set.

The ENESTYC surveys periodically gather data from manufacturing firms and were fielded in 1995, 1999, 2001, and 2005. The 2001 and 2005 ENESTYC surveys stand out from previous ENESTYC surveys in that they included questions on participation in the largest SME programs in the country: the 2001 survey asked about eleven programs and the 2005 survey, eighteen programs. Firms were asked four retrospective questions about each of these programs, exploring firms' familiarity with the program, the timing of their participation current at the time of the survey, before the survey, or never, the year in which they first joined the program (for those that participated), and the types of support they received. The 2005 ENESTYC survey dropped several SME programs that had ceased operation and included a number of other SME programs introduced since 2001.

The EIA is the annual manufacturing survey and uses the same sampling frame as the ENESTYC and the Industrial Census.[3] Although its sampling design is not probabilistic, the EIA is representative of the manufacturing sector: the survey comprises 65 percent of occupied personnel and 85 percent of the gross value of manufacturing production. The process used to select establishments for the EIA is based on three criteria: the establishment must be engaged in one of the 231 activity classes that have most contributed to the value of production; it must share at least 80 percent of the gross production value; and it must employ 100 or more workers. In addition, in the activity classes with the smallest establishments, a random sample of approximately 100 is selected. The sample size varies from 5,500 to 7,300 establishments.

A linked data panel of establishments over the 1994–2005 period can be created from the annual surveys. It contains annual data on measures of firm performance such as sales, production, employment, total compensation, and income from exports as well as some intermediate outputs that the programs may affect, such as technology transfers.[4] We worked with the National Institute of Statistics and Geography on linking establishments from the

3. Establishments involved in *maquila* exports and basic petrochemical firms were excluded.

4. Technology transfer is defined in the survey as payments to third parties in exchange for the use of patents, trademarks, or technical advice in the production process.

TABLE 2. SME Program Participation

SME program	*Participated before 2005*	*Did not participate before 2005*
CIMO-PAC	232	1,777
PNAA	247	1,762
FITI	187	1,822
PROSEC	113	1,896
CONOCER (National Council for Standardization and Certification of Labor Qualification)	87	1,922
Other program	80	1,929
State government support	67	1,942
Productive chains	47	1,962
CREDIEXPORTA (Credit to Exportation)	47	1,962
PAT (Technical Assistance Program)	44	1,965
COMPITE (National Committee for Productivity and Technological Innovation)	41	1,968
Financing	39	1,970
Municipal government support	37	1,972
Mixed or sectoral funds	36	1,973
CRECE (Regional Center for Business Competitiveness)	31	1,978
Fondo Pyme	27	1,982
PROMODE (Training and Business Support Program)	9	2,000
FAMPYME (Support Fund for Micro, Small, and Medium Enterprises)	7	2,002
FIDECAP (Fund to Promote the Integration of Productive Chains)	4	2,005

Source: Linked ENESTYC 2005–EIA panel data.

ENESTYC survey with the EIA through an identification code constructed by the agency. We link the 2005 ENESTYC to the EIA surveys from 1994 to 2005 because the former involves larger numbers of participating firms. This leaves us with a panel data set covering the period from 1994 to 2005. Besides the performance measures in the EIA, the data set includes information about whether the respective firm participated in SME programs in any prior year, which programs the firm participated in, and the initial year of participation.[5]

Table 2 presents summary statistics regarding the linked ENESTYC 2005 and EIA data. For each program, firms in the potential treatment group are those that participated in the program any year up to 2005, where the first year of participation is known. The potential control group is formed by the firms that answered that they did not participate in the program before 2005. Table 2

5. A similar merge was attempted using the 2001 version of the ENESTYC, but the numbers of participating firms identified through this match was too small to be plausibly used for evaluation.

shows the number of cases in the potential treatment (second column) and control (third column) groups, the latter category having more respondents.

Table 2 shows that CIMO-PAC, the PNAA, FITI, and PROSEC were the most commonly used SME support programs by firms. The National Council for Standardization and Certification of Labor Qualification is also well known, but because it is a skill competency policy rather than a program, it is not included in the analysis. There are approximately 2,000 firms in the panel, and firms are observed for twelve years at the most, so the data set gives near 23,000 observations at firm-year level. Our panel is unbalanced because there is missing information for some firm-year observations. Examples of missing data include a firm that is not in the EIA sample in some years in the 1994–2005 period (EIA is not designed as a panel) or a firm that did not answer the question.

Methodology

Traditional propensity score matching and difference-in-differences methods, commonly used to address selection bias issues, are not suitable to the specific structure of the data in this paper. We adopt a more flexible approach that allows us to estimate treatment effects—taking into account differing entry points into programs, year-specific shocks, and varying time since program participation—and exploit the information on dependent and independent variables for several years. First, we rely on fixed-effects models to eliminate the effects of observable and unobserved (time-invariant) firm heterogeneity as a source of bias in the estimates of program impacts. Second, to control for time-variable sources of bias, we use a Cox proportional hazard model to estimate propensity scores, restricting the sample to treatment and control firms that fall in the common support region. The construction of the common support is explained in greater detail below.

Consider a general linear model for firm i in time t that relates outcomes Y to observable firm attributes X and a dummy variable for participation in program k, D^k:

$$Y_{it} = v_i + \lambda_t + \beta X_{it} + \alpha D_{it}^k + u_{it}, \tag{1}$$

where v_i is a vector of unobserved but fixed confounders (that is, a time-invariant firm-specific component), λ_t is the year effect treated as a parameter to be estimated, and u is a randomly distributed error term. The observed Y_{it}

is either Y_{1it} or Y_{0it}, depending on participation status. The dummy variable D^k_{it} takes a value 1 if firm *i* has participated in program *k* any time between year 1994 and year *t,* and 0 otherwise; *k* corresponds to one of the four programs analyzed: CIMO-PAC, FITI, PROSEC, and the PNAA.

Equation 1 is a fixed-effects model, and α is a proxy for the impact of participation in the program. It is important to note that, according to the data structure and definition of participation, α is not the program effect as generally defined. It can be interpreted as the average treatment effect of having participated in program *k* in any year up to time *t,* bounded to the 1994–2005 period. Under this model, and thanks to the inclusion of fixed effects, α is free of the bias from the self-selection of firms into programs based on their observable and unobservable time-invariant productivity attributes. In addition, it is free of selection bias related to the observable characteristics considered in the construction of the common support.

In our data, treatment firms could participate in more than one program. If a firm could participate in programs *k* and *m,* and the programs were not substitutes, then it is possible that α in equation 1 might overestimate the effect of the program. One way to avoid this bias would be to include in the treatment group the firms that participate only in program *k* and in the control group only firms that never participated in other programs. Including the firms that did not participate in any program, however, would reduce the sample sizes for treatment firms in table 2 by more than 50 percent. The study then includes an indicator variable for participation in another SME program different from *k,* OD^k_{it}, as a control variable. For each program and outcome, equation 1 becomes

$$Y_{it} = v_i + \lambda_t + \beta X_{it} + \alpha D^k_{it} + \gamma OD^k_{it} + u_{it}, \qquad (2)$$

where OD^k_{it} takes the value of 1 if firm *i* participates in the other program (different from program *k,* for example, participation in program *m*) in any year up to time *t,* and 0 otherwise.

Nine outcome measures were selected for the study, which are related to the program goals: value added per worker, production per worker, total sales, employment, hours worked, wages per worker, exports, technology transfers, and fixed assets. All these variables are expressed in logarithms, and monetary variables are expressed in constant 2005 pesos. For each program, the outcome measure *Y* is related to the program indicator variable D^k, which takes on a value of 0 for all the years preceding the first year of participation in program *k* (preprogram period) and 1 for all of the years that follow, including the first year (postprogram period) and participation in the other program different from *k*, OD^k. In addition to the program variables, the explanatory variables, vector *X*, include indicator variables for location, firm size, and year dummy variables for 1994 through 2005 to control for the effects of year-specific stochastic shocks. In addition, it would have been desirable to include for each program additional specific explanatory variables, for example, for CIMO-PAC whether the firm was a taxpayer, for FITI whether the firm is registered in the National Registry of Scientific and Technological Institutions and Firms and is up to date on tax obligations, for PROSEC whether the firm is up to date on tax obligations. Unfortunately this information is not publicly available.

To minimize the bias owing to time-variant covariates, we restrict the sample to treatment and control firms falling in the common support region, where propensity scores were estimated, including pretreatment productivity factors such as sales, as well as firm attributes detailed below.

Instead of using logit or probit models for program participation, we use a Cox proportional hazard model to estimate the propensity score of the likelihood of program participation for the sample of treatment and control groups followed over the 1994–2005 period. An alternative approach would have been to estimate separate logit models of program participation for different cross sections (or year intervals) to derive propensity scores for each treatment cohort (or group of cohorts). This was not feasible because of small sample sizes, which led to imprecise estimates of the logit model. We prefer the Cox proportional hazards model not only because of sample-size considerations but also for its unified treatment of the underlying process of selection into programs over time. The Cox proportional hazard model relates the likelihood of entry into the program, conditional on survival (nonentry) up to that point in time, to a baseline hazard function and a set of independent variables. At time *t*, for each firm, the underlying hazard function $h(\cdot)$ may be written as follows:

$$h(t, Z_1, Z_2, \ldots, Z_m) = h_0(t)\exp(\phi_1 Z_1 + \phi_2 Z_2 + \cdots + \phi_m Z_m),$$

where *Z* is a vector of *m* covariates for the firm at time *t* and $h_0(t)$ is the baseline hazard when the values of all the covariates are set to 0 at time *t*.

We use the relative hazard of being treated in time *t* for first time for a firm with attributes *Z* as the propensity score for defining the region of common support and keep only enterprises that fall inside this region. The attributes *Z* that are included in the Cox model are characteristics of the firm at time *t*,

TABLE 3. Estimated Hazard Ratios: Cox Proportional Hazards Models[a]

	CIMO		*PNAA*		*FITI*		*PROSEC*	
Variable	*Hazard ratio*	*P > |z|*	*Hazard ratio*	*P > |z|*	*Hazard ratio*	*P > |z|*	*Hazard ratio*	*P > |z|*
Region								
Center	1.53	0.05	1.17	0.34	0.91	0.67	1.75	0.04
Mexico City	1.44	0.08	0.45	0.00	0.76	0.20	0.91	0.76
Southern	0.95	0.90	0.66	0.19	0.88	0.74	0.56	0.44
Sector								
Textile industry, clothing and leather industry	0.77	0.17	0.64	0.03	1.02	0.93	1.96	0.10
Wood products	0.64	0.06	0.93	0.75	1.33	0.26	3.36	0.00
Paper products	0.54	0.20	0.74	0.49	0.29	0.23	2.57	0.18
Chemical	0.55	0.05	0.86	0.59	1.40	0.35	3.69	0.01
Mineral products	0.94	0.89	0.42	0.15	0.39	0.36	1.08	0.94
Basic metallic industry	0.82	0.74	0.64	0.45	n.a.		10.01	0.00
Metallic products, machinery, and equipment	0.64	0.13	0.92	0.74	2.41	0.01	8.08	0.00
Other manufacturing industries	0.84	0.86	1.49	0.69	2.78	0.33	n.a.	
Age of firm	1.00	0.50	1.00	0.88	1.00	0.38	0.99	0.10
Firm is a branch	0.67	0.03	0.81	0.20	0.51	0.00	0.65	0.09
Foreign capital share (percent)	1.00	0.35	1.00	0.01	1.00	0.30	1.00	0.14
Total sales growth (percent)	1.00	0.99	1.00	0.01	1.00	0.98	1.00	0.24
Log(total sales) lagged 1 year	1.04	0.39	1.24	0.00	1.15	0.02	1.05	0.48

Source: Linked ENESTYC 2005–EIA panel data.
a. The base categories were set as "North" for region, "food/beverages and tobacco" for sector, and the firm is not a branch.

such as region, sector, age of the firm, and others; and time-varying productivity factors, such as preparticipation sales growth and the one-year lag of the logarithm of sales.[6] (A complete list of regressors for the Cox model is listed in table 3.) From the estimated hazard ratios shown in table 3 for CIMO-PAC, firms that are located in the central part of Mexico and are not branch firms have a higher probability of enrolling in the program; firms in the wood products and chemical sectors have a lower probability compared with those in the food, beverage, and tobacco sector. Higher lagged sales for a firm increase the hazard of first-time participation in the PNAA, whereas a firm's

6. Preparticipation sales growth refers to sales growth between years $t-1$ and t until first-time participation.

location in Mexico City and position in the textile sector decrease the hazard. With respect to FITI, hazards for firms in the wood products, chemical, and metallic products sectors are higher than for firms in the food, beverage, and tobacco sector. The hazards for firms that are not branches is higher than for those that are branch firms, and firms with higher sales lagged for one year have a higher probability of participation. Establishments that are located in the central region of Mexico, are not branches, or belong to the textile, wood products, chemical, basic metallic, or metallic products sectors have a higher probability of participation in PROSEC.

As the propensity score for each firm, we use the mean of the relative hazard of being treated for the first time in t for all years in which they are available. For the treatment group, the means are computed for all years up to the year of first program participation, after which relative hazard rates are not defined because the failure event has occurred. In the case of the control group, the means are calculated over the 1994–2005 period. For each of the four programs, the relative hazards averaged higher for the treatment group than for the control group. The average hazards were as follows: 3.53 for the treatment group versus 1.78 for the control group for CIMO-PAC, 13.57 for the treatment group versus 9.91 for the control group for the PNAA, 6.73 for the treatment group versus 5.94 for the control group for FITI, and 8.94 for the treatment group versus 5.06 for the control group for PROSEC. These results are consistent with the treatment group as a whole having a higher relative probability of program participation. For each program, the common support region is the intersection of distributions of hazards of control and treatment groups.

Attrition

The SME enterprise support programs typically require that firms be in business for at least one to two years before they participate in the program and that they are not themselves designed to promote entry into the program. It is theoretically possible that the presence of such programs may induce additional entry of firms that would not otherwise have entered, but this is not the primary focus of the programs. We focused on estimating the impact of the program on firms already in business. Thus there is no bias from ignoring the entry of firms, only the need to be careful in stating the treatment effect to be estimated.

However, ignoring the departure (exit) of firms may involve bias if attrition from the panel is nonrandom. It is possible that firms that would have failed in the absence of the program are able to remain in business as a result of the program. As a result, an evaluator might understate the impact of the programs, since the treated firms that stay in are likely to exhibit worse average productivity or to be experiencing more negative shocks than the control firms.

To test the sensitivity of the results to departure, we followed the bounding approach of Lee (2005). This method is also used in McKenzie and Woodruff (2008) to get upper and lower bounds of the treatment effect. Implementing the Lee (2005) bounds requires a monotonicity assumption, which states that the treatment assignment affects sample selection in only one direction. In the context of this analysis, the method requires assuming that there are some firms that would have departed if they had not been in the SME program but that firms will not depart because they received the SME program. This assumption seems plausible in our case.

To construct the Lee (2005) bounds, the distribution of the outcome variable for the group assigned to treatment is trimmed by the difference in attrition rates between the two groups as a proportion of the retention rate of the group assigned to treatment.[7] An upper bound on the treatment effect is constructed by trimming the lower tail of the distribution and then estimating the effect. A lower bound is constructed by trimming the upper tail of the distribution. In this paper only upper bounds were calculated because we are dealing with potential bias owing to firms that lag behind and that would have departed if they had not been in the program.

Time Effects

Finally, we investigate how long after first-time participation it takes for program impacts to be realized. This paper also tests for the time effects of program impacts from the estimated coefficient on the interaction term between D^k and YRS^k, a variable measuring the years since first participation in program k. Rather than forcing a functional form on these time effects (for example, with a quadratic specification of time and time squared), we define a set of indicator variables for different intervals (1, 2, 3, 4, 5–6, 7–9, and 10 or more years) following the date a firm entered the program. This allows the effects of the interaction terms between the program indicator

7. For example, McKenzie and Woodruff (2008) trim the upper or lower 6.7 percent of the profits distribution for the group assigned to treatment.

and time since participation to vary nonlinearly with time in and after the program:

$$(3)\qquad Y_{it} = v_i + \lambda_t + \beta X_{it} + \alpha D_{it}^k + \delta_1 D_{it}^k * YR1_{it}^k + \delta_2 D_{it}^k * YR2_{it}^k + \delta_3 D_{it}^k * YR3_{it}^k + \delta_4 D_{it}^k * YR4_{it}^k + \delta_5 D_{it}^k * YR5_{it}^k + \delta_7 D_{it}^k * YR7_{it}^k + \delta_{10} D_{it}^k * YR10_{it}^k + u_{it},$$

where $YR1_{it}^k$ is a dummy variable that is equal to 1 if at time t the firm i was for the first time in program k one year ago, and 0 otherwise; $YR2_{it}^k$ takes value 1 if the firm was in the program for the first time two years ago, and 0 otherwise; $YR3_{it}^k$, $YR4_{it}^k$, $YR5_{it}^k$, $YR7_{it}^k$, and $YR10_{it}^k$ correspond to three years, four years, five or six years, seven to nine years, and ten or more years, respectively.

The resulting estimates, δ_1, δ_2, δ_3, δ_4, δ_5, δ_7, δ_{10}, can be interpreted as the effects of having been treated for the first time one, two, three, or however many years ago, respectively, and α as the effect of having been treated for the first time at t. These effects are estimated while holding constant all other time-varying factors, including inflation and macroeconomic shocks. The model accounts for these factors by including year dummy variables to capture year-specific stochastic shocks. A second assumption is that self-selection into treatment is not dependent on time. The presence of cohort effects in treatment—firms that choose to participate early are different from those that join in later years—can introduce bias into these estimates.

Results of the Study

This section discusses the estimated treatment effects of CIMO-PAC, the PNAA, FITI, and PROSEC, with an emphasis on differences across programs. We also test for the sensitivity of program impact estimates to the possibility that program participation inhibits firm exit from the panel data. Finally, we examine how quickly or slowly program impacts are realized over time.

Impacts of Programs

Using the fixed-effects model presented in equation 2 in the common support region, we estimate the effects of each program. The upper panels of tables 4 and 5 present the programs' impacts on outcome variables. Each estimate

TABLE 4. Program Impacts on Performance[a]

Program	Value added per worker	Production per worker	Sales	Employment	Worked hours	Wages per worker
CIMO	–0.012 ns	–0.001 ns	–0.041**	–0.030**	–0.030**	0.004 ns
	(0.03)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)
	22,314	22,479	22,221	22,485	22,483	21,936
PNAA	0.103**	0.074**	0.064**	–0.016 ns	–0.006 ns	0.050**
	(0.03)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)
	22,427	22,593	22,342	22,599	22,597	22,049
FITI	0.033 ns	–0.002 ns	0.086**	0.092**	0.088**	–0.014 ns
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)
	21,776	21,938	21,694	21,944	21,942	21,406
PROSEC	0.121**	0.101**	0.131**	0.058**	0.067**	0.015 ns
	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)
	21,576	21,727	21,483	21,733	21,731	21,204
Trimmed sample						
CIMO	–0.012 ns	–0.015 ns	–0.044**	–0.029*	–0.028*	0.013 ns
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)
	21,482	21,642	21,369	21,607	21,608	21,106
PNAA	0.126**	0.068**	0.072**	–0.039**	–0.026*	0.064**
	(0.03)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)
	21,451	21,613	21,351	21,601	21,598	21,076
FITI	0.074**	0.026 ns	0.099**	0.062**	0.061**	0.002 ns
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)
	21,478	21,659	21,387	21,632	21,632	21,111
PROSEC	0.112**	0.107**	0.135**	0.038**	0.043**	0.039**
	(0.04)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)
	21,522	21,681	21,426	21,676	21,675	21,156

Source: Linked ENESTYC 2005–EIA panel data.

a. Fixed effects models in the common support region. For each program, the first row corresponds to coefficients, the second to standard errors, and the third to the number of observations.

*Significant at the 10 percent level.

**Significant at the 5 percent level.

Ns denotes not significant at the 10 percent level.

represents the average program effect of having participated in the program in any prior year—for the period 1994–2005—in the respective outcome.

Tables 4 and 5 show that firm participation on CIMO-PAC is not associated with gains in outcome variables. The effect of the programs on outcomes such as exports is small and negative. The results for CIMO-PAC on performance also turned out to be not significant, with the exception of employment and hours worked, both around –3 percent. We carried out additional estimations on the impact of CIMO-PAC before 2001 with the ENESTYC 2001, since CIMO-PAC is one of the few programs with a large number of firms sampled

TABLE 5. Program Impacts on Intermediate Outcomes[a]

Program	*Exports*	*Technology transfer payments*	*Fixed assets*
CIMO	−0.130*	0.161 ns	0.040 ns
	(0.08)	(0.14)	(0.04)
	11,483	4,929	22,165
PNAA	0.052 ns	−0.102 ns	0.092**
	(0.07)	(0.11)	(0.04)
	11,535	4,930	22,283
FITI	0.178**	−0.083 ns	0.039 ns
	(0.08)	(0.12)	(0.04)
	11,251	4,849	21,636
PROSEC	0.160**	0.158 ns	0.159**
	(0.08)	(0.14)	(0.05)
	11,240	4,809	21,429
Trimmed sample			
CIMO	−0.151**	0.190 ns	0.031 ns
	(0.08)	(0.14)	(0.04)
	11,177	4,786	21,317
PNAA	0.036 ns	−0.112 ns	0.128**
	(0.07)	(0.11)	(0.04)
	11,161	4,777	21,300
FITI	0.236**	−0.088 ns	0.065 ns
	(0.08)	(0.12)	(0.04)
	11,183	4,790	21,336
PROSEC	0.224**	0.162 ns	0.203**
	(0.08)	(0.14)	(0.05)
	11,196	4,797	21,375

Source: Linked ENESTYC 2005–EIA panel data.
a. Fixed effects models in the common support region.
**Significant at the 5 percent level.
*Significant at the 10 percent level.
Ns denotes not significant at the 10 percent level.

in both ENESTYC 2001 and 2005. It is important to mention that the program underwent significant changes after 2001, including its decentralization to the subnational level and a decline in economic support to CIMO-PAC firms of about US$330 for the period 2001–06. The results from these latter estimations indicate that participation in CIMO-PAC in any year up to 2001 showed a positive impact on outcomes such as fixed assets (8 percent) and no significant effects on performance, which are in line with the earlier impact evaluations from Tan and Lopez-Acevedo (2005), which also find positive impacts on intermediate outcomes but no significant impacts on performance before 2001.

The second BDS program is the environment certification program PNAA. This program is well known and used by manufacturing firms. Between 2002 and 2006, the program tripled the number of audits initiated—from 293 in 2002 to 933 in 2006—and the number of clean industry certificates issued doubled in the same period, increasing from 169 in 2002 to 338 in 2006. The results show that participation in the PNAA is associated with positive gains on intermediate and final outcomes. Firm participation in the PNAA produced gains on value added per worker of around 10 percent, on production per worker of around 7 percent, and on sales of 6 percent but had no significant effect on employment, hours worked, or wages per worker. Participation did not yield gains on exports or technology transfer payments but did yield gains on fixed assets of nearly 9 percent. The benefit of participation in the PNAA seems high compared with the cost, since the firm investment in the program is relatively low—between US$16,000 and US$20,000—and the gains are important.

Participation in PROSEC yielded higher impacts in value added, productivity, and sales than participation in FITI. Participation in PROSEC is associated with gains on value added per worker of close to 12 percent and around 10 percent in productivity per worker, whereas FITI has no effect on these outcomes. The impact on sales is 13 percent for PROSEC and 9 percent for FITI. Both programs have similar impacts—which are slightly smaller for PROSEC than for FITI—on employment, 6 versus 9 percent, on hours worked, 7 versus 9 percent, and on exports 16 versus 18 percent. The estimated impact of PROSEC on fixed assets is 16 percent, whereas FITI does not have an effect on this variable.

Although participation in FITI also yields gains in outcome variables, the gains are smaller compared with PROSEC; mainly when government support is considered, the FITI support is approximately 30 percent of the amount invested in the authorized projects, which represents an amount between US$120,000 and US$200,000 per project, while the support for PROSEC is about 6 percent of the value of the imported goods (machinery and inputs).

Bounding Estimates of Program Impacts

One issue that arises is that only EIA firms that survived until the 2005 ENESTYC survey were included in the study's panel. This means that the data set does not include firms that departed before 2005, which could lead to a survivor bias if program participation increases the possibility of survival for firms that lag behind and would otherwise have departed (for example, the least productive firms stop operations in the absence of the program).

As discussed earlier in this paper, we bound estimates of program impacts by reestimating regression models after dropping the bottom 5 percent of the treatment group in terms of outcome variables (for example, for sales, assuming that firms with the lowest sales would otherwise have departed).[8] The significance and magnitude of the programs' impacts are quite similar under the trimming (tables 4 and 5, bottom panel) and the original estimates (tables 4 and 5, upper panel). The biggest differences are for PROSEC; for example, the estimated impact on exports is 22 percent compared with 16 percent under trimming, and the effect on fixed assets is 20 percent compared with 16 percent. The effect of FITI on exports is 24 percent compared with 18 percent, and on value added per worker it is 7 percent, but under the trimmed sample the effect becomes insignificant. Finally, the impact of the PNAA on employment goes from no significance (in the original estimation) to −4 percent under the trimmed sample. As we expected, in most of the cases, the coefficients of the trimmed sample are larger than the coefficients of the original sample; in a few cases, the opposite is true. The essential conclusion from this is that the sensitivity analysis indicates that in general, the direction and size of treatment effects are robust with regard to controls for potential biases for firms departing BDS programs.

Time Paths of Treatment Effects

Thus far, we have estimated the average treatment effect of program participation without consideration of whether these effects vary as time from first treatment elapses. Although they are useful, these estimates of average treatment effects leave unanswered the question of whether impacts are realized immediately or only slowly over time. None of the indicator variables for the effect of having participated for first time one, two, or however many years ago, in equation 3, are statistically significant before three or four years ago (see table 6). In the case of FITI, the estimated coefficient in employment becomes positive starting three years after program entry and increases in value. The treatment effect is 8 percent at three years and 10 percent at four years and increases to 14 percent at five to six years, 20 percent at seven to nine years, and 31 percent for more than ten years since program entry. Value added per worker shows differences after four years; this effect also

8. In the World Bank (2010) Chile country paper, the author drops 5 percent of the treatment group. McKenzie and Woodruff (2008) also drop 5 percent. In the absence of firm departure rates for treatment and control groups for Mexican enterprises, we also use this rate.

TABLE 6. Time Effects by Program[a]

Program	*Outcome*	*1 year later*	*2 years later*	*3 years later*	*4 years later*	*5–6 years later*	*7–9 years later*	*10+ years later*
CIMO	Value added per worker	0.010 ns	–0.034 ns	–0.053 ns	0.067 ns	–0.023 ns	–0.076 ns	–0.203*
	Employment	0.000 ns	0.008 ns	–0.016 ns	–0.052 ns	–0.030 ns	–0.078 ns	–0.064 ns
	Exports	–0.031 ns	0.087 ns	0.178 ns	0.108 ns	–0.260 ns	–0.518**	–0.572**
PNAA	Value added per worker	0.030 ns	–0.004 ns	0.043 ns	0.057 ns	–0.009 ns	–0.133*	–0.245**
	Employment	0.008 ns	0.009 ns	–0.039 ns	–0.015 ns	–0.010 ns	–0.068 ns	0.043 ns
	Exports	0.068 ns	0.090 ns	0.141 ns	0.197 ns	0.191 ns	–0.266 ns	–0.039 ns
FITI	Value added per worker	0.009 ns	0.037 ns	–0.012 ns	0.154*	0.259**	0.013 ns	0.000 ns
	Employment	0.046 ns	0.047 ns	0.081*	0.102**	0.141**	0.195**	0.305**
	Exports	–0.051 ns	0.071 ns	0.383**	0.116 ns	0.251 ns	0.066 ns	0.306 ns
PROSEC	Value added per worker	0.032 ns	–0.037 ns	0.030 ns	–0.028 ns	0.107 ns	0.076 ns	0.074 ns
	Employment	0.003 ns	–0.015 ns	–0.054 ns	–0.074 ns	0.032 ns	–0.021 ns	–0.208*
	Exports	–0.087 ns	–0.016 ns	0.006 ns	–0.043 ns	0.388*	0.335 ns	0.368 ns

Source: Linked ENESTYC 2005–EIA panel data.
a. Fixed effects models in the common support region. Estimates of time since first participation in program.
**Significant at the 5 percent level.
*Significant at the 10 percent level.
Ns denotes not significant at the 10 percent level.

increases over time. Our estimates for the other three programs do not show clear patterns over time.

Conclusions

This paper uses firm panel data to evaluate the impacts of different types of SME support programs in Mexico. The paper makes use of the program participation module in the ENESTYC survey, which includes retrospective questions about firm participation, date of first participation, type of support received, and familiarity with SME programs administered by several agencies. The ENESTYC was linked to the EIA to form the panel. In this way, preprogram and postprogram outcome variables are tracked over time for both treatment and control groups during the 1994–2005 period.

The paper reports evidence that program participation in one BDS program, the PNAA, and in two programs supporting R&D, FITI and PROSEC, is causally related to improvements on intermediate outcomes, such as exports and fixed assets, as well as positive gains on performance such as production per worker, sales, and, to a lesser extent, employment. We also stress that positive treatment effects vary across programs, with participation in PROSEC, the PNAA, and FITI having the most consistent positive impacts on outcomes, in that order. We find no significant treatment effects for CIMO-PAC. The program that yielded the highest effect is PROSEC. These results remain robust after trimming the bottom 5 percent (in terms of outcome) of this study's treatment group to account for possible firm departure bias.

The analyses also highlight the importance of time effects from program participation. Beginning at three to four years after program entry, the estimated coefficients become positive and increase in value and statistical significance for selected variables for FITI. For this program, the treatment effect on employment is 8 percent at three years and increases to 31 percent at ten years after program entry. The results suggest that the effect of enterprise support programs might not be immediate, which could account for negative results in previous studies using a shorter time horizon. This finding is consistent with the World Bank's (2010) Peru and Chile country papers. These studies also find a strong and increasing time effect.

Several research lines emerge from this study's analysis. One key finding is that the very high number of programs and their constant evolution over time (including changing names and structures, closing old programs and opening new ones) makes rigorous impact evaluations of SME support programs a major challenge. One area of future work is to investigate cohort effects in the panel for those programs that underwent major design changes. The initial research on CIMO-PAC carried out in this paper could serve as an example for a similar analysis of other programs.

Comment

Alessandro Maffioli: In their paper, Lopez-Acevedo and Tinajero-Bravo address the important question of the potential impact of enterprise support programs on the performance of small and medium-sized enterprises (SMEs). This topic has not been extensively explored in the existing literature, and thus new findings in this area are certainly relevant for both scholars and policymakers. Specifically, the authors evaluate the impact of four SME support programs in Mexico: two programs involving business development services (CIMO and the PNAA) and two R&D support programs (FITI and PROSEC). They use a panel of firm-level data for the period 1994–2005, created by linking SME program participation information to a panel of annual industrial surveys. The authors' empirical strategy is based on estimating average treatment effects, combining a fixed-effects methodology with a Cox proportional hazard model, to estimate the propensity score of the likelihood of program participation; analyzing the sensitivity of program impact estimates to the possibility that program participation inhibits firm exit from the panel data; and examining the dynamic pattern of the estimated effects.

The paper finds evidence that the participation in the PNAA, FITI, and PROSEC is causally related to improvements on intermediate outcomes (exports and fixed assets) as well as to positive performance gains (production per worker, sales, and employment). However, no significant treatment effects for CIMO are found. As a robustness check, the paper shows that these results remain robust after trimming the bottom 5 percent (in terms of outcome) of the treatment group to account for possible firm departure bias. The paper also shows evidence that the effect of enterprise support programs might not be immediate.

This paper is a valuable contribution in many ways. Although SME support programs are widely used in both developed and developing countries, evidence on their effectiveness is still quite scarce and, therefore, mostly inconclusive. Because of this, there is no clear consensus on what the most appropriate SME support programs are and on the specific mechanisms through which positive effects actually materialize. The paper is important also because of its focus on Latin America, especially considering that most of the existing research in this area still focuses on developed countries (see the authors' table 1, which reviews the literature). In this sense, this paper adds to a recent but growing literature focused on the evaluation of productive development programs in Latin America, including agricultural development programs (for a survey, see González and others 2010; Maffioli and others 2012); innovation programs (Hall and Maffioli 2008; Crespi, Maffioli, and Melendez 2011; Crespi, Solís, Tacsir 2011); export promotion programs (Volpe and Carballo 2008); SME support programs (Castillo and others 2013; Eslava, Maffioli, and Meléndez 2012); supplier development programs (Arráiz, Henriquez, and Stucchi 2012); and cluster development programs (Figal Garone and others 2012). Finally, the construction of a panel data set that can be used to measure long-term effects of this kind of program also significantly contributes to closing an important knowledge gap. In fact, because many of the existing evaluations relied on data that covered relatively short posttreatment periods, they often left unanswered all questions on the long-term effects and on the overall dynamics of the effects.

These merits notwithstanding, the paper still shows some methodological limitations that should be addressed by future studies in this area. To deal with possible selection bias issues, the paper adopts an identification strategy that combines matching techniques and panel data analysis. Because various cohorts of beneficiaries are considered, the paper uses a Cox proportional hazard model to estimate the propensity score. Although the intuition at the base of this approach is relatively clear, its properties have not been clearly discussed or demonstrated by any robust theoretical work. In addition, although the paper analyzes multiple treatments at the same time, it does not fully consider the possible interactions between these interventions. Ignoring these potential interactions leaves unaddressed relevant policy questions, such as whether there are complementarities among programs that could be exploited through the design of new policy instruments, their coordination, and sequencing. Obviously, the study of the simultaneous effect of different programs implies additional methodological challenges, since it requires dealing with a multistep selection bias. In fact, in this setting firms not only decide whether to participate in various programs but they also decide in which specific program or programs to participate and in which order. It is quite clear that in this setting the potential selection biases and the identification assumptions required to solve them are not the same as in the case of a single treatment.

Summing up, the line of research undertaken by Lopez-Acevedo and Tinajero-Bravo is surely very interesting and relevant. I hope the authors will continue working on this line of research and that their future work can keep contributing to shed light on the effects of SME policies in Latin America.

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