Economic Recovery and the Determinants of Productivity and Innovation: Evidence from Post-WWII Italy

My dissertation is an empirical analysis of the economic development of Italy that, between the late 1940s and the early 1970s, moved from being a war-ravaged agricultural country to the seventh most industrialized power of the world.[1] I first analyze the process of Italian post-WWII physical capital reconstruction and the extent to which it was affected by the Marshall Plan—the program of economic and financial aid sponsored by the United States to help European recovery between 1948 and 1952. Second, I examine the long-term impact of the transfer of managerial knowledge and technology on productivity of Italian firms between 1952 and 1970, using evidence from the Marshall Plan Technical Assistance and Productivity Program. Finally, I investigate the effects on innovation of a series of reforms to the college system that Italy implemented between 1961 and 1969 with the goal of increasing STEM (science, technology, engineering, math) human capital accumulation.

This work contributes to our understanding of the role of foreign aid, management and technology transfers, and education reforms on historical economic development and innovation.[2] More in general, it answers to broad economic questions that, despite being currently relevant, are hard to tackle with modern data.

THE ROLE OF THE MARSHALL PLAN ON ITALIAN POST-WWII RECOVERY

When WWII came to an end on 25 April 1945, Italian GDP per capita was 38 percent lower than in 1938 and the industrial production represented 34 percent of that in 1938 (Lombardo 2000). In this chapter, I investigate the extent to which the Marshall Plan affected the Italian economic recovery from WWII and its subsequent industrial production expansion.

I use newly collected data on the types of aid (in-kind subsidies, free grants, and loans to firms) allocated across Italian regions and sectors, which I combine with the regional monthly industrial production index and growth rates.

I first document that the Marshall Plan's money was used to recover and strengthen the already existing production system. For instance, free grants were used to rebuild infrastructures and were given to the most damaged areas, while loans were almost

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[1] During these years, Italian GDP grew at the unprecedented annual rate of 6.3 percent (Fauri 2006).

[2] For the impact of foreign aid on economic development, see, for instance, Qian (2015) and Burnside and Dollar (2000). For the effects of management and technology transfers on firm performance, see Bruhn, Dean, and Schoar (2017) and Bloom et al. (2013). For the role of education expansion on innovation, see Toivanen and Väänänen (2015).

uniquely granted to large companies in the most industrialized regions. Second, I quantify the separate effects of grants and loans on Italian industrial production. Using a pre-post estimator, I estimate that, after receiving the U.S. grants, the industrial production increased by 20 percent and reached the pre-war level by 1950, before Italian firms received any loan. To estimate the effects of loans on industrial production growth rates, I exploit the fact that Italy lost the war and, therefore, only industries not related to war were subsidized by the United States. In a difference-in-differences analysis, I show that subsidized industries had a 2.3 monthly higher growth rate than not subsidized ones.

THE MARSHALL PLAN PRODUCTIVITY PROGRAM AND THE LONG-TERM EFFECTS OF MANAGEMENT AND TECHNOLOGY TRANSFERS

Despite Italy, as well the rest of Western Europe, recovered relatively fast from WWII, there was an increasing productivity gap between U.S. firms and European plants (Boel 2003). As a consequence, during the 1950s, as part of the Marshall Plan, the U.S. administration sponsored the Technical Assistance and Productivity Program, which offered management-training trips for European managers to U.S. firms and granted state-of-the-art machines to European firms. In this chapter, I examine the long-run effects of such management and technology transfers on Italian firm performance.

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 15 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 budget and only firms from five smaller Italian provinces—one for each of the original regions—eventually participated in the program. I therefore compare the performance of firms that applied for and eventually received the management or the technology transfer with that of firms applying for the same transfer, but not receiving it due to the budget cut. I show that, before the budget cut, participating and excluded 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 15 years after the program. Productivity of the participating firms rose by 11 percent within one year, relative to the management comparison group, and continued to grow without reaching a plateau, with a cumulative increase of 37 percent after 15 years. Second, the technology transfer also boosted firm performance, but the gains did not continue to grow over time. Productivity rose gradually by 11 percent in ten years, relative to the technology comparison group, but then flattened out. Third, the effects of the program on firms that received the combined management and technology transfers were significantly larger than the sum of the single transfers, suggesting a complementarity between management and technology. The productivity of these firms increased by an additional 14.5 percent in 15 years.

What changed in the firms that participated in the U.S. managerial training? More than 90 percent of them adopted the new American managerial practices within three years and were still implementing them 15 years later. Specifically, these companies started performing regular maintenance of machines and tracking of 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, improved performance led firms to increase the number of plants and the manager-to-worker ratio, and to be more likely to become managed by professional managers (instead of remaining family-managed businesses). Improved performance also gave firms greater access to bank credit, which, in turn, allowed them to invest more in physical capital. I find no evidence that the long-run effects of managerial training are explained by variations in firm exports or market power caused by the program.

THE UNIVERSITY STEM EDUCATION REFORMS AND THEIR EFFECTS ON INNOVATION

As the Italian industrial sector expanded in the post-WWII period, the demand for high- skilled STEM workers increased significantly (Felice and Vecchi 2015). The growth in university STEM degrees, however, was constrained by the fact that, due to the college access regulations, only 30 percent of all Italian high school graduates could enroll in university STEM majors (ISTAT 1986). To increase the amount of STEM skills in the economy, a series of reforms were gradually implemented between 1961 and 1969. Their key content was allowing a group of high-school students, who were trained in STEM, but historically denied access to scientific university studies, to enroll in STEM majors. This chapter, joint with Nicola Bianchi, studies the extent to which the innovative activity of this group of students was affected by the reforms.

I collect administrative data on the population of 46,473 students who completed high school in Milan between 1958 and 1973: historical education data, which Nicola Bianchi (2017) collected directly from the archives of high schools and universities; employment histories provided by the Social Security Institute; patents issued by the Italian Patent Office between 1968 and 2010, as well as all international patents included in the European Patent Office's PATSTAT database. I match the inventors listed in the patent data to school and employment records. This process allows identifying 869 individuals who patented at least once. Thanks to information from the work histories, I can also infer innovative activities that do not lead to patenting. I identify, for example, individuals in occupations that focus on the production of academic research.

I document three main findings. First, scientific higher education had a direct impact on the type of innovation produced. Industrial students with a university STEM degree became more likely to patent in the fields of chemistry, medicine, and IT, and less likely to patent in mechanics and industrial processes. As a consequence, scientific higher education made the patenting output of industrial and academic students more homogenous. Second, STEM education increased the probability of producing patents among the students who found employment in privately-owned firms. Higher human capital allowed these individuals to occupy managerial roles or high-skilled white-collar positions, instead of the blue-collar jobs accessible with a high school diploma. In these spots at the top of the hierarchical structure, they became more likely to be involved in the innovative processes within the firm. Third, a university STEM degree changed

the sorting into different occupations. Some industrial students with high pre-collegiate ability used the university STEM degree to access self-employed professions and public jobs. These occupations were not accessible with only a high school diploma and did not focus on the production of patents. As a result, these industrial students became less likely to produce patents, because the university STEM degree allowed them to escape technical jobs within manufacturing firms. Data on U.S. patents, however, suggest that these individuals would not have produced high-quality patents, had they stayed in patent-centric positions.

CONCLUSIONS

This dissertation has found that foreign aid, and management and technology transfers may have large and persistent effects on industrial production and firm performance. It has also documented that expanded access to STEM education may have direct and indirect effects on the production of innovation. What are the implications of this research for public policy? Italy in the 1950s was comparable to some developing countries today, where foreign aid, business training programs, and education reforms are used as means to promote economic development and growth. The use of a historical setting sheds new light on the long-term effects of such policies, whose evaluations in modern world are usually made over a limited number of months or years and on relatively small samples through randomized control trials.

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