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## **Project proposal**

### *Acquiring skills to innovate ?*

The aim of this research is to analyse the relationship between skills and innovation from the labour demand point of view. Acquiring a new technology is usually seen as a key objective of the firm to ensure its market share and further development. But, in order to integrate innovation, firms must have enough skills. Our main objective would be to explain why a firm invests in the general competences of its labour force despite the risk of poaching. We think that the need of skills in order to discover and integrate innovation can be part of the answer. Enhancing innovation is a major concern of firms. For example, numerous articles provide macroeconomic evidences of a skill-biased technical change. They conclude that the implementation of a new technology requires a much higher proportion of skilled workers.

The seminal work of Gary Becker (1962,64) on the human capital theory is based on a dichotomy between general skills which are useful at the same degree for all firms of the economy and specific competencies which are only valuable for the company which provide it. The investment in on-the-job training by firms themselves is a recent expanding field in labour economics. In the standard human capital theory, employers can't finance seemingly general training because of a poaching externality. But many empirical analyses contradict these conclusions, showing that firms finance, at least, a large portion of these investments (Acemoglu and Pischke 1998,99). Another conclusion of these studies is that productivity growth is higher than wage growth. Many explanations have been found in order to explain the divergence between the theoretical conclusions of Becker (1962,64) and the stylized facts. Two broad ranges of explanations have emerged. On the one hand, the notion of transferable training, neither general nor specific, and the constrained mobility of trainees create strategic behaviours between the few firms which value the training (Stevens 1994,96). On the other hand, the private information of the training firm concerning abilities and skills of its manpower leads to a winner's curse, so the risk of trainees' poaching does not dissuade firms from training its labour force (Acemoglu and Pischke 1998,2000).

At the same time, the model of Acemoglu (1997) deals with both training for workers and innovation for firms. One of the main hypothesis is that the new technology and the competences

are complements in the production function. As the author says “skills are more valuable to a firm which has the new technology”(p. 446). This is in line with the technological bias toward higher qualifications described in Acemoglu (1998). A major result of this analysis is the emergence of multiple equilibria, either no training and no innovation or both of them. Another key reference is a working paper by Booth and Zoega (2000) which introduce the problem of heterogeneity of the labour force and consequently of firms. This includes some elements of personnel economics into the human capital theory. The main conclusion of the analysis is that firm-sponsored training will take place in the firms with the "better" workforces because of a monopsony power in the skilled labour demand. This will increase differences with the other firms in terms of human capital and growth.

From these starting points, we would like to introduce a design of the innovation process. For example in Ulph and Ulph (1990,94), two firms are engaged in a race for a new technology. It takes the form of a patent race as the first firm which discovers the new technology gets an exclusive right preventing the other firm from doing the same. This framework would better correspond to radical innovations for which protection is possible rather than organizations' improvement through on-the-job learning. It is now well accepted that a firm needs skills to use efficiently a new technology. Our goal will be to determine under which conditions, innovation is a sufficient reason for firms to invest in the general skills of their workforce.

This work will have direct consequences not only for firms but also for policy makers. In most OECD countries, the high-tech sector appears as an expanding source of innovation and growth. At the same time, the demand for highly qualified manpower, such as informaticians, overtakes the supply. Our work would stress the right incentive schemes for a wide range of situations in order to enhance both firm-sponsored training and innovation. The right policy would depend on the institutional framework of the labour market. So, policy recommendation depends crucially on the national context. This work would also stress another good reason for investing in skills. Training has not only a direct positive effect on individual productivity, but it can also benefit to the firm by knowledge externalities. This would increase the probability of success in a patent race, under some conditions which remain to determine.

Our methodology will be based on the combination of two research designs. In a first step, we would try to develop a formalized model, using the wide range of tools from the game theory to solve it. This analysis will allow us to determine the important variables and their critical values which would define particular issues. It is important to say that the result won't be a unique solution,

but a wide range of answers depending on a few key variables which themselves model different environments. In a second time, we will use micro-econometrics to test the outcome of the model on individual data. This second step will of course deeply depend on the availability of data sources.

The theoretical model will be developed in a well-known strategic environment, two firms competing on a final product market. The explanation of firm-sponsored training in this model is based on asymmetric information. More precisely, we will assume that nobody knows the ability of an individual worker before his training, and this constitutes a private information for the incumbent firm after training. It seems particularly appropriate for young workers or for a new type of skills. This assumption of adverse selection has already been made in Acemoglu and Pischke (1998). There is a duopsony on the labour market to recruit and generally train new workers. But, there is also uncertainty on both productivity and mobility of the trainees. So, the result in terms of efficient labour endowments for the firms will become uncertain. At the second step of the study, the patent race, the issue deeply depends on the initial situation of the two firms, as shown by Ulph and Ulph (1990,94). We think that the outcome of the race will depend on the parameters of the model. But many questions remain at this step, We can first question the apparent complementarity between skills and innovation, and maybe if the new technology would be installed. These developments will take place in a decentralized economy, instead of the more common firm-union bargaining. But further analysis will probably reconsider this choice.

The second step of the research will be an econometric study to confront theoretical results and empirical analysis. The recent development of micro-econometrics of panel data allows us to take into consideration specific effects for individuals and firms. This will reduce the bias due to heterogeneity in skills' endowments of the labour force. We will also be able to conclude about the different strategies of firms regarding innovation. But, in order to use these new econometric tools, we need a corresponding data source. This type of micro-econometric analysis is based on matched employers-employees data source. Considering the particular specification of the theoretical model, a suitable database could be a sector-based administrative file. It concerns competing firms for which we will have access to quite exhaustive informations about themselves and their employees. The last question will be the availability, and the access of such database.

This research will be an attempt to formalize in a new way the link between skills and innovation. The results of such an analysis will also be very important in order to evaluate and, if necessary, to reform the institutional framework of on-the-job training and innovation. We hope that this work would show the crucial role of human resources in the global industrial policy of a

firm. It can also be part of the a larger explanation of the differences observed between industrial sectors or states in terms of human capital accumulation and new technology adoption.

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