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Strategic complementarities between innovative firms and skilled workers: The poverty trap and the policymaker's intervention☆

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ABSTRACT

The economy under study is populated by two types of firms (innovative and not) and two types of workers (skilled and unskilled). The aim is to develop a model that confirms the existence of complementarities between innovative firms (R&D activities) and skilled workers (human capital) and traces corresponding optimal dynamics. Workers follow an imitative behavior to choose their action type (skilled or unskilled). As the share of innovative firms is large enough, then the share of skilled workers in equilibrium depends on the reviewing rate (of imitation) for those unskilled workers. The policy maker intervention is justified only for a certain time by reducing the threshold to reach the high-level equilibrium, but once the economy is in a path for a high-level equilibrium such an intervention may stop.

1. Introduction

Benhabib and Spiegel (1994), by focusing on the role of human capital in economic development, suggest that the specific role of the human capital (skilled workers) is to facilitate the adoption of technology from abroad and to create domestic technology (innovative firms). This evidence reinforces the importance of the matching among the skills and the technological profile. So, matching is fundamental to isolate one of the most important aspects of the acquisition of human capital and technology. For workers the crucial issue is the type of firms they interact with, while for firms it is the type of workers they hire. In the high-skill equilibrium, for example, workers expect that firms invest on technology, and then invest on hiring human capital. Given these workers' expectations, firms find it optimal to invest on R&D activities, and therefore expectations are fulfilled in equilibrium.

Several studies develop different models to prove that high-skilled labor and high-technological firms are complements in order to obtain a high-level equilibrium (particularly see, Acemoglu, 1997, 1998). Acemoglu (1997)

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considers the same type of interdependence under heterogeneous individuals' human capital. Acemoglu (1998) focuses on skill-biased technological progress and inequality growth between and within groups of skilled and unskilled workers. Focusing on common situations in which workers accumulate general skills to prepare for the (firm-specific) technological progress. The seminal paper by Nelson and Phelps (1966) studies complementarity between R&D and investments in human capital and consider this latter factor as one that facilitates technology adoption and diffusion. Then, Redding (1996) formalizes such an idea in an R&D-based growth model showing the low-skill and low-quality traps, caused by strategic complementarity between homogeneous human capital (low education investment) and R&D, within an imperfect labor market. In this vein, Acemoglu (1998) and Kiley (1999) developed models of endogenous technology choice that explain the factor bias of technological progress. They studied whether technological change is complementary to skilled or unskilled labor subject to firms' decisions. The chosen design (the factor bias) depends on the relative abundance of the two types of labor. An exogenous increase in the relative supply of skilled labor then causes an immediate drop in the skill premium followed by a recovery of the skill premium measured as the ratio of skilled-unskilled wages, as the mix of technologies adjusts towards more skill-intensive ones. Galor and Moav (2000) also develop a model where skill-biased technological change raises both the incentives to invest in human capital and the skill premium. This is the well-known notion of "skill-biased technical change" (SBTC) which implies a shift in the production technology that favors high-skilled over low-skilled labor by increasing its relative productivity and, therefore, its relative demand (see Acemoglu, 2002; Aghion, 2006; Hornstein et al., 2005). Then, by the "SBTC" the investments in R&D, new products, new process, new technologies – even the ICTs, Information and Communication Technologies – increase the firms' demand for skilled workers, assuming they better know how to implement the new technologies.

In this paper we develop a model where firms' decisions depend on the share of skilled workers and investment costs on R&D while workers' decisions follow an imitative behavioral rule. In this vein, the model by Accinelli et al. (2010) considers that workers imitate to decide whether being skilled or unskilled type and they show the dynamic complementarities between innovative firms and skilled workers. Here, we extend such a model, even though the general motivation of this paper is mainly theoretical, by considering the key role of a policy proposal, i.e.: to subsidize education, R&D etc. which are rather intuitive to overcome a poverty trap. However, our most important point is the provision of a mechanism capable of explaining the presence of poverty traps based on imitative behavior and bounded rationality (from the workers' side) coupled with a strategic coordination problem about the investment decisions to become innovative or not based on the technological costs (from the firms' side).

From the firms' side game, the dynamics show that for innovative firms is more profitable to hire skilled workers, and then the new technologies reduce the demand for unskilled workers and increase the demand for skilled workers, since skilled workers adapt more easily to technological change.[1] Our model suggests that under skill-biased technological change it is more profitable for workers to be the skilled and for firms to be innovative but there still coexists in such an economy a share of unskilled workers and non-innovative firms, something which is real and truth observable in developing countries (see Feenstra and Hanson, 1997; Ros, 2000).

From the game the workers' decisions are such that a worker imitates the best performed strategy in the economy. We consider that the worker's decision for being skilled or unskilled is driven by an imitative behavior; meanwhile the initial distribution of innovative firms is taken as given.[2] So if being unskilled worker is the best one then a worker decides on it, otherwise the opposite. But workers' decisions by imitative behavior depend on training costs to acquire skills and on the share of innovative firms.

The huge and important empirical literature on this subject provide arguments in favor of our hypotheses on suggesting strong secular relative demand growth favoring highly educated workers that has persisted throughout the past decades characterized by a shift in demand away from unskilled and toward skilled labor in manufacturing (see Autor et al., 1998; Berman et al., 1994; Betts, 1997). For instance, on the workers' side Caroli et al. (2001) and Caroli and Van Reenen (2001) pointed out the links between skills and changes in work organization to show that as the proportion of skilled workers increases, the economy travels through a sequence of organizational equilibria, i.e. as the relative supply of skills increases the organization of work becomes more decentralized. From the firms' side, Greenan and Guellec (1994) shown how firm organization may change due to endogenous technical change, i.e. the firm is depicted as an organization where a collective knowledge on manufacturing is built through learning by doing, requiring coordination between workers within the workshop. Kaiser (2000) found evidence in favor of skill-biased technological change in the fast-growing German business-related services sector.

The remainder of this paper is organized as follows. Section 2 defines the economy as a game in strategic form. Section 3 studies the firms' dynamic of innovative and non-innovative and their corresponding evolution such that there is a threshold level of the share of skilled workers for the firms to decide being innovative ones. Section 4 studies the workers' dynamic under the assumption that they follow an imitative behavior given the current state of the economy. Section 5 studies the convergence of the share of firms and the case of a poverty trap. Section 6 studies the role of the policy maker to reach a high-level equilibrium of innovative firms and skilled workers. Section 7 concludes the paper.

[1] This assumption is akin to the Nelson and Phelps (1966) argument that greater skills allow for faster adoption of technology.

[2] On imitation theory, we suggest: Björnerstedt and Weibull (1996), Schlag (1999), and Weibull (1995).