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The Long-Term Effects of Management and Technology Transfers[†]

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This paper examines the long-run causal effects of management on firm performance. Under the United States Technical Assistance and Productivity Program (1952–1958), the United States organized management training trips for Italian managers to US firms and granted technologically advanced machines to Italian companies. I exploit an unexpected budget cut that reduced the number of participating firms and find that, compared to businesses excluded by the budget cut: performance of Italian firms that sent their managers to the United States increased for at least fifteen years after the program; performance of companies that received new machines increased, but flattened out over time; management and new machines were complementary. (*JEL* F23, L25, M16, M54, N34, N64, O33)

Empirical research has documented large and persistent differences in performance among firms, even within narrowly defined industries (Syverson 2004; Foster, Haltiwanger, and Syverson 2008). One possible explanation for these persistent differences is that they might reflect variations in management practices. However, establishing a causal relationship between management and firm outcomes is challenging: more productive firms may simply adopt better management practices. A few recent studies evaluate the causal effect of management on firm performance using randomized control trials (RCTs) (Bloom et al. 2013; Bruhn, Karlan, and

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Schoar 2017). These works employ a relatively small sample size, and cannot assess heterogeneous or spillover effects. More importantly, since RCTs have been implemented fairly recently, whether these effects persist over the long run is not known.

This paper examines the long-run effects of management on firm performance, using evidence from a unique historical episode, the United States Technical Assistance and Productivity Program (hereafter, Productivity Program). During the 1950s, as part of the Marshall Plan, the United States sponsored training trips for European managers to learn modern management practices at US firms. The program also issued subsidized loans to European businesses to purchase technologically advanced US machines.[1] In Italy, small and medium-sized manufacturing firms from five geographic regions could apply for this program (panel A of Figure 1) and could decide whether to send their managers to the United States (hereafter, management transfer), to purchase US machines (technology transfer), or to do both (combined management and technology transfers).

I use newly assembled panel data, collected from numerous historical archives, on the population of 6,065 Italian firms eligible to apply for the Productivity Program. For each firm, I collected and digitized balance sheets from five years before to fifteen years after the Productivity Program and linked them to firms' application records.

My identification strategy relies on a budget cut that happened when the Productivity Program was about to start. In 1952, after all firm applications had been submitted and reviewed, the United States unexpectedly cut the program's budget, and only firms from five smaller Italian provinces—one for each of the original regions—eventually participated in it (panel B of Figure 1). I therefore compare the performance of firms that applied for and eventually received the management or the technology transfer (treated firms) with that of firms applying for the same transfer, but not receiving it due to the budget cut (comparison firms). I show that, before the budget cut, treated and comparison firms were very similar in their observable characteristics, including preprogram performance trends.

I find three key results. First, firms that sent their managers to the United States were more likely to survive and had higher sales, employment, and productivity than companies that applied but did not get the management transfer due to the budget cut. These effects were large and grew over time for at least fifteen years after the program. The productivity of treated firms rose by 15 percent within one year, relative to the management comparison group, and continued to grow without reaching a plateau, with a cumulative increase of 49.3 percent in fifteen years. Second, the technology transfer also boosted firm performance, but the gains did not persist. The productivity of treated firms rose gradually by 11.5 percent in ten years, relative to the technology comparison group, but then flattened out. Third, there was a complementarity between management and technology. The effects on firms that received the combined management and technology transfers were significantly larger than the sum of the single transfers. For instance, their productivity increased by an additional 12.1 percent in 15 years, relative to the sum of the other two transfers.

[1] The management training was based on the Training Within Industry (TWI) method, and included factory operations, production planning, human resources training and management, and marketing (Silberman, Weiss, and Dutz 1996). The US machines had more modern technology than that used in Europe and could produce the same output in less than half the time (Dunning 1998).

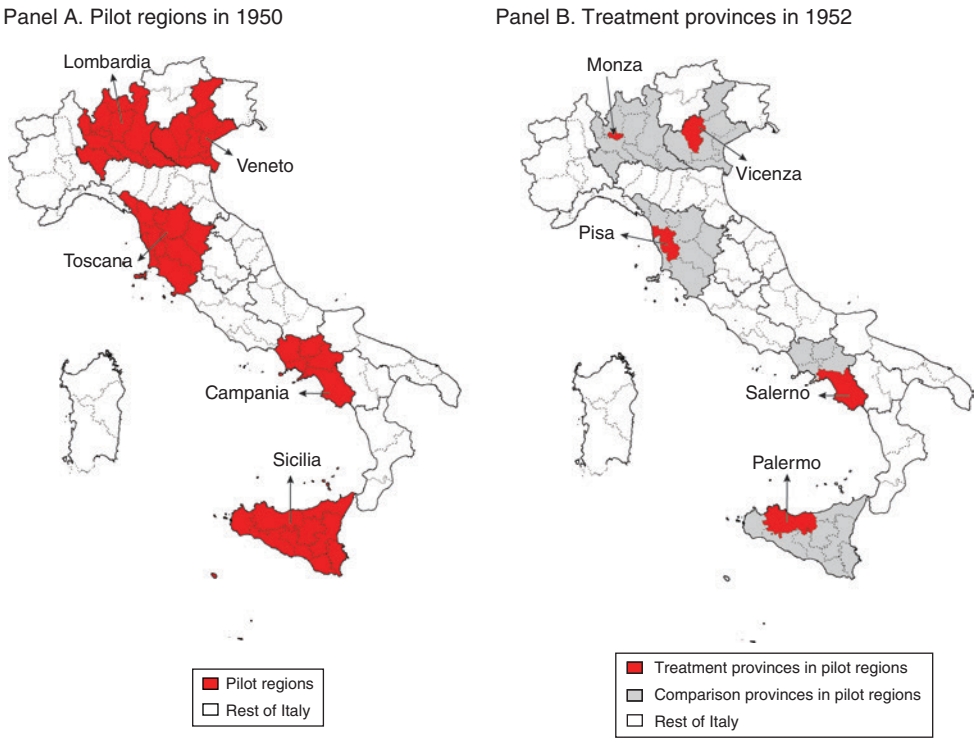

FIGURE 1. PILOT REGIONS AND TREATMENT PROVINCES SELECTED FOR THE PRODUCTIVITY PROGRAM, 1950–1952

Notes: Pilot regions chosen for the pilot phase of the Productivity Program in 1950 (panel A) and treatment provinces selected after the US budget cut in 1952 (panel B). Only firms located in treatment provinces eventually received US transfers, conditional on having applied for the program

What changed in the firms that received the managerial training? More than 90 percent of them adopted the new American managerial practices within 3 years and were still implementing them 15 years later. Specifically, these companies started regularly maintaining their machines and tracking their sales and orders. They also improved working and safety conditions, organized training classes for managers and other workers, and invested in market research, branding, and advertising. In the longer run, changes in firm organization and access to the credit market amplified the initial effects of the program. Specifically, improved performance led firms to increase the number of plants and the manager-to-worker ratio, and to be more likely to become professionally managed (instead of remaining family-managed). Improved performance also gave firms greater access to credit market, which, in turn, allowed them to invest more in physical capital.

The contribution of this paper is threefold. First, the idea that management is correlated with the productivity of inputs dates back to Walker (1887). More recent studies have shown a positive association between management practices, or managers, and firm performance (Bertrand and Schoar 2003; Bloom and Van Reenen 2007). Random control trials have provided causal evidence that management consulting leads to better firm outcomes (Bloom et al. 2013; Bruhn, Karlan, and

Schoar 2017). This paper is, to the best of my knowledge, the first study that uses non-experimental data to examine the long-term causal impact of management.

Second, this paper contributes to the literature about technology adoption and its complementarity with management. It has been shown that the importance of capital goods that embody new technology has positive effects on firm productivity (Pavcnik 2002, Goldberg et al. 2009). Moreover, firms with better management improve their productivity upon increasing the use of information technologies (IT) (Bloom, Sadun, and Van Reenen 2012). My research shows that the causal impact of technologically advanced capital goods on firm performance does not persist over time if it is not accompanied by proper managerial training.

Finally, this paper relates to the literature on the effects of the Marshall Plan on European recovery after World War II. A large body of research in past decades has focused on the macroeconomic effects of the plan (Mayne 1970, Milward 1984, De Long and Eichengreen 1991, Eichengreen and Uzan 1992). My work is the first to use firm-level data on a large scale to study the microeconomic impact of one program of the Marshall Plan.

The rest of the paper is structured as follows. Section I describes the Marshall Plan and the Productivity Program in Italy. Section II describes the data. Section III presents the empirical framework and discusses the identification strategy. Section IV examines the effects of the Productivity Program on firm performance. Section V analyzes the mechanisms through which the Productivity Program affected firm performance. Section VI studies the indirect effects of the Productivity Program on nonparticipating firms. Section VII concludes.

I. The Marshall Plan and the Productivity Program

The Marshall Plan was an economic and financial aid program, sponsored by the United States, that focused on helping 17 western and southern European countries recover from World War II (Boel 2003).[2] It was in operation from 1948 to the end of the 1950s. Between 1948 and 1951, when it was officially known as the European Recovery Program (ERP), it transferred approximately $130 billion (in 2010 USD) to Europe (Eichengreen and Uzan. 1992) to help rebuild war-devastated regions, remove trade barriers, and prevent the spread of Communism (Hogan 1987).

During the first months of the ERP, the United States realized that European firms were characterized by lower labor productivity than US plants (ECA 1949) and US observers argued that this difference was largely due to the lack of a "managerial mentality" (Segreto 2002). A 1949 US Bureau of Labor Statistics (BLS) report on Italian plants stated:

> *Workers are not trained by the firms, and the flow of work and the employees operations are not carefully studied and integrated.* [...] *The insufficient critical allocation of labor, and the accumulation of numerous small losses in efficiency determine an excess of workers per output, estimated between 50 percent and 400 percent.* [...] *Plants are not well-organized and often work areas, lighting, and ventilation are not adequate.*

[2] The 17 countries were Austria, Belgium, Denmark, France, West Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland, Turkey, and United Kingdom (Boel 2003).

> *There is less* (*compared to the US*) *thorough maintenance of machines*, *equipment and tools*, *that result in more frequent breakdown and work interruptions.* [...] *Modern marketing strategies are undeveloped*, *and distribution channels are old-fashioned.*[3]

In 1949, after visiting several factories across Europe, James Silberman, the BLS chief of productivity and technology development, claimed that inefficiencies in management were a more severe problem than war damages (Silberman, Weiss, and Dutz 1996). Similarly, Ewan Clague, the BLS commissioner, stated that "productivity levels in the United States were more than twice those in Great Britain, and more than three times that of Belgium, France and other industrial countries of Europe" (Boel 2003).

In 1950, to improve the productivity of European firms, the US government introduced the Productivity Program. All countries that participated in the ERP were also part of this program, which lasted from 1952 to 1958. During this time, the United States organized study trips for European managers to US plants, followed by consulting sessions of US experts at European firms. Managers were taught modern management practices, based on the Training Within Industry (TWI) method, which covered factory operations, production planning, human resources training and management, and marketing (ICA 1958). Factory operations consisted of regular machinery maintenance and general maintenance of safety conditions within the firm; production planning consisted of sales and order control. Human resources training and management called for employee training within the firm and regular supervision. These combined practices allowed faster problem solving and constant improvements of production methods. Finally, marketing training emphasized market research, product requirements, branding, and design, as well as advertising campaigns and modernization of distribution channels. TWI did not focus on quality management and lean production; these would be developed by Toyota in the early 1970s. Today, however, quality control is still not included in many training programs geared to small and medium-sized firms (McKenzie and Woodruff 2012), at which the Productivity Program was aimed.

The Productivity Program's main focus was management training, but the United States also introduced a loan program to help firms renew their capital stock. These loans were restricted to the purchase of technologically advanced machines produced in the United States (ICA 1958) and not sold in Europe. US machines were more productive than European ones. For example, in the beverage industry, US bottle-washing machines were able to wash and sterilize up to 200 bottles per minute. European machines took 3 minutes to wash 50 bottles, and did not provide sterilization (Dunning 1998). Similarly, in US steel manufacturing, the roof temperature of an open-hearth furnace was controlled by an electronic potentiometer, which increased roof life four-to-fivefold (Dunning 1998).

A. *Implementation of the Productivity Program in Italy*

United States authorities originally intended to roll out the Productivity Program in Italy in two phases: first, a pilot program, which, if deemed effective, would be followed by nationwide implementation. The pilot program would be run in five

[3] *Productivity Survey of Italian Firms*, compiled for the US Bureau of Labor Statistics on August 24, 1949.

regions, labeled pilot regions: Lombardia, Veneto, Toscana, Campania, and Sicilia (panel A of Figure 1). The US observers chose each pilot region to be representative of an Italian macroarea: northwest, northeast, center, south, and islands (CNP 1960). Firms had to meet four criteria to be eligible to participate in the pilot program. From 1949 to 1951, they had to (i) be located in one of the five pilot regions, (ii) operate in the manufacturing sector, (iii) have between 10 and 250 employees, and (iv) compile a balance sheet (required by Italian law for all firms with at least 2010 $150,000 in annual revenues). Eligible firms had to submit an application between January and June 1951 (ICA 1958), indicating whether they wanted to send their managers to US firms (management transfer), to purchase new US machines (technology transfer), or to do both (combined management and technology transfers). Out of 6,065 eligible firms, 3,624 applied for US assistance. Applications were reviewed by a committee composed of Italian and US specialists; fewer than 1 percent were rejected (ICA 1958).[4]

However, on December 12, 1951, after all firm applications had been submitted and reviewed, the United States cut the budget for the pilot phase. The main motivation for the cut was the deepening of US involvement in the Korean War, which reduced money available for the Productivity Program (Chillè 1993). When applying for the program, firms were unaware of a potential future budget cut. As a result, the United States reduced the scope of the program from the regional to the provincial level[5] and implemented it in only five provinces: one in each of the original pilot regions (panel B of Figure 1). The Productivity Program timeline is illustrated in Figure 2.

Even after the budget cut, the goal of the pilot phase remained to test the program's effectiveness before the nationwide implementation. Therefore, US observers selected provinces that were representative of each pilot region. These provinces "[had] the average economic characteristics of the pilot region where they were located. They were not the most or the least developed areas" (CNP 1960). For instance, in the pilot region of Veneto, the province of Vicenza was selected because "its structure reproduces Venetos structure very well" (Bianchi 1993). The five selected provinces were Monza for Lombardia,[6] Vicenza for Veneto, Pisa for Toscana, Salerno for Campania, and Palermo for Sicilia (Figure 1, panel B). Ultimately, the Productivity Program was never expanded.

The decision of aiming the Productivity Program at small and medium-sized firms was due to the fact that they got no other aid via the Marshall Plan (Boel 2003). Moreover, no other public programs were implemented by either the US or the Italian government, for which such firms were eligible at that time (Boel 2003; Fauri 2010).

In the rest of the paper, I refer to selected provinces as treatment provinces, and to the other provinces not selected as comparison provinces.

[4] Only 30 applications were disregarded: 16 because they were incomplete, 11 because they requested loans for machines available for sale in Europe, and 3 because their debt was considered too high. These 30 firms are excluded from my analysis in the rest of the paper.

[5] Regions are the largest Italian administrative areas, comparable to US states, but with no political power. Provinces are Italian administrative areas, smaller than regions, comparable to US counties.

[6] Although Monza was a very well defined geographical area, with 50 municipalities, it was officially recognized as a province in 2004 (Legge n.146, June 11, 2004) and started operating in 2009 (with the name of Monza and Brianza).

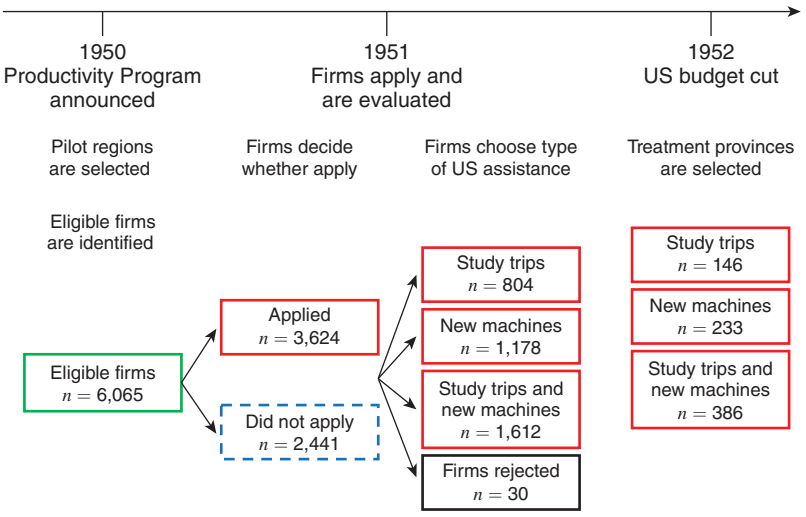

FIGURE 2. TIME LINE OF THE PRODUCTIVITY PROGRAM IN ITALY, 1950–1952

B. *Description of the Productivity Program in Italy*

Firms participated in the Productivity Program between 1952 and 1958, based on the order in which they submitted their applications. The study trips for managers lasted eight to twelve weeks. Managers were grouped in teams of fifteen to twenty people coming from firms operating in the same industry across Europe. Almost all tours were preceded by a week-long orientation period, during which team members could get to know each other. After that, the teams visited five or six US firms that had product lines similar to those that European firms could sell. The US firms also had a scale of operation and managerial level to which European plants could aspire in ten years (Silberman, Weiss, and Dutz 1996). A typical week consisted of three working days of plant visits. Managers worked side-by-side with their US colleagues in order to learn how US firms were managed. Francesco Sartori, the manager and owner of Lanificio Sartori (located in Schio, Vicenza), who visited the United States in 1953, noticed "usually Italian workers work twice as long as workers in the United States but only finish half the amount of work. [. . .] In the US, we learned to manage firms the way they did and we were able to bring back those practices to our firms." (Report compiled by US experts who visited Lanificio Sartori in 1955, during the monitoring period)[7]. During the other two weekdays, managers received formal training and participated in meetings and seminars. Silberman noted that "demanding work requirements prevented boondoggling" (Silberman, Weiss, and Dutz 1996, p. 447). At the end of the study trips, the trainees had to leave the United States and return to their origin firms. According to the 1952 Immigration and Nationality Act, they could not reenter the United States for two years.

As for technology transfer, upon receiving the new machines, firms were granted a loan corresponding to the market value of the machines, repayable over ten years

[7] Relazione Tecnica Missione 227/B3 (1955).

(ICA 1958) at an interest rate of 5.5 percent (ICA 1958). By comparison, the Italian market interest rate on loans was on average 9 percent between 1952 and 1958 (Zamagni 1997). In addition to transferring physical capital, the program also organized study trips to the United States for Italian engineers and technicians to acquire the know-how needed to use these new machines. These trips lasted between four and seven weeks, during which Italian workers spent three days per week in US plants, observing the machines in operation and two days per week attending seminars and writing technical reports (ICA 1958).

All firms that participated in the Productivity Program were subject to a three-year monitoring period by US experts, who periodically visited them, consulted with them on carrying out the program, and observed whether the new management practices and/or the new machines were in use (ICA 1958).

II. Data

In this section, I document the data collection process and describe the data collected.

A. *Eligible Firms and Balance Sheets Data*

I identified the population of firms eligible to apply for the Productivity Program in 1951 by referring to firm registries stored at the Historical Archive of Confindustria, the Italian manufacturing federation.[8] Specifically, I identified 6,065 eligible firms, searching for firms that met the program's criteria.[9] Next, I collected and digitized all their yearly balance sheets from 1946 to 1973.

On average, eligible firms were multi-plant organizations with 48 employees, assets of $1.6 million, and sales of $1 million (in 2010 USD), that had been in operation for 12 years (Table 1). Almost all firms were family owned,[10] 43 percent of them were also family managed,[11] and only 13 percent were exporters.

Firm characteristics differ based on their geographical location. Northern pilot regions had larger firms than southern ones, with higher assets, sales, and productivity (online Appendix Table A.1). Also the distribution of firms across manufacturing industries is heterogeneous (online Appendix Figure A.1, panel B). In all regions, more than 40 percent of firms were in the textile industry. In Lombardia, Veneto, and Toscana, more than 20 percent of firms were in the machinery industry, while in Campania and Sicilia the food industry was predominant.

[8] According to 1942 Italian Civil Code, all firms operating in a given province had to register with the corresponding *Camere di Commercio Industria Artigianato e Agricoltura* (CCIAA), a local institution comparable to a US Chamber of Commerce (Art. 2429, *Codice Civile Italiano, Regio Decreto-Legge* March 16, 1942, n. 262).

[9] The criteria for applying to the Productivity Program, as explained in Section IA, were (i) to be located in one of the five pilot regions, (ii) to operate in the manufacturing sector, (iii) to have between 10 and 250 employees, and (iv) to compile a balance sheet.

[10] Although a formal definition of family-owned firm was not introduced in the Italian Civil Code until 1975 (Art. 230-bis), the 1951 Industrial Census defined family firms as "a firm, of any size, in which the majority of decision-making rights is in the possession of the natural person(s) who established the firm or in the possession of their spouses, parents, child or children's direct heirs."

[11] The 1951 Italian Industrial Census defined a family-managed firm as a firm in which "at least one representative of the family or kin is formally involved in the governance of the firm."

TABLE 1—SUMMARY STATISTICS FOR THE 6,065 FIRMS ELIGIBLE TO APPLY FOR THE PRODUCTIVITY PROGRAM, 1951

	All eligible firms				Management	Technology	Combined	Did not apply
	Mean (1)	SD (2)	Min. (3)	Max. (4)	Mean (5)	Mean (6)	Mean (7)	Mean (8)
Plants per firm	1.33	1.58	1	5	1.25	1.45	1.62	1.10
Employees per firm	47.67	56.39	15	250	41.27	59.89	66.47	31.32
Current assets (k USD)	1,632.59	2,355.67	356.72	9,432.76	1,891.49	1,545.82	1,932.59	1,389.37
Annual sales (k USD)	1,015.63	1,956.78	193.46	7,487.91	915.63	945.78	1,293.44	897.88
Value added (k USD)	491.55	773.45	60.93	3,945.09	507.55	558.41	633.28	359.30
Age	12.41	7.44	4	43	10.93	15.67	9.87	13.00
Productivity (log TFPR)	2.48	0.51	1.98	3.71	2.67	2.55	2.70	2.24
Export	0.13	0.33	0	1	0.13	0.12	0.14	0.13
Family managed	0.43	0.50	0	1	0.25	0.33	0.27	0.64
Submit application	0.59	0.49	0	1	1	1	1	0
Management	0.13	0.34	0	1	1	0	0	0
Technology	0.20	0.39	0	1	0	1	0	0
Combined management and technology	0.27	0.44	0	1	0	0	1	0
Managers in US	—	—	—	—	2.33	—	2.45	—
Engineers in US	—	—	—	—	—	3.19	3.37	—
Loans (k USD)	—	—	—	—	—	223.49	250.77	—
Observations	6,065	6,065	6,065	6,065	809	1,190	1,625	2,441

Notes: Summary statistics for the 6,065 firms eligible to apply for the Productivity Program in 1951. Data are provided at the firm level. Columns 1, 2, 3, and 4 present, respectively, mean, standard deviation, minimum, and maximum of characteristics and outcomes of all the 6,065 eligible firms. Columns 5, 6, 7, and 8 report the mean of the same variables, separately, for 809 firms that applied for management transfer, 1,190 firms that applied for technology transfer, 1,625 firms that applied for the combined management and technology transfers, and 2,441 firms that did not apply. *Plants per firm* reports the total number of plants per firm; *Employees per firm* reports the number of employees per firm; *Current assets, Annual sales*, and *Value added* are in 2010 USD, reevaluated from 1951 to 2010 values at 1 lira = 30.884 euros and exchanged at 0.780 euro = USD 1; *Productivity* (*log TFPR*) is the logarithm of total factor productivity revenue, estimated using the Ackerberg, Caves, and Frazer (2006) method; *Export, Family managed, Submit application, Management, Technology, Combined management and technology* are indicators that equal one if, respectively, a firm exported, was family managed, applied for the Productivity Program, chose management transfer, chose technology transfer, and chose the combined management and technology transfers; *Managers in US, Engineers in US*, and *Loans* (*k USD*) report, respectively, the number of managers or engineers to be sent in US firms and the dollar amount of loans requested.

B. *Applications for US Management and Technology Transfers*

I collected and digitized the applications submitted by eligible firms in 1951 from two historical archives: the Italian Central Archives of the State (ACS) for firms that applied for management transfers and the Historical Archive of the Istituto Mobiliare Italiano (ASIMI) for firms that applied for technology transfers.

The applications are an incredibly rich source of information. Each firm has a unique folder, containing administrative information such as firm name, the municipality in which it was located, the application date, the number of managers to be sent on a study trip for firms that applied for the management transfer, and the type of machinery requested, the loan amount, and the number of engineers/technicians to be sent to the United States for firms that applied for the technology transfer. This information is available for all the firms that applied, whether they eventually received US assistance or not. For firms that eventually received the management transfer, the folders also contain the date and the length of the study trips, the US firms in which the training took place, the technical reports compiled by the US experts who visited these firms for three years after the study trips. For firms that eventually received the technology transfer, the folders contain the date in which the

new machine was received, its commercial value that corresponds to the value of the loan granted to the firm, and whether and when the loan was repaid, as well as the US technical reports for three years after receiving the support.

Of the 6,065 eligible firms, 3,624 applied for the Productivity Program and 2,441 did not. Among applicant firms, 809 applied for the management transfer, 1,190 for the technology transfer, and 1,625 for the combined management and technology transfers (Table 1). Using firm name and address, I uniquely matched all the applications with firm balance sheets. Firms that applied for the Productivity Program were, on average, larger than companies that did not apply, had higher sales, and were 25 percent more productive. Around 30 percent of firms that applied were family-managed, compared with 64 percent of firms that did not apply (Table 1). Most firms that did not apply were operating in traditional industries such as food, textile, and wood industries (online Appendix Figure A.1, panel B).

Between 1952 and 1958, 1,275 Italian male managers, on average 35 years old, participated in the study trips; 88 percent of them were still working in the same firm 15 years after their engagement with the program. This evidence is consistent with the very low labor turnover across Italian firms (Saibante 1959). Ninety-eight percent of the loans were repaid within the ten-year horizon.[12]

III. Identification Strategy

The identification strategy of this paper relies on an unexpected cut in the US budget that reduced the scope of the Productivity Program from the regional to the provincial level (Figure 1, panels A and B). This budget cut occurred after all firm applications had been reviewed (and only 30 out of 3,624 were rejected). Therefore, in each pilot region only firms located in treatment provinces participated in the program, while companies located in comparison provinces did not.

I estimate the causal effects of the Productivity Program via the following equation, which is run over the sample of treated and comparison firms that were on the market from 5 years before to 15 years after the program:[13]

$$(1) \qquad outcome_{it} = \alpha_i + \nu_t + \sum_{\tau=-5}^{15} \delta_\tau [Treat_i \cdot (Years\ After\ Treat = \tau)] + \epsilon_{it},$$

where the dependent variable, $outcome_{it}$, is one of the key performance metrics of logged (deflated) sales, number of employees, and TFPR of firm i in year t. Although for robustness, TFPR is estimated in a number of ways, the core method uses a version of the Ackerberg, Caves, and Frazer (2006) method.[14] Firm fixed effects α_i control for variation in outcomes across firms constant over time. Year fixed effects ν_t control for variation in outcomes over time that is common across all firms. $Treat_i$ is an indicator that equals one if firm i is located in a treatment province, eventually

[12] Of the remaining loans, 1.5 percent were extended and repaid in 15 years, and 0.5 percent were transferred to other firms through a procedure called *accollo*. The average Italian yearly inflation rate between 1952 and 1970 was 3.2 percent.

[13] The effects of the Productivity Program on firm survival are analyzed in Section IVA.

[14] Ackerberg, Caves, and Frazer (2006) extend the framework of Olley and Pakes (1996) and Levinsohn and Petrin (2003) to control for the simultaneity bias that arises because input demand and unobserved productivity are correlated. Details about the TFPR estimation can be found in online Appendix E.

selected to participate in the Productivity Program; *Years After Treat* $= \tau$ is equal to the difference between the calendar year t and the year in which firm i participated in the Productivity Program.[15] The variable ϵ_{it} is the error term. Standard errors are block-bootstrapped at province level with 200 replications.[16] Each δ_τ coefficient captures the effects of the Productivity Program τ years after its implementation. The omitted coefficient is $\delta_{\tau=-1}$, which corresponds to the year before the treatment.

The identifying assumption is that the performance of firms in treated and comparison provinces that applied for the same US transfer in 1951 would have been on the same trend in absence of the Productivity Program. The remainder of this section provides evidence in support of the research strategy and discusses the identifying assumption.

A. *Were Treated and Comparison Provinces in Each Pilot Region Comparable?*

I show that treatment provinces in each pilot region were comparable to the comparison provinces. First, I regress provincial economic indicators, such as population, number of firms, number of manufacturing firms, employment-population ratio, and manufacturing labor share on dummies for treatment provinces and pilot regions. None of the estimated coefficients on the treatment province indicators both in 1937 and in 1951 is significantly different from zero, indicating that treatment provinces look similar to the comparison ones in the same region (online Appendix Table A.2, panels A and B, columns 1–5).[17] I also show that the growth rate of population, number of firms, and number of manufacturing firms (the only three variables available in both the 1937 and the 1951 censuses) was not significantly different from zero in the treatment provinces (online Appendix Table A.3).

Two of the goals of the Marshall Plan were to help Europe recover from World War II and prevent the spread of Communism (Hogan 1987). I therefore show that damages caused by World War II, percentage of ERP aid received between 1948 and 1952, and percentage of firms that participated in the 1948 communist strikes, were not different in the treatment provinces (online Appendix Table A.2, panel A, columns 6–8).

Second, I perform an ANOVA test for mean equality both between treated and comparison provinces, and between each pilot region and the corresponding treatment province. None of these tests indicate significant differences (online Appendix Table A.4).

[15] Firms in comparison group never got treated. In order to follow comparison firms from 5 years before to 15 years after the program in estimating equation (1), I assign them a "treatment year" based on their application's submission date. More details about this can be found in online Appendix D.1.

[16] A potential problem with difference-in-differences estimation is that, in the presence of serial correlation in the dependent variable, standard errors may be underestimated even with clustering. Block bootstrap, which maintains the autocorrelation structure within groups by keeping observations that belong to the same group together in a "block," has been shown to perform best (Bertrand, Duflo, and Mullainathan 2004). Applied to this specific case, the block bootstrap maintains the structure of autocorrelations within provinces, as it samples provinces instead of observations.

[17] Panel B of online Appendix A.2 shows that treatment provinces were comparable to other provinces in each pilot region before World War II. If it would have not been the case, differential firm outcomes in the postwar period might have reflected not only effects of the Productivity Program, but also provinces' return to their prewar levels of development. 1937 is the last prewar year for which data are available.

Table 2—Verifying Balance in Terms of Firm Characteristics and Outcomes in Treatment versus Comparison Provinces

	Management			Technology		
	Treatment provinces			Treatment provinces		
	Yes (1)	No (2)	Difference (3)	Yes (4)	No (5)	Difference (6)
Plants per firm	1.17	1.28	−0.122	1.32	1.50	−0.17
	(1.21)	(1.25)	(0.245)	(1.29)	(1.31)	(0.298)
Employees per firm	37.06	42.52	−5.89	57.66	61.20	−3.67
	(39.87)	(40.63)	(15.69)	(44.65)	(46.54)	(12.33)
Current assets (k USD)	1,943.21	1,894.39	47.39	1,497.58	1,581.78	−98.58
	(2,678.91)	(2,741.57)	(98.74)	(2,453.12)	(2,333.94)	(156.01)
Annual sales (k USD)	946.71	915.69	30.92	958.43	954.67	3.45
	(1,672.39)	(1,655.78)	(78.95)	(1,709.43)	(1,679.19)	(4.94)
Value added (k USD)	499.39	513.22	−14.56	567.11	563.36	3.94
	(643.12)	(657.90)	(21.92)	(601.23)	(610.89)	(5.69)
Age	10.21	11.17	−1.01	14.69	16.11	−1.56
	(6.89)	(7.03)	(2.45)	(8.91)	(9.68)	(3.45)
Productivity (log TFPR)	2.63	2.70	−0.07	2.55	2.58	−0.05
	(0.47)	(0.45)	(0.22)	(0.61)	(0.59)	(0.12)
Export	0.14	0.13	0.01	0.11	0.12	−0.01
	(0.34)	(0.34)	(0.04)	(0.32)	(0.32)	(0.03)
Family-managed	0.25	0.25	0.02	0.35	0.33	−0.03
	(0.44)	(0.43)	(0.05)	(0.43)	(0.47)	(0.06)
Submit application	0.11	0.14	−0.03	0.18	0.20	−0.02
	(0.32)	(0.34)	(0.04)	(0.39)	(0.40)	(0.05)
Observations	146	658	804	233	945	1,178

(*Continued*)

B. *Were Firms in Treated and Comparison Provinces Observationally Equivalent?*

I test directly whether firms in treated and comparison provinces that applied for the same US transfer were statistically indistinguishable in terms of their observed characteristics and outcomes in 1951, before the treatment provinces were selected. I estimate a cross-sectional regression, separately for each US transfer, in which I regress firm characteristics and outcomes in 1951 on an indicator for firms located in treatment provinces and a full set of pilot region fixed effects. None of the twenty-seven estimated coefficients on the treatment provinces indicator are statistically significant (Table 2, columns 3, 6, 9). I conclude that these groups of firms were statistically indistinguishable on observables before the Productivity Program.

C. *Were Firms in Treated and Comparison Provinces on the Same Trend before the Productivity Program?*

I use pre-Productivity Program data from 1946 to 1951 to estimate differential time trends in outcomes for firms in treated and comparison provinces. I first estimate a constant linear time trend model that allows for an interaction of the constant linear trend with an indicator for firms located in treatment provinces.

TABLE 2—VERIFYING BALANCE IN TERMS OF FIRM CHARACTERISTICS AND OUTCOMES IN TREATMENT VERSUS COMPARISON PROVINCES (*Continued*)

	Combined		
	Treatment provinces		
	Yes (7)	No (8)	Difference (9)
Plants per firm	1.56	1.66	−0.12
	(1.45)	(1.55)	(0.301)
Employees per firm	69.26	66.30	2.33
	(47.85)	(49.82)	(8.76)
Current assets (k USD)	2,037.45	1,920.07	115.34
	(2,671.82)	(2,891.01)	(167.23)
Annual sales (k USD)	1,263.07	1,316.72	−55.61
	(1,908.45)	(1,782.33)	(89.13)
Value added (k USD)	617.31	645.02	−25.49
	(701.56)	(764.90)	(38.21)
Age	11.35	9.51	1.81
	(7.89)	(8.03)	(4.55)
Productivity (log TFPR)	2.67	2.74	−0.06
	(0.88)	(0.93)	(0.56)
Export	0.14	0.14	0.01
	(0.34)	(0.35)	(0.08)
Family-managed	0.22	0.29	−0.09
	(0.41)	(0.45)	(0.11)
Submit application	0.30	0.26	0.05
	(0.46)	(0.44)	(0.08)
Observations	386	1,226	1,612

Notes: Balancing tests for 804 firms that applied for management transfer (columns 1–3), 1,178 firms that applied for technology transfer (columns 4–6), and 1,612 firms that applied for the combined management and technology transfers (columns 7–9). Thirty firms whose applications were rejected are excluded. Data are provided at the firm level. Columns 1–2, 4–5, and 7–8 present mean and standard deviation (in parentheses) of characteristics and outcomes for firms in treatment and comparison provinces, separately for the management transfer, the technology transfer, and the combined management and technology transfers. Columns 3, 6, and 9 report the coefficients estimated from regressing each variable on a dummy for being located in a treatment province and a full set of pilot region fixed effects. Lombardia is the excluded pilot region. Standard errors are block-bootstrapped at the province level with 200 replications. *Plants per firm* reports the total number of plants per firm; *Employees per firm* reports the number of employees per firm; *Current assets*, *Annual sales*, and *Value added* are in 2010 USD, reevaluated from 1951 to 2010 values at 1 lira = 30.884 euros and exchanged at 0.780 euro = USD 1; *Age* counts since how many years a firm entered the market; *Productivity* (*log TFPR*) is the logarithm of total factor productivity revenue, estimated using the Ackerberg, Caves and Frazer (2006) method; *Export* and *Family-managed* are indicators that equal one if, respectively, a firm exported and was family-managed; *Submit application* is an indicator for eligible firms that applied for that given type of US transfer.

The estimates from this model suggest that, for each US transfer, there is a positive time trend in firm employment, assets, sales, and productivity (online Appendix Table A.5). These results are consistent with the Italian recovery from World War II (Lombardo 2001). However, the estimated coefficients on the interaction term are very close to zero and not significant (online Appendix Table A.5). Moreover, the estimated coefficient on the treatment provinces indicator is not statistically different from zero in all the specifications, confirming the results from the balancing tests presented in Table 2. Estimating a separate time trend for each of the five regions and treatment provinces confirms that there are no significant differences (online Appendix Table A.6).

Second, I estimate a model in which I replace the linear time trend variable with a full series of year dummies and interactions of each year dummy with an indicator for firms in treatment provinces. The estimated coefficients on the interaction terms are small in magnitude, and never significantly different from zero (online Appendix Table A.7). Moreover, some are positive and others are negative, confirming the lack of any consistent pattern. Finally, the *F*-statistics, reported at the bottom of each panel, show that I cannot reject the null hypothesis that the interaction terms are jointly equal to zero (online Appendix Table A.7). The results do not change if I estimate a treatment province's yearly time trends (online Appendix Table A.8). These findings suggest that firms that applied for any transfer in treated and comparison provinces were on a similar time trend in the six years before the Productivity Program.

IV. Effects of the Productivity Program

In this section, I examine the effects of the Productivity Program on firm survival, sales, employment, and productivity, the complementary effects between management and technology, heterogeneous effects, and effects on exports and imports.

A. *Extensive Margin: Firm Survival*

Firms that participated in the Productivity Program were more likely to survive than firms that applied but were excluded because of the budget cut. I analyze the effects of the program on firm survival by estimating the Kaplan-Meier survival function for firms in treated and comparison provinces over three different samples: firms that applied for the management transfer, firms that applied for technology transfer, and firms that applied for combined management and technology transfers before the budget cut. Figure 3, panels A through C illustrate such curves. The *x*-axis reports years after US intervention, and the *y*-axis reports the estimated survival probability, $\hat{S}(t)$, calculated according to the formula $\hat{S}(t) = \prod_{t_\tau \leq t} \left(1 - \frac{d_\tau}{n_\tau}\right)$ where n_τ is the number of firms that survived until time τ and d_τ is the number of firms that closed down at time τ.[18]

The survival probability of firms in treatment provinces is higher than that of firms in comparison provinces, and the difference increases over time. In the three years after the program—which corresponds to the monitoring period in which US experts visited participating firms in Italy—no firms in treatment provinces exited the market, and the estimated survival probability of firms in comparison provinces was over 96 percent. Survival rates diverge over time, however; after 15 years the estimated survival probability for firms in treatment provinces is between 88.5 percent and 93.9 percent, while it drops to between 67.6 percent and 69.1 percent for firms in comparison provinces.[19] This difference is mostly driven by the low

[18] I consider that a firm exited the market at time t if the balance sheet at time $t+1$ includes a liquidation form: meaning, that the firm closed down. I do not find evidence of firms that exited the market because they were acquired.

[19] In all the samples, the log-rank test, stratified by pilot region, rejects the null hypothesis of equality between the empirical survivor functions of the two groups. The estimation of the corresponding Cox survival model is reported in online Appendix Table A.12.

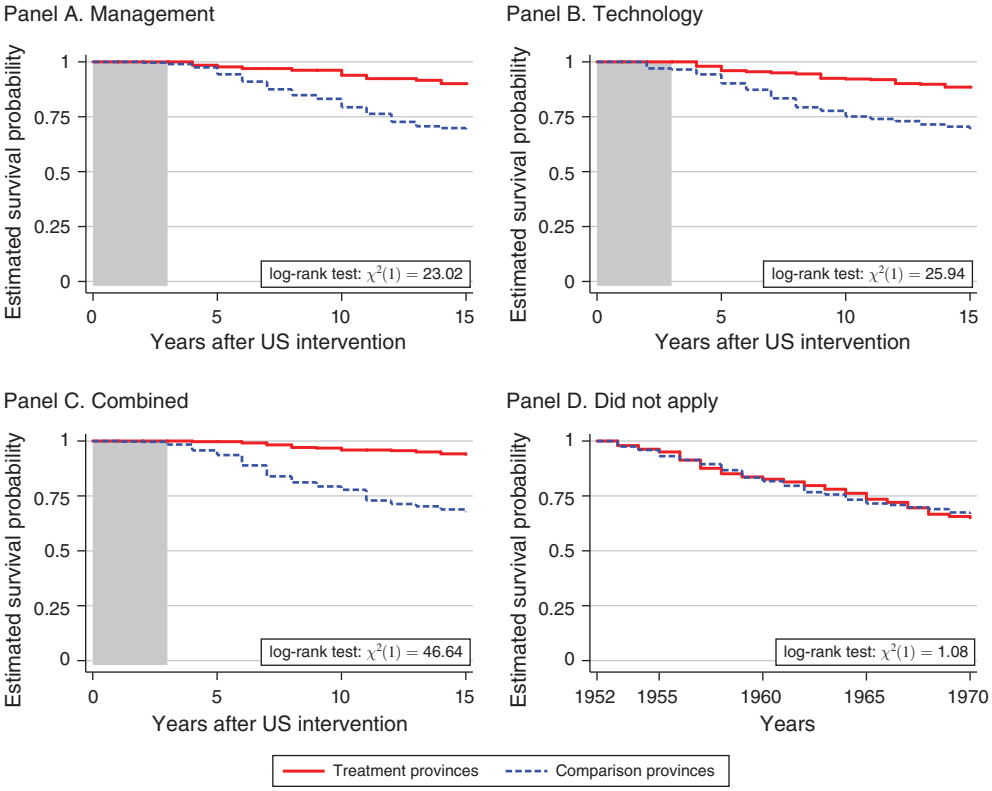

FIGURE 3. EFFECTS OF THE PRODUCTIVITY PROGRAM ON FIRM SURVIVAL

Notes. Kaplan-Meier survivor function for 731 firms that applied for management transfer (panel A), 1,052 firms that applied for technology transfer (panel B), 1,468 firms that applied for the combined management and technology transfers (panel C), and 2,441 firms that did not apply for the Productivity Program (panel D). The sample is restricted to firms that survived until the intervention year. In each panel, the Kaplan-Meier survivor function is estimated separately for firms in treatment and comparison provinces. Data are provided at firm level. The gray shaded area corresponds to the three-year follow-up period after US intervention. Log-rank test, stratified by pilot regions, of the null hypothesis of equality of survival functions between the two groups is reported.

shutdown probability of firms in treatment provinces, while the survival rate of firms in comparison provinces is comparable to that of firms that were eligible to participate in the program but did not apply (65 percent after 15 years, Figure 3, panel D).[20] Thus the program reduced the failure rate of the treated firms.

The differences in survival between treated and comparison firms persisted until today. I matched firms that applied for the Productivity Program in 1951 with Italian firms in the Amadeus database between 2010 and 2013, using their names and headquarters' address. I find that 15.1 percent of firms that got the management transfer and 12.3 percent of firms that got the combined management and technology transfers between 1952 and 1958 were still on the market between 2010 and 2013,

[20] A survival rate of 65 percent after 15 years is higher than the average survival rate of Italian manufacturing firms in 1951 (50 percent after 5 years, ISTAT 1986). The reason is that firms eligible to participate in the Productivity Program were larger (48 employees on average) than other manufacturing firms (6 employees on average, according to the 1951 Census).

compared to 2.1 percent and 2.5 percent of firms that applied for the same intervention but did not get it because of the budget cut. In all, 5.5 percent of firms that received new machines survived until 2013, compared to 1.9 percent of firms that applied for but did not receive this transfer.

B. *Intensive Margin: Sales, Employment, TFPR*

The results of equation (1), estimated on firms that survived in the 15 years after the Productivity Program, indicate the effects of the management transfer and the combined management and technology transfers were large and continued to grow for the 15 years after the program, while the effects of technology transfer reached a plateau after ten years. Since equation (1) is run only on the subsample of firms that applied for the program, the estimated treatment effect could be interpreted as an upper bound.

Sales of companies in treatment provinces that applied for the management or the combined management and technology transfers increased by 6.1 percent and 9.4 percent, respectively, one year after the intervention, compared to firms in comparison provinces that applied for the same transfer (Table 3, panel A, column 1).[21] These differences continued to increase significantly over time and, after 15 years, amounted to 39.9 percent and 57.6 percent, respectively (Table 3, panel A, column 1). Sales of firms that applied for the technology transfer also rose, but the gains took time to materialize and did not continue to grow over time. The cumulative gain after 15 years was 7.1 percent, but the impact was no longer significantly increasing after ten years (Table 3, panel B, column 1).

Employment did not immediately respond to the intervention, but, in all three samples, the number of employees rose within 5 years after the start of the program. While the estimated difference significantly increased over time for firms that applied for the management or the combined management and technology transfers, the effects after 10 and 15 years flattened out for the technology transfer (Table 3, panels A through C, column 5).

TFPR of firms that got the management or the combined management and technology transfers went up by 15.0 percent and 21.7 percent, respectively, within 1 year since the intervention, compared to firms in comparison provinces (Figure 4, panels A and C). The difference in TFPR between the two groups of firms constantly increased and, after 15 years, it amounted to 49.3 percent and 86.3 percent, respectively. After the Productivity Program implementation, TFPR for firms that applied for the technology transfer was on an upward trend, becoming statistically significant after five years. The cumulative effects after ten years amounted to 11.5 percent, and then flattened out (Figure 4, panel B).[22]

[21] Note that the dependent variables are estimated in logs, so that the percentage variation is $6.1 = [\exp(0.059) - 1] \times 100$ and $9.4 = [\exp(0.090) - 1] \times 100$.

[22] The DID approach does not allow capturing the growth rate of firms that did not participate in the Productivity Program. The 1950s and the 1960s were decades of sustained economic growth for Italy, especially in the manufacturing sector (Felice and Vecchi 2015). In online Appendix Table A.13, I report the growth rates of eligible firms that did not receive the US transfers and the growth rate of the Italian economy between 1950 and 1970. These rates are roughly comparable, which indicates that the firms that did not participate in the program were, nevertheless, growing in the Italian boom years.

TABLE 3—EFFECTS OF THE PRODUCTIVITY PROGRAM ON SALES, EMPLOYMENT, AND TFPR

	log sales				log employees				log TFPR			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A. Management												
Year 1 after PP	0.059	0.057	0.063	0.055	0.008	0.007	0.011	0.007	0.140	0.099	0.109	0.135
	(0.015)	(0.012)	(0.011)	(0.009)	(0.008)	(0.005)	(0.007)	(0.006)	(0.027)	(0.028)	(0.037)	(0.032)
Year 5 after PP	0.110	0.099	0.122	0.099	0.063	0.060	0.076	0.059	0.208	0.154	0.194	0.197
	(0.027)	(0.025)	(0.037)	(0.030)	(0.018)	(0.017)	(0.024)	(0.015)	(0.045)	(0.040)	(0.049)	(0.038)
Year 10 after PP	0.194	0.155	0.215	0.179	0.201	0.189	0.246	0.188	0.291	0.223	0.298	0.276
	(0.041)	(0.039)	(0.055)	(0.037)	(0.031)	(0.038)	(0.054)	(0.035)	(0.054)	(0.053)	(0.058)	(0.051)
Year 15 after PP	0.336	0.289	0.376	0.325	0.300	0.281	0.344	0.287	0.401	0.281	0.373	0.378
	(0.059)	(0.056)	(0.071)	(0.055)	(0.045)	(0.047)	(0.081)	(0.049)	(0.064)	(0.067)	(0.099)	(0.065)
Observations	11,298	13,902	13,902	11,298	11,298	13,902	13,902	11,298	11,298	13,902	13,902	11,298
Number of firms	538	731	731	538	538	731	731	538	538	731	731	538
Panel B. Technology												
Year 1 after PP	0.007	0.006	0.008	0.006	0.015	0.009	0.019	0.013	0.020	0.017	0.023	0.018
	(0.006)	(0.005)	(0.006)	(0.005)	(0.011)	(0.012)	(0.015)	(0.009)	(0.015)	(0.017)	(0.023)	(0.015)
Year 5 after PP	0.042	0.038	0.048	0.037	0.037	0.033	0.052	0.032	0.075	0.069	0.081	0.067
	(0.015)	(0.013)	(0.017)	(0.012)	(0.012)	(0.011)	(0.022)	(0.011)	(0.017)	(0.013)	(0.015)	(0.013)
Year 10 after PP	0.070	0.059	0.084	0.063	0.079	0.068	0.089	0.069	0.109	0.096	0.123	0.100
	(0.031)	(0.026)	(0.045)	(0.028)	(0.039)	(0.029)	(0.042)	(0.032)	(0.047)	(0.041)	(0.055)	(0.042)
Year 15 after PP	0.069	0.056	0.083	0.062	0.078	0.064	0.088	0.065	0.107	0.093	0.120	0.098
	(0.032)	(0.031)	(0.044)	(0.035)	(0.035)	(0.030)	(0.042)	(0.031)	(0.048)	(0.046)	(0.056)	(0.041)
Observations	15,708	20,213	20,213	15,708	15,708	20,213	20,213	15,708	15,708	20,213	20,213	15,708
Number of firms	748	1,053	1,053	748	748	1,053	1,053	748	748	1,053	1,053	748
Panel C. Combined												
Year 1 after PP	0.090	0.087	0.094	0.088	0.040	0.037	0.044	0.036	0.196	0.191	0.200	0.193
	(0.025)	(0.023)	(0.018)	(0.017)	(0.010)	(0.008)	(0.014)	(0.010)	(0.028)	(0.025)	(0.037)	(0.029)
Year 5 after PP	0.247	0.236	0.271	0.241	0.175	0.166	0.197	0.169	0.333	0.312	0.351	0.327
	(0.037)	(0.034)	(0.045)	(0.032)	(0.038)	(0.035)	(0.059)	(0.034)	(0.045)	(0.041)	(0.055)	(0.047)
Year 10 after PP	0.300	0.280	0.369	0.292	0.362	0.340	0.399	0.341	0.471	0.433	0.508	0.454
	(0.054)	(0.059)	(0.069)	(0.057)	(0.045)	(0.042)	(0.068)	(0.048)	(0.062)	(0.063)	(0.081)	(0.064)
Year 15 after PP	0.455	0.425	0.502	0.445	0.497	0.451	0.541	0.481	0.622	0.595	0.668	0.609
	(0.069)	(0.065)	(0.081)	(0.061)	(0.063)	(0.069)	(0.082)	(0.064)	(0.066)	(0.063)	(0.089)	(0.061)
Observations	22,722	27,870	27,870	22,722	22,722	27,870	27,870	22,722	22,722	27,870	27,870	22,722
Number of firms	1,082	1,468	1,468	1,082	1,082	1,468	1,468	1,082	1,082	1,468	1,468	1,082
Sample	Bal.	Bounds	Unbal..	Matched	Bal.	Bounds	Unbal..	Matched	Bal.	Bounds	Unbal..	Matched
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns 1, 5, and 9 report selected coefficients estimated from equation (1) for firms that applied for management transfer (panel A), firms that applied for technology transfer (panel B), and firms that applied for the combined management and technology transfers (panel C) and survived for 15 years after the Productivity Program. Columns 2, 6, and 10 report the Lee's (2009) tightened lower bounds. Columns 3, 7, and 11 report the coefficients estimated from equation (1) on the unbalanced panel (i.e., including rms that exited the market over time) from 5 years before to 15 years after the Productivity Program. If a firm exits the market in year t, missing values are imputed for the dependent variables starting on year $t + 1$. Columns 4, 8, and 12 report coecients estimated from equation (2), re-weighting each observation by the inverse of its propensity score. The omitted coefficient is $\delta_{\tau=-1}$, which corresponds to the year before the treatment. Data are provided at the firm level. The dependent variables are logged deflated *Sales*, converted from 1951 Italian lira to 2010 euro and exchanged at 0.780 euro = USD 1 (columns 1–4); logged *Employment*, reporting the number of employees per firm (columns 5–8); and logged *TFPR*, estimated using the Ackerberg, Caves, and Frazer (2006) method (columns 9–12). Standard errors are block-bootstrapped at the province level with 200 replications.

The results presented above are estimated on firms that survived in the 15 years after the Productivity Program. Since the differential survival probability between firms in treated and comparison provinces is likely to be nonrandom, I compute

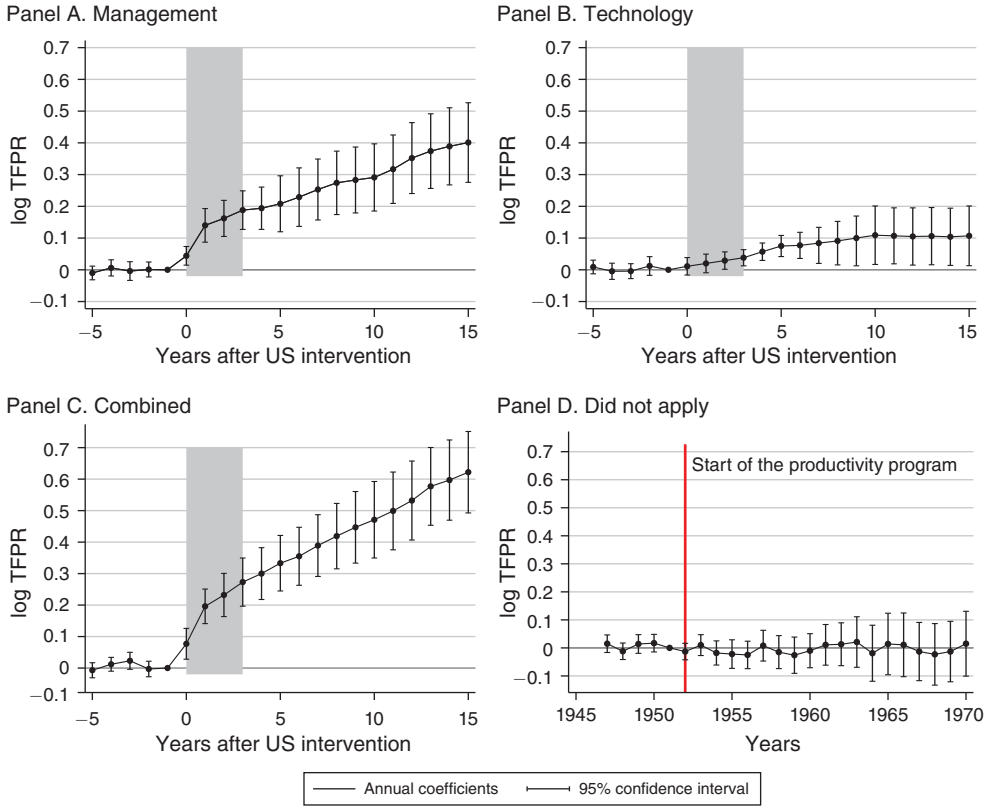

FIGURE 4. EFFECTS OF THE PRODUCTIVITY PROGRAM ON FIRM TFPR

Notes. Coefficients estimated from equation (1) for 538 firms that applied for management transfer (panel A), 748 firms that applied for technology transfer (panel B), 1,082 firms that applied for the combined management and technology transfers (panel C), and 1,621 firms that did not apply for the Productivity Program and survived in the 15 years after it. Data are provided at the firm level. The US intervention year is normalized to zero, and the gray shaded area corresponds to the three-year follow-up period in panels A–C. In panel D, the vertical line denotes the start of the Productivity Program (1952). The dependent variable, log TFPR, is total factor productivity revenue, estimated using the Ackerberg, Caves, and Frazer (2006) method. Standard errors are block-bootstrapped at the province level with 200 replications.

the Lee's (2009) tightened bounds.[23] This approach consists of obtaining the same share of observations in treated and comparison provinces, by trimming the "excess observations" in treatment provinces. The lower bound trims the largest values of the outcome variable, while the upper bound trims the smallest values. Lee's (2009) lower bounds, which are the most relevant for this context, follow the same pattern as the baseline estimates (Table 3, panels A through C, columns 2, 6, and 10). However, they are smaller in magnitude, since they trim the largest outcome values of the treated firms.

[23] I tighten the Lee's (2009) bounds by sales, assets, TFP, sector, pilot region, ownership, and export indicators. The identifying assumption is monotonicity: some firms would have attrited had they not been assigned to treatment provinces, but that no firm attrits as a result of being assigned to treatment provinces. This assumption seems plausible in the examined research design.

Estimates on the unbalanced panel (i.e., including firms that exited the market over time) are larger than the baseline estimates, consistent with the idea that firms in comparison provinces that survived in the 15 years after the program without participating in it were better than firms that failed. These results have a similar magnitude of the Lee's (2009) upper bounds (online Appendix Table A.14). The fact that keeping in the sample firms that failed and trimming the smallest outcome values of the treated firms leads to similar results suggests that the baseline estimates are, if anything, downward biased.

My findings indicate that the management transfer had large, persistent effects on firm performance. To the best of my knowledge, this is the first paper to provide a long-term analysis, but the magnitude of the short-run results is comparable or smaller to other findings in the literature. For instance, Bloom et al. (2013) document a 9 percent increase in sales and a 17 percent increase in output TFP one year after offering management consulting to large Indian firms. In a follow-up survey on the same firms, Bloom et al. (2017) still find a significant performance gap between treatment and control plants eight years after the experiment.[24] My results are smaller than those of Bruhn, Karlan, and Schoar (2017), which estimate a 26 percent increase in TFP within one year in response to managerial consulting offered to 432 small Mexican enterprises, and a 70 percent growth in sales and a 44 percent increase in employment within five years. They are also smaller than the estimates in Cai and Szeidl (2017), which find a 10.3 percent increase in sales and a 5 percent increase in employment one year upon creating business associations for the owner-managers of 2,820 young Chinese small firms.

C. *Complementarity between Management and Technology*

Did the simultaneous adoption of US management practices and the purchase of technologically advanced US machines have complementary effects on firm performance? I find that the performance of firms that received the combined management and technology transfers increased significantly more than the sum of the single transfers. This suggests complementarity between management and technology.

Since firms chose the transfer they wanted to receive, it is likely that businesses that chose the management transfer were different from companies that chose the technology or the combined management and technology transfers. I compare the effects of the different US interventions, with the inverse probability of treatment weighting (IPTW) method, using the propensity score. First, I compute firm propensity score as the probability of choosing a US intervention given the following covariates: size, assets, sales, productivity, exports, and family ownership in 1951. Second, I re-weight each observation by the inverse of its propensity score to create a synthetic sample in which the distribution of these covariates is independent of the US intervention chosen, and estimate

$$(2)\quad outcome_{it} = \alpha_i + \nu_t + \sum_{j=1}^{3}\sum_{\tau=-5}^{15} \delta_{j,\tau}(Trans_i^j \cdot Treat_i \cdot (Years\ After\ Treat = \tau)) + \epsilon_{it},$$

[24] In this case, however, the gap is not increasing over time. A possible reason for this difference could be that the "amplification" mechanisms I examine in Section V, such as the shift from family management to professional management and access to credit, are likely to be less important for large firms.

where $Trans_i^j$ is an indicator for firms that applied for management transfer for $j = 1$, for technology transfer for $j = 2$, and for combined management and technology transfers for $j = 3$, and the other variables are as defined for equation (1). More details about the IPTW are included in online Appendix D.5. The complementary effect τ years after the US intervention is captured by $\delta_{COMBINED} - (\delta_{MANAGEMENT} + \delta_{TECHNOLOGY})$.

Management and technology were complementary. In each year after the Productivity Program, sales, employment, and productivity of firms that received the combined management and technology transfers were statistically significantly higher than the sum of the single management or the single technology transfers (online Appendix Table A.15). For instance, after 15 years, the additional growth was 5.1 percent in sales,[25] 12.6 percent in employment, and 12.1 percent in TFPR (Table 3).

D. *Allowing for Heterogeneous Effects*

I first examine heterogeneous effects by firm productivity level before the Productivity Program compared to the Italian industry average. The effects of the management and the combined management and technology transfers were significantly larger for firms with lower productivity (online Appendix Table A.16), which suggests that these transfers helped less productive Italian firms to catch up with the others. However, the effects of the program were also large and increasing over time for relatively more productive firms. By contrast, for the technology transfer alone, the results are largely driven by companies that were ex ante more productive. These firms significantly improved their performance even in the short-run, which suggests that firms lagging behind might not have been able to take full advantage of technologically advanced machines.

Second, I investigate whether the Productivity Program effects differ by firm size. For firms that received the management or the combined management and technology transfers, larger firms (with 50 or more employees) experienced a larger increase in sales, employment, and TFPR one year after the US intervention (online Appendix Table A.17, panels A and C). This finding may indicate that smaller firms faced higher adjustment costs in introducing new management practices (Bloom, Sadun, and Reenen 2016). However, in the long run, these costs faded out and the impact of the program was relatively larger for companies with fewer than 50 employees. In contrast, the impact of the technology transfer, both in the short run and the long run, was greater for larger firms. Those firms were more similar in size to US firms employing technologically advanced machines before the program (online Appendix Table A.17, panel B).

Did local economic conditions affect the results of the Productivity Program? Looking at firm geographical location, for all three transfers, the effects of the Productivity Program are larger in northern Italy (Lombardia and Veneto) than in the rest of the country (online Appendix Table A.18, panels A through C). However, it is worth noting that the results for central and southern Italy follow the same pattern as the main specification. Allowing heterogeneous effects by industry growth

[25] $5.1 = \exp[(0.455 - (0.336 + 0.069)) - 1] \times 100$.

rate leads to similar results. Firms operating in industries with higher growth rates increased their performance more, but the effects of the program are large also on firms operating in lower growth rate industries. This suggests that local economic conditions are not entirely driving the results, though the Productivity Program might have interacted with them (online Appendix Table A.19, panels A through C).

Finally, I find few heterogeneous effects by looking at the calendar year in which firms participated in the Productivity Program (online Appendix Table A.20, panels A through C).

E. *Exports and Imports*

Firms that eventually participated in the Productivity Program were systematically more likely to engage in exporting. In 1951, only 13 percent of applicant firms were exporters. The estimates of a linear probability model indicate that firms that received the management or the combined management and technology transfers were, respectively, 2.4 percent and 3.3 percent more likely to be exporters one year after the intervention and 29.0 percent and 31.5 percent more likely after 15 years. Firms that received the technology transfer were 1.3 percent more likely to be exporters one year after the intervention and 5.1 percent after 15 years (online Appendix Table A.21).

Conditional on being exporters in 1951, firms that sent their managers to the United States had higher export revenues. Firms that received the management or the combined management and technology transfers had 1.5 percent and 4.6 percent higher export volumes one year after the intervention and 16.8 percent and 21.0 percent after 15 years. By contrast, the increase in exports of firms that received the technology transfer is not significant.

Firms that received the management or the combined management and technology transfers were more likely to become importers. Conditional on being importers in 1951, those firms increased the ratio of imports to inputs, which may suggest that better managed firms sourced higher quality inputs.

These results indicate that better managed firms have better export performance (Bloom, Manova, and Van Reenen 2016), but that the effects are not driven simply by exposure to the United States.

To exclude that the export channel is driving all the long-run results, I re-estimate equation (1) on the sample to firms that did not start exporting in any of the 15 years after the Productivity Program. My reported estimates are smaller in magnitude than those attained using the full sample, but they follow the same pattern over time (online Appendix Table A.22). Although exports are correlated with improved firm performance, they do not completely explain my findings.

V. Mechanisms

In this section, I examine potential mechanisms of why the management transfer had a large and persistent effect on firm performance, while the technology transfer did not. I first study what changed within treated firms after they received the managerial training. I then analyze possible amplification effects through changes in firm organization and access to the credit market.

A. *Implementation of the Productivity Program Contents*

What changed in the firms that received the US managerial training? I examine which contents of the Productivity Program were implemented by those companies, by combining quantitative evidence from firm balance sheets with qualitative evidence from technical reports compiled by US experts who visited the treated firms in the three years after the program.

Firms report expenditures in worker training and marketing on their balance sheets, so this information is available for both the treatment and the comparison groups. Before the start of the Productivity Program, fewer than 6 percent of firms were reporting either of these managerial practices on their balance sheets (online Appendix Figure A.3). For treated firms that got the management or the combined management and technology transfers, this percentage jumped to more than 70 percent one year after the program and to more than 95 percent three years after. Moreover, the percentage does not decrease in the following years, suggesting that these firms retained the practices even after the end of the US monitoring. For comparison firms, that percentage remains almost unchanged during the same period (online Appendix Figure A.3, panels A, B, E, and F). By contrast, for treated firms that got the technology transfer, there is almost no change in the percentage (online Appendix Figure A.3, panels C and D). This indicates that the simple exposure to US production methods did not affect firm "managerial capital" without proper training.

I investigate the content of the practices implemented by firms using qualitative evidence from technical reports compiled by US experts who visited the treated firms in the three years after the program. Although these data are available only for firms that eventually participated in the program, it offers some insight on what changed within the firms. The technical reports indicate that 65 percent of the firms that received the management or the combined management and technology transfers started performing routine maintenance on their machinery and 71 percent began instituting safety conditions within one year. After three years, these percentages rose to 87 percent and 92 percent, respectively (online Appendix Table A.23). As a result, downtime to repair machines dropped by 22.3 percent, and 28.5 percent fewer job-related injuries were reported over the same period. More than 95 percent of the firms started tracking their production and managing sales and orders. Further, 73 percent of businesses that received the management transfer and 75 percent of those that received the combined management and technology transfers implemented human resources training and marketing expenditures in their balance sheets within one year of the program. These percentages increased to 95 percent and 97 percent, respectively, within three years. Human resource training included training for leaders, implemented by 90 percent of treated firms, and training for the rest of the workers, implemented by more than 95 percent of treated firms; bonuses for the most productive workers were introduced by more than 85 percent of the treated firms. Marketing involved the organization of advertising campaigns, implemented by almost all treated firms, and the creation of an independent branding and marketing research group.

The simultaneous and relatively quick adoption of managerial practices by most treated firms does not allow a separate evaluation of the impact of each practice but is consistent with the large increase in sales and TFPR observed in the three years

after the program. For instance, factory operations decreased machine downtime and worker injuries, which likely had a rapid impact on firm productivity. Similarly, production planning could have reduced inventory, and therefore increased productivity by decreasing capital. Finally, advertising campaigns could at least, in part, explain the large, rapid sales growth.

It is reasonable to think that the effects of other practices materialized over the years. For example, it likely took some time to train all the workers and enable them to use their new knowledge in the production process. Similarly, market research and branding are likely to have produced effects in the longer run. These techniques, regularly performed even after the program ended, could have had a cumulative effect over time and instigated a continuous cycle of improvement (Womack, Jones, and Roos 1990; Liker 2004), which can explain why firm performance continued to improve in the 15 years after the program.

B. *Firm Organization*

Companies that participated in the program also made changes to their organization in response to the Productivity Program and their improved performance. In turn, such changes likely amplified the initial effects of the program. To capture these effects, I estimate equation (1), using the following as dependent variables: firm's number of plants, the manager-to-worker ratio, and an indicator for professionally managed firms (i.e., businesses with no family representative or kin formally involved in their governance).

Over time, firms that received the management transfer or the combined management and technology transfers gradually increased their number of plants, with a cumulative rise of 13.0 percent and 18.8 percent, respectively, in 15 years. The rise in plants is determined by the increased firm size, measured by the number of employees, which also materialized over time (Table 4, panels A and C, column 1). More employees and more plants require more managerial supervision. Treated firms increased not only the number of managers, but also their manager-to-worker ratio (Table 4, panels A and C, column 2). A higher manager-to-worker ratio may have ensured better workers and plant organization, with consequent productivity gains. Finally, firms that received the management or the combined management and technology transfers were more likely to become professionally managed businesses (Table 4, panels A and C, column 3). The shift from family to professional management may have affected firm capital structure, investment strategy, and overall business planning. Bertrand and Schoar (2003) show that individual managers are central in making these decisions. Finally, better managed firms paid higher average wages to their workers, which may indicate that trained managers were able to hire/retain better workers (online Appendix Table A.24, panels A and C).

I do not find evidence of any changes in number of plants, manager-to-worker ratio, or probability of becoming professionally-managed for firms that received the technology transfer (Table 4, panel B, columns 1–3). This result is consistent with the evidence presented in Doms, Dunne, and Troske (1997), which shows that the adoption of new technologies is not associated with variation in firm workforce and organization. In my setting, however, I cannot distinguish between skilled and unskilled workers.

Table 4—Effects of the Productivity Program on Firm Organization and Capital

	Plants (1)	Mgmt./Work (2)	Governance (3)	Loans (4)	Investment (5)	ROA (6)
Panel A. Management						
Year 1 after PP	0.005	0.003	0.001	0.003	0.005	0.009
	(0.006)	(0.005)	(0.001)	(0.004)	(0.006)	(0.003)
Year 5 after PP	0.044	0.010	0.022	0.048	0.057	0.017
	(0.012)	(0.003)	(0.008)	(0.012)	(0.010)	(0.006)
Year 10 after PP	0.071	0.074	0.151	0.125	0.111	0.105
	(0.020)	(0.019)	(0.014)	(0.037)	(0.031)	(0.022)
Year 15 after PP	0.122	0.099	0.240	0.177	0.154	0.149
	(0.031)	(0.027)	(0.037)	(0.044)	(0.036)	(0.022)
Observations	11,298	11,298	11,298	11,298	11,298	11,298
Number of firms	538	538	538	538	538	538
Panel B. Technology						
Year 1 after PP	0.004	−0.013	0.010	0.110	0.099	0.004
	(0.005)	(0.019)	(0.013)	(0.030)	(0.017)	(0.002)
Year 5 after PP	0.003	0.012	−0.011	0.077	0.094	0.007
	(0.007)	(0.013)	(0.016)	(0.034)	(0.026)	(0.003)
Year 10 after PP	0.008	0.009	0.006	0.048	0.061	0.017
	(0.007)	(0.009)	(0.007)	(0.028)	(0.032)	(0.019)
Year 15 after PP	0.006	−0.013	−0.008	0.037	0.049	0.013
	(0.007)	(0.016)	(0.009)	(0.041)	(0.051)	(0.018)
Observations	15,708	15,708	15,708	15,708	15,708	15,708
Number of firms	748	748	748	748	748	748
Panel C. Combined						
Year 1 after PP	0.010	0.006	0.013	0.120	0.112	0.028
	(0.012)	(0.007)	(0.015)	(0.021)	(0.026)	(0.007)
Year 5 after PP	0.052	0.029	0.015	0.155	0.191	0.044
	(0.014)	(0.011)	(0.005)	(0.028)	(0.042)	(0.011)
Year 10 after PP	0.090	0.078	0.178	0.168	0.225	0.147
	(0.028)	(0.027)	(0.041)	(0.053)	(0.049)	(0.055)
Year 15 after PP	0.172	0.140	0.265	0.276	0.252	0.202
	(0.036)	(0.033)	(0.042)	(0.061)	(0.058)	(0.062)
Observations	22,722	22,722	22,722	22,722	22,722	22,722
Number of firms	1,082	1,082	1,082	1,082	1,082	1,082
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes. Columns 1–2 and 4–6 report the coefficients estimated from equation (1) for 538 firms that applied for management transfer (panel A), 748 firms that applied for technology transfer (panel B), and 1,082 firms that applied for the combined management and technology transfers (panel C) and that survived in the 15 years after the Productivity Program. Column 3 reports the coefficients estimated from the linear probability model (LPM) of equation (1) for the same samples of firms. Data are provided at the firm level. The dependent variables are logged *Plants*, reporting the number of plants per firm; logged *Mgmt./Work*, indicating the ratio of firm managers to workers; *Governance* is an indicator variable that equals one for firms that were professionally managed (i.e., businesses with no family representative or kin formally involved in their governance); logged *Loans*, reporting outstanding loans; logged *Investment*, reporting investment values; and logged *ROA*, return on assets, measured as the ratio between profit and capital. Standard errors are block-bootstrapped at the province level with 200 replications.

C. *Financing and Investment*

I test whether firms that participated in the Productivity Program changed their financing and investment behavior. To do so, I estimate equation (1), using the following as dependent variables: outstanding loans from banks, investment, and profitability, measured by firm return-on-assets (ROA).

In the short run, firms that received the management or the combined management and technology transfers did not increase bank loans and investment. However, in the longer run, as their performance continued to improve, these businesses took on bigger bank loans, increased their investments, and saw greater ROA compared to firms excluded by the budget cut (Table 4, panels A and C, columns 4 and 5). These changes happened even though such companies received no injection of capital from the program.

If access to credit was a "multiplier" mechanism for the long-run effects of the US management transfer, there may be some heterogeneous effects depending on the degree of local financial development. I measure local financial development by the number of province banks' branches, and I estimate heterogeneous effects separately for provinces with a number of branches above or below the median.[26] In the short run, high access to credit is not associated with better performance (online Appendix Table A.25, panels A and C). However, in the long run, firms located in provinces with high access to credit experienced much larger growth in sales, employment, and TFPR. The fact that the heterogeneous effects arise only in the long run suggests that the credit channel mattered only after firms improved their performance, and it likely amplified the initial effect of the program.

Firms that the received the technology transfer experienced an increase in loans and investment upon receiving the new American machines. However, in the long run, there is no additional increase in loans and investment, compared to nonparticipating firms (Table 4, panel B, columns 4 and 5). Moreover, ROA remained almost unchanged, indicating that these companies did not become more profitable. This evidence is consistent with the idea that capital alone cannot generate firm growth, but that "managerial capital" is needed (Bruhn, Karlan, and Schoar 2017). In fact, firms that got the technology transfer were not able to maintain their competitive advantage, once the life cycle of the new machines—estimated around ten years (Boel 2003)—ended. This is confirmed by the absence of heterogeneous effects from access to credit markets (online Appendix Table A.25, panel B).

VI. Indirect Effects of the Productivity Program

This section investigates whether the Productivity Program had indirect effects on nonparticipating firms, either because they did not apply or because they were excluded by the budget cut.

[26] Choosing the province as the "relevant" local market for access to credit is motivated by the fact that it is the unit used for antitrust purposes, as explained in Guiso, Sapienza, and Zingales (2004).

Table 5—Performance of Firms That Did Not Apply for the Productivity Program

	log sales		log employment		log TFPR	
	(1)	(2)	(3)	(4)	(5)	(6)
Year 1952	0.015	0.012	−0.011	−0.009	0.009	0.007
	(0.017)	(0.016)	(0.015)	(0.013)	(0.010)	(0.009)
Year 1955	0.018	0.016	0.022	0.019	−0.010	−0.007
	(0.014)	(0.012)	(0.021)	(0.019)	(0.017)	(0.014)
Year 1960	−0.003	−0.002	0.012	0.010	0.013	0.010
	(0.025)	(0.022)	(0.026)	(0.021)	(0.027)	(0.026)
Year 1965	−0.009	−0.006	−0.018	−0.016	0.015	0.012
	(0.031)	(0.029)	(0.033)	(0.038)	(0.035)	(0.033)
Year 1970	0.011	0.009	−0.011	−0.008	−0.016	−0.014
	(0.039)	(0.036)	(0.042)	(0.037)	(0.046)	(0.041)
Observations	49,830	42,146	49,830	42,146	49,830	42,146
Number of firms	2,441	1,621	2,441	1,621	2,441	1,621
Sample	Unbalanced	Balanced	Unbalanced	Balanced	Unbalanced	Balanced
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes. Coefficients estimated from equation 1 for firms that did not apply for the Productivity Program. In columns 1, 3, and 5, all firms are included; in columns 2, 4, and 6, the samples are restricted to firms that survived in the 15 years after the Productivity Program. Data are provided at the firm level. The dependent variables are logged deflated *Sales* converted from 1951 Italian lira to 2010 euro and exchanged at 0.780 euro = USD 1 (columns 1–3); logged *Employment*, reporting the number of employees per firm (columns 4–6); and logged *TFPR*, estimated using the Ackerberg, Caves, and Frazer (2006) method (columns 7–9). Standard errors are block-bootstrapped at the province level with 200 replications.

A. *Firms That Did Not Apply for the Productivity Program*

If firms in treatment provinces had performed better than firms in comparison provinces even in absence of the Productivity Program, firms that did not apply from such provinces should also have performed better than firms that did not apply from comparison provinces. Therefore, comparing eligible firms in treated and comparison provinces that did not apply for any interventions could be interpreted as a placebo test, under the assumption that the Productivity Program produced effects only on firms that participated in it.

I repeat the main analysis of the paper using as sample firms that did not apply for the Productivity Program in treated and comparison provinces. On the extensive margin, the Kaplan-Meier survival curves for these two groups of firms are similar and repeatedly overlap over time, suggesting the absence of a trend (Figure 3, panel D). The log-rank test fails to reject the null hypothesis of equality between the two curves. On the intensive margin, the estimates of one indicate that firms that did not apply for the Productivity Program in treatment provinces show no differential changes with respect to firms in comparison provinces in both the short run and the long run (Table 5). The full pattern of TFPR over time, illustrated in Figure 4, panel D, confirms the absence of different performance for firms that did not apply, both before and after the Productivity Program. Moreover, the estimated coefficients are positive in some years and negative in others, which further undermines the establishment of a pattern.

However, if the Productivity Program determined spillover effects, not finding differences in performance between such firms could also be due to a combination of positive and negative spillovers. I discuss possible spillover effects in Section VIB.

Why Didn't All Eligible Firms Apply?.—Forty percent of firms eligible to participate in the Productivity Program did not apply, although participation was financed entirely by the United States. Firms that did not apply for the Productivity Program differ from those that did. I examine the relationship between firm characteristics and self-selection into the Productivity Program by estimating the following multinomial logit model

$$\log\left(\frac{\Pr(Apply_i = j)}{\Pr(No\ Apply)}\right) = \alpha_j X_i + \beta_j Treat_p + \lambda_r + \zeta_s + \epsilon_i\,, \tag{3}$$

where the choice is to apply for the management transfer, to apply for the technology transfer, to apply for the combined management and technology transfers, or not to apply (my baseline); $Treat_p$ is an indicator for firms located in treatment provinces, λ_r is pilot region fixed effects, and ζ_s is manufacturing industry fixed effects; X_i is a vector of firm characteristics in 1951.

Larger firms, with higher sales and TFPR were more likely to apply for the Productivity Program, compared to firms that did not apply (online Appendix Table A.26). For instance, a 1 percent higher number of employees increased the probability of applying between 0.8 percent and 2.8 percent. Firms that were family-managed were between 15.1 percent and 17.6 percent less likely to apply. By contrast, being located in a treatment province does not affect the probability of applying.[27]

There are at least three explanations for the fact that "better" firms were more likely to apply for the program. First, smaller and less productive firms may not have realized they needed assistance, and therefore did not apply. Second, firms that were very far below the frontier may have thought that the Productivity Program would not lead to any improvement, given the differences between them and US companies. Firms that did not apply might have had liquidity constraints. Even though the program paid for the study trips, there was an opportunity cost in filling out the application and, later, for sending managers to the United States or for purchasing new machinery. Thus, even if the expected net present value of participating in Productivity Program was positive, firms may have decided not to apply.

B. *Spillover Effects*

The Productivity Program improved the performance of firms that received transfers. However, it might also have affected nonparticipating firms. For instance, firms that did not receive US transfers might have imitated receiving firms and started implementing modern management practices or buying new technologically advanced

[27] It seems unlikely that some firms did not apply because they were unaware of the Productivity Program. In fact, the US administration promoted a massive advertising campaign of the Productivity Program through a number of local institutions, including banks and Chambers of Commerce (ICA 1958).

machines. Participant firms might also have stolen business from nonparticipating firms, generating negative spillovers. In this setting, a complete spillover analysis is not possible, since I observe only firms that were eligible for participating in the Productivity Program. Nevertheless, I can offer some suggestive evidence on the program's indirect effects on nonparticipating firms.

Specifically, I assume that a nonparticipating firm located close to treated firms operating in the same manufacturing industry is likely to be exposed to negative spillovers through competition in input and output markets. A nonparticipating firm located close to treated firms operating in different manufacturing industries is relatively more likely to be exposed to positive spillovers: the absence of competition, at least in the output market, may have encouraged receiving firms to share their new knowledge.

I estimate the following equation using as sample all the firms in treatment provinces and in comparison provinces that did not receive US assistance (either because they did not apply or because they were excluded after the budget cut):

$$(4)\quad outcome_{it} = \alpha_i + \nu_t + \sum \mu_j Diff\ Ind_i^j \cdot Post_t + \sum_{j=1}^{3} \lambda_j Same\ Ind_i^j \cdot Post_t + \epsilon_{it}\,.$$

The term $Diff\ Ind_i^j$ is the count of firms that received the US transfer j (where $j = 1$ for management transfer; $j = 2$ for technology transfer; $j = 3$ for the combined management and technology transfers), operating in a different industry and located in the radius of x km from firm i, where x is 5, 10, or 20 km; $Same\ Ind_i$ is the count of firms that received the US transfer j, operating in the same industry and located in the radius of x km from firm i; $Post_t$ is an indicator variable that equals one for the years after these firms received the US transfer. The dependent variables are a shutdown indicator, sales, employees, and TFPR. The coefficients μ_j capture the effect of an additional firm within x km in a different industry that received the US transfer j on the outcome of nonparticipating firms. The coefficients λ_j capture the effect of an additional firm within x km in the same industry that received the US transfer j on the outcome of nonparticipating firms.

Having an additional firm within 5, 10, or 20 km that received any US transfer but operated in a different industry has no effect on the probability of survival, sales, employment, and TFPR of a nonparticipating firm (online Appendix Table A.27). This result suggests that imitation effects by nonparticipating firms were almost zero.[28] The estimates also indicate that having an additional treated firm within a radius of 10 km and operating in the same industry has a negative, but small, effect on sales and TFPR. A possible explanation for the limited negative spillovers, although not testable, could be that receiving firms started competing at the national or European level, and therefore they had limited effects on the local market.

These results do not contradict other findings of the literature. For instance, Bloom et al. (2017), eight years after conducting a RCT on large Indian firms, find almost no diffusion of managerial practices between the treatment and the control

[28] To take into account possible spillover effects, I re-estimate equation (1), excluding firms within five kilometers of a firm that got any US intervention. The results are similar to those from the main specification; they confirm that the adjustment is modest (online Appendix Table A.28).

groups. Greenstone, Hornbeck, and Moretti (2010) estimate spillover effects from the opening of a large manufacturing plant on the TFP of incumbent plants in the same county. By contrast, firms that participated in the Productivity Program were all small and medium-sized companies.

Why Did Nonparticipating Firms Not Catch Up?.—The absence of positive spillover effects generates a natural question: why did not other firms start implementing the new management practices or purchase the technologically advanced machines from the private market, in light of the improved performance of treated firms?

A back-of-the-envelope calculation indicates that for firms that received the management transfer the benefits of adopting US practices largely overcame the costs. The firm's average participation cost, entirely paid by the program, was $38,723 (in 2010 USD),[29] which corresponds to 6.9 percent of average firm annual profits before the start of the program ($550,724). Given that the increase of profits attributed to the Productivity Program within three years is estimated to be 7.1 percent, for nonparticipating firms it would have been profitable to pay this amount out of pocket and receive management training. However, the United States did not allow those firms to enroll in the program, even if they had paid their own participation costs. Nevertheless, such enterprises could have started implementing modern management practices by imitating the receiving firms. Why did not they do that? As noted in Gibbons and Henderson (2012), there might be different explanations. Excluded firms might not have been aware of the adoption of such practices by treated firms. Information seems to play an important role in today's development context as well. For instance, Bloom et al. (2013) find that one reason why large Indian textile firms do not adopt managerial practices is that they are not aware of their existence. Moreover, nonparticipating firms may have thought these practices were not profitable, attributing the success of treated firms to other factors, for example, networking effects. Or, even if they were aware of the importance of such practices, they might not have known how to implement them without training from US experts. Moreover, treated firms had no incentive to discuss the details of their business with potential competitors, especially given their small dimension. Finally, labor mobility in Italy during the 1950s and 1960s was extremely low (Saibante 1959). For instance, 88 percent of managers who visited the United States were still working in the same firms 15 years after the intervention. Data on the mobility of the rest of the workers is not available, but it is reasonable to think that firm-to-firm worker movements were very limited, with consequent modest knowledge spillovers, as described in Stoyanov and Zubanov (2012).

Excluded firms also could have purchased US machines in the private market, without benefiting from the lower interest rates. In this case, credit constraints might have been relevant. An ex post calculation of the profitability of such an investment

[29] A firm's cost to participate in the US study trips is given by the sum of the administrative costs of visas, lodging, and travel for each trainee, the wages earned by such trainees while working to the US plants, and the cost to monitor the firms in the follow-up period. I estimate such costs by using the data I collected from the Productivity Program accounting, stored at the Italian Central Archives of the State (ACS), accessed in January 2014. It is harder to estimate the opportunity cost of sending the managers in the United States. However, given that the average age of trainees was 35 years, it is reasonable to think that more senior people were able to run the firms during this period of leave. Moreover, the US experts started monitoring such companies, helping to limit the impact of this opportunity cost.

indicates that the average cost of buying the US machines was \$235,782,[30] or 39.8 percent of firm annual profits before the start of the program (\$591,338). The estimated increase in profits due to the new machines over 15 years (4.8 percent) was therefore not enough to repay the investment.

VII. Conclusions and Discussion

I estimate the long-run effects of the adoption of management practices and new technologies on firm performance, using evidence from the Marshall Plan Productivity Program. This is, to the best of my knowledge, one of the first studies that uses non-experimental data to examine the extent to which managerial practices and technologically advanced machines affect business outcomes. This paper also contributes to the long-standing debate about the effects of the Marshall Plan on recovery in Europe after World War II, by providing the first firm-level evidence on a large scale. I collected and digitized balance sheets for 6,065 Italian firms eligible to participate in this program, tracked over a 20-year period. I estimate the effects of the program by exploiting an unexpected cut in the US budget: I compare firms that eventually participated in the program with firms that were initially eligible to participate but that were excluded after the budget cut. I find that Italian firms that sent their managers on US study trips were more likely to survive and had higher sales, employment, and productivity. These positive effects persisted for at least 15 years after the program. Companies receiving the technologically advanced machines also improved their performance, but conversely the impact did not continue to grow in the long run. Finally, I find evidence of complementarity between management and technology.

What are the implications of this research for public policy? Italy in the 1950s was comparable to some of today's developing countries, where business training and technology transfers are among the most common forms of active support for small and medium-sized firms (McKenzie and Woodruff 2012). However, such policies are usually evaluated over a limited number of months or years and using relatively small samples. In contrast, the Productivity Program provides evidence on a large and heterogeneous number of firms in both the short run and the long run. Another advantage of this research is that I am able to observe all firms, including eligible non-applicants, whereas in most settings only applicant firms are observed. Firms that did not apply for the Productivity Program were, on average, smaller and less productive than firms that applied for it, suggesting that firms with more need for business training and technology transfers might not want to participate in such programs.

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[30] The cost of receiving new machines is estimated from the buying price of the machines plus the interest rate of 5.5 percent.

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