Abstract
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Skills acquisition and innovation process: An econometric approach applied to the Defence Industrial Base

The ability to innovate is a crucial element of success for a firm belonging to the Defence Industrial Base (thereafter DIB). It is also of major importance for national security hence for the government. A technologically updated equipment is a necessary condition for an army to fulfil its task. The government has to make sure that the organisation of the national research effort and the strategic management of skills will maintain and enhance the technological leadership of its industry. Firms capabilities to innovate are for a large part due to the skills of their workforce, especially researchers. Our research program is concentrated on the human part of these industrial skills. We want to evaluate the impact of an innovative context on the highly skilled recruitment. Our analysis is based on two starting points. On the one hand, papers of labour economists dealing with human capital in an imperfect framework. On the other hand, the literature on "patent race" which models the case of an exclusive innovation.

There is two interconnected races, the first for innovation, the second for human capital. “Patent race” models have been developed in industrial organisation to take into consideration the research policies of “high tech” firms (Dasgupta & Stiglitz 1980, Ulph & Ulph 1994). The main hypothesis in this framework is that only one firm can implement the innovation. A patent, or a similar mechanism, prevents other competitors from doing the same. The main condition in order to develop innovations seems to be the availability of human capital (Roth & Xing 1994), therefore recruiting new competencies will be a strategic element of future innovative capabilities. In some industrial sectors, especially those involved in DIB, the speed of technical progress is continuously increasing. That's why the need for flexible and highly qualified workforce becomes more and more important.

The stylised facts

Defence-related firms give an original framework, highly relevant for this analysis. These markets are both technologic and oligopolistic. Some prime contractors could even appear as national monopolists in specific markets. Workforce qualifications are higher than the mean of the industry. These competencies are also more sector-specific and competition is based on innovation rather than price. In the French context, the army is now becoming an All Volunteer Force and military procurement budgets are shrinking. Industries are facing a double challenge: they have to maintain and enhance their technological advance by recruiting new competencies. But they also face a lack of such highly qualified manpower in a context of growing needs due to technological competition. The competition for R&D personnel is crucial in order to innovate, but we will show that the innovative history of a firm will also influence further recruitment.

Workforce human capital has, at least, two effects on firms efficiency. A direct one, higher individual human capital means higher individual productivity. But this is also a source of externalities in firms. For example, teamwork can induce informal training such as “learning by watching”. This will allow higher productivity for all team members. In the research context, the meeting of different experiences or educational backgrounds will lead to new ideas or solutions. In such a situation, recruiting and winning the loyalty of its manpower is a strategic proposition for innovative firms. For example, workforce reactions to poaching

propositions are a crucial element in the building of a stock of human capital and of future success.

The theoretical background

Modern tools of labour microeconomics (Booth & Snower 1996, Stevens 1996, Acemoglu 1997, Acemoglu & Pischke 1999) allow us to take imperfect competition into consideration on the labour market as it already exists on the final product market. In this new framework, the dichotomy of Becker between firm specific skills and perfectly general skills is enlarged. It allows skills to be of some interest for a small number of firms. This oligopsonistic situation will lead to strategic interactions among competitors. For example, the introduction of mobility costs will give to the incumbent employer a "monopsony power", so firms will be able to fix their wages strictly under marginal productivity.

This will be an inciting for firms to invest in their manpower human capital, despite the poaching externality (Stevens 1996). This theoretical proposition is consistent with an important stylised fact of the European labour markets. Firms finance, at least in part, the training of their employees, even if these skills seem to be general. From the employer point of view, the acquisition of a stock of competencies is a necessary condition, but not a sufficient one, to innovate and to enhance the production process. Another proposition which inspired this article is the idea of a complementarity between investment in new technologies and human capital. It has already inspired a huge literature since the seminal work of Griliches (1969) on the skill-biased technical change.

Acemoglu (1997) has shown that this complementarity between skills and new technologies can be responsible for multiple equilibria. The first where firms invest in new technologies and people invest in skills, the other where neither invest. We add to this framework the context of an innovation race: only one firm will be able to implement the innovation, leading to asymmetry between competitors. We develop a theoretical model on the basis of Stevens (1994) in which we take into account the impact of an exclusive innovation.

The empirical results

The theoretical model proposed above deals with highly skilled workforce when the market for such skills is a duopsony and innovation is exclusive. If the effect of human capital on innovation is widely accepted, our model tries to show the reverse causality. By giving a higher market power, past innovations ease further recruitment. Thanks to a sample of French Defence-related firms, it will be possible to test this proposition. The database comes from the French "Innovation" & "Compétences pour innover" surveys and firms are identified as belonging to DIB thanks to a database of the French ministry of Defence.

The econometric test is based on binary choice, more precisely a bivariate probit. The two dependent variables are the answers of the following questions:
Did you innovate, either in product or in process?
Did you recruit highly skilled workforce in order to innovate?
Our first, temporary, conclusion is that the predictions of the theoretical model cannot be rejected. Taken into account the size of the firm, its industrial sector and the presence of a research structure, the superior probability to innovate for firms belonging to the DIB, becomes also less significant. The first results give information about the links between highly skilled recruitment and innovation probability and allow to discriminate effects by firm size and industrial sectors. Intuitively, it depends also crucially on the presence of a research structure. Other results will be added to the final version of the paper.