NBER - PIE Post-Doctoral Fellowship

(Fellowships applied for: Innovation Policy and Entrepreneurship)

Michela Giorcelli, Ph.D. Candidate[1]
Department of Economics - Stanford University

In my research I study the extent to which knowledge diffusion and technology transfer affects firm-level innovation in the long run. In all my works I use historical natural experiment to address economic questions that, although currently relevant, would be hard to tackle with only modern data.

In my job market paper, **The Long-Term Effects of Management and Technology Transfer: Evidence from the US Productivity Program**, I examine the long-run impact of management practices and technology transfers on firm performance. During the 1950s, as part of the Marshall Plan, the US administration sponsored management-training trips for European managers to US firms and granted US state-of-the-art machines to European firms. I use newly-assembled Italian data on the population of firms eligible to participate in this program, tracked over a twenty-year period. 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 were eventually excluded after the budget cut. I find that management transfer significantly increased Italian firms' survival, sales, employment and productivity. These positive effects persisted for at least fifteen years after the program, a finding that can be explained by the increased investment rate, capital intensity, training expenditure, and professional manager hires in such firms. Companies that received new machines also improved their performance, but the effects were short-lived.

In the next years, I would like to advance two early-stage projects that are currently underway. The first of these two projects, **Technology Transfer, Innovation, and Entrepreneurship**, uses evidence from the Marshall Plan to study whether international technology transfer from more developed to less developed firms stimulates innovation and entrepreneurship in receiving companies. The second project, **The Promotion of STEM Education and Its Effect on Innovation**, intends to identify the effect of university STEM education on the propensity to become an inventor and entrepreneur by exploiting a massive increase in Italian university STEM enrollment among graduates who completed high school after 1961.

In the rest of the proposal I will describe these two research projects.

Description of the research projects[2]

1) Technology Transfer, Innovation, and Entrepreneurship

This project uses evidence from the US Marshall Plan in Italy to examine whether international technology transfer from more developed to less developed firms stimulates innovation and entrepreneurship in receiving companies.

The Marshall Plan was a US international aid plan to help rebuild Western European economies after WWII. Starting in 1952, it funded the United States Technical Assistance and Productivity Program (hereafter, Productivity Program) to encourage the transmission of technical information from US firms at the technological forefront to European firms recovering from the war. In practice, the Productivity

[1] Contact information: michelag@stanford.edu ; website: http://web.stanford.edu/~michelag/ ; Mailing address: 579 Serra Mall, Stanford, CA 94305.
[2] Both projects are coauthored with Nicola Bianchi.

Program organized consulting sessions of US experts in Europe and study trips of European technicians and engineers to the US.

To perform the empirical analysis, I collected balance sheets for the population of firms eligible to participate in this program. I will link these data, already used in my job market paper, with new data on the patents issued by the Italian Patent Office from 1946 to 2010, that I am now digitizing.

The identification strategy will be based on a change in the policy implementation by the US. Originally, the US and Italian authorities intended to rollout the Productivity Program in two phases: first, in only 5 Italian regions and, then, in the whole country. In 1951, the Italian firms interested in receiving Productivity Program support started submitting applications. However, when the program was about to start in 1952, the US decided to cut the budget and the policy was eventually implemented only in 5 provinces[3] – one for each region that was originally selected for the program. From 1952 to 1958, 619 firms in 5 Italian provinces participated to the program and around 2,500 Italian technicians and engineers visited the US.

Once the data digitization is complete, I will be able to measure how participating into the program (therefore, receiving technological training from US firms) affected patenting activity of Italian firms. In particular, I will compare how patenting changed after 1952 among participating firms in eligible provinces, relative to similar firms in nearby provinces that were originally eligible for the program, submitted an application, but did not end up receiving US assistance. Moreover, I will study whether this training generated innovation spillovers by comparing the change in patenting in provinces where participating firms were located with eligible provinces and the provinces in the rest of Italy. Finally, I will examine whether participating firms were more likely to patent abroad, by matching Italian patents granted in Italy with Italian patents granted in the US. In this case, I will also be able to measure the quality associated with a given patent, by looking at patent citations, a piece of information available in the US but not available in the Italian dataset.

The contribution of this project would be twofold. First, it would provide one of the first empirical analyses of the relationship between international technology transfer and firm-level innovation and entrepreneurship the long run. Second, it would be informative about policy implications regarding technology transfer in developing countries, since post WWII Italy is comparable to some developing countries' today in terms of GDP per capita level and growth rate.

2) The Promotion of STEM Education and Its Effect on Innovation

In many countries, the promotion of university STEM (Science, Technology, Engineering, and Math) education is considered a national priority. In the United States, for example, a committee of presidential advisors suggested that the US university system should produce 34 percent more STEM graduates annually for the country to maintain its international competitiveness (PCAST, 2012). Policies that promote university STEM education, in fact, could spur economic growth by increasing the number of inventors and innovative entrepreneurs in the economy. These policies, however, are not guaranteed to achieve their intended goals. For instance, STEM graduates have desirable skills that make them employable in different economic sectors. As a consequence, a share of STEM graduates might find employment in occupations that do not produce innovation.

[3] The sub-areas in which Italian regions are divided.

This project intends to identify the effect of university STEM education on the propensity to become an inventor and entrepreneur by exploiting a massive increase in Italian university STEM enrollment among graduates who completed high school after 1961. In 1961, the students from a high-school for industry-sector professionals (*ITI*) were allowed to enroll in STEM majors for the first time. As a result, the number of university degrees—specifically STEM degrees—awarded to such students after 1961 increased dramatically (72 percent increase from 1961 to 1964 and 183 percent from 1965 to 1968).

The dataset used in this project is fairly unique, because it combines very detailed education data with information on patenting activity and entrepreneurship. The starting point is represented by the dataset used in Bianchi (2015), who collected information from high school and university archives for nearly 50,000 students who completed high school in Milan from 1958 to 1974 ("students" dataset). To study the effect of the promotion of STEM education on innovation, we linked the students in this dataset to information on patent owners from a database (that we assembled) including all patents issued by the Italian Patent Office from 1968 to 2010 ("patents" dataset). We are now in the process to extend the matching to two additional foreign patent databases: 1) PATSTAT, which collects all patents issued by the European Patent Office; 2) the USPTO database, which collects all patents issued by the US Patent Office. These databases will allow us to study the effect of the 1961 reform on the likelihood to patent abroad. These result will be important for two reasons. First, patenting abroad is costlier. Therefore, Italian inventors are more likely to patent abroad only their more valuable (or better) inventions. Second, the foreign patents will allow us to analyze the effect of the 1961 reform on the international competitiveness of Italian inventors, an essential component of economic growth. To study the effect of the promotion of STEM education on entrepreneurship, we are in the process of linking the "students" dataset to information on entrepreneurs ("firms" database) provided by Infocamere (the IT branch of the Italian *Chamber of Commerce*). Finally, we will merge these data to the Italian Social Security (*INPS*) data to get information on occupation, tenure on the job, type of contract, economic sector, wages, welfare benefits, participation to active labor market programs.

Our preliminary findings suggest that the promotion of university STEM education decreased the probability of becoming an inventor among *ITI* students. *ITI* graduates who completed high school after 1961 were 2.7 percentage points less likely to receive one or more patents. The number of patents per inventor decreased by 0.17 units among ITI students who completed high school after 1961.

This result might appear counterintuitive: the opportunity to enroll in a university STEM major decreased the propensity to invent. We think that this finding might be driven by the fact that *ITI* students who received a STEM degree were more likely to end up in occupations that were not leading to innovation (for example, managerial positions). The *INPS* data would allow us to test this theory and to analyze in detail the relationship between education, labor market, and innovation.