



How does technological innovation and diffusion affect inter-industry workers' mobility?

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ABSTRACT

Does technological change amount to accumulation of general, and so transferable, human capital? To approach this question I rely on a theoretical framework in which the “technology distance” between industries reduces inter-industry transferability of workers' skill. Empirically, I use US panel data on individual intra-industry and inter-industry mobility decisions between 1982 and 1990, a period of rapid technological change in all manufacturing sectors, to estimate a mixed logit econometric specification that does not rely on the IIA assumption. I find support to the main idea that technological innovation and diffusion have different effects on workers' industrial mobility patterns. “Knowledge spillovers”, differently from “rent spillovers”, indeed boost the chances of workers' inter-industry mobility. Surprisingly, this is more consistently so in low-tech industries than in high-tech industries. Consistently with the expectations developed in the theoretical framework, in low-tech industries skilled workers respond more sharply to technology diffusion than unskilled workers.

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(...) Technological innovations, institutional reforms, and fresh ideas do not affect the aggregate level of economic activity abruptly: they need to diffuse from region to region, from activity to activity, cross-boundaries and seas, be evaluated, adapted, and refined. Their promoters have to dislodge the entrenched, persuade the skeptic, and reassure the fearful. *Mokyr (2005)*, p. 285

1. Introduction

The Industrial Enlightenment was in part about the expansion of useful knowledge. According to *McGee (2004)* technological progress often depended on “analogical” thinking, in which inventors, consciously or subconsciously, transform an idea they have already seen into something novel. Since most of these ideas travel embodied in humans, workers' mobility is paramount for technological progress. So, who are the fearful?

In a “cognitive capitalism” it is the rivalrous nature of intellectual human capital that poses to employers' the problem of skilled and technical workers' mobility. Stated in other words, if R&D investment translates into human capital or knowledge that workers can transfer and utilize in other firms, workers' mobility amounts to knowledge diffusion. While this is generally evaluated as an important condition for the spread of new firms and research units (e.g., in *Zucker et al., 1998*), mobility of workers and particularly of highly technical workers is potentially a threat to the firm whenever it's the firm/industry that bears the cost of R&D activities (*Kim and Marschke, 2005*). In other words, intellectual human capital is rivalrous because it is characterized by natural excludability in the sense that its utilization in a firm usually excludes its simultaneous utilization in another firm.¹ This argument is central to con-

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¹ The case of outsourcing, by which technical staff sells their specialized skills to more than one firm, raises the issue of the relationship between this alternative form of employment and technological diffusion. For more on this issue see *Magnani (2003)*.

textualize the interest in skilled workers' mobility and in how the labor market for skilled technical workers works (Rosen, 1972; Pakes and Nitzan, 1983; Song et al., 1996; Fallick et al., 2005). More fundamentally an analysis of workers' mobility, what prevents and what engenders it, is paramount to understand the contemporary ways in which capitalism attends to its central imperative and challenge: namely, "to immobilize workers, to tie it to the labor relation and to prevent its flight, the breach of contract and the refusal to work" (Moulier-Boutang, 1998).

This paper investigates the effects of industry R&D intensity on workers' mobility. A so far overlooked aspect in the literature on how technology change impacts upon the labor markets is the effects of technological change that occurs by means of diffusion of existing knowledge. This oversight has persisted in spite of the intensification of phenomena of technology diffusion brought by the deepening of input dependence among firms and industries starting from the 1970s (Wolff, 1997) and by a rise in R&D performed by non-manufacturing industries (OECD, 1996). In the face of the rapid technology changes driven by both innovation and diffusion, this paper explores the hypothesis that the dual aspects of technological change are among the determinants of workers' mobility.

I structure the discussion as follows. Section 2 reviews the literature and introduces a simple model, which relies on the notion of "skill distance" developed in Silverberg et al. (1988) to discuss the impact of technological change on inter-industry mobility. Section 3 describes the data and discusses measurement of technology issues. Section 4 introduces the econometric strategies, namely multinomial models and mixed logit models of inter-industry mobility. Section 5 discusses the empirical findings, while Section 6 concludes.

2. Technological change, technological distance and skill transferability

This study's focus on workers' mobility is motivated by its importance for an economy's adjustment to structural change. In particular, structural shift in the 1980s and 1990s sparked a number of adjustments strategies at the firm's level in the US, roughly characterizing "the US firms' downsizing", a term that encompasses phenomena like corporate layoffs, re-engineering, restructuring and job displacements (Baumol et al., 2003). Millions of workers have moved across industries in response to a structural change in the US industrial composition from manufacturing to trade and services. Using data from the Panel Study of Income Dynamics (PSID), Parrado et al. (2007) estimate that industrial mobility declined from 15 to around 10% between the first and the second half of the 1970s to vary between 15 and 20% in the 1981–93 period (Parrado et al., 2007, p. 442). DiPrete and Nonnemaker (1997a) illustrate the relative size of US workers' inter-industry mobility flows by 2-digit industry of employment to find substantial variations across industries (see Table 1, reproduced from DiPrete and Nonnemaker, 1997a, p. 393).

The argument that technology change facilitates workers' mobility is here developed in terms of the technology effect on workers' skill transferability. The idea that R&D

investment translates into human capital or knowledge that workers can transfer and utilize in other firms has a number of relevant potential consequences. Firstly, firms may under-invest in R&D unless the labor market is able to internalize such externality. For example, Kim and Marschke (2005) develop and test a model of the patenting and R&D decisions of an innovating firm whose scientist-employees sometimes quit to join or start a rival. They show theoretically that the risk of a scientist's mobility reduced the firm's R&D expenditure. Another important consequence is that because intellectual human capital is scarce and valuable, accumulation of general human capital requires a change in the *wage structure*, rather than in the *wage level*, that is able to prevent workers' mobility.² To the extent that R&D activities contribute to the accumulation of general human capital, they should steepen the earning profile and particularly so for technical and skilled workers.

The importance of assessing the degree of specificity of human capital dates back to Becker (1962) who initially focussed on the dichotomy between firm-specific and general capital.³ More recently, the whole issue of the source of the specificity has been examined to argue that an important role in limiting workers' mobility may be industry-specific capital rather than firm-specific capital (Neal, 1995; Parent, 2000). Furthermore, there is accumulating evidence that workers' mobility has intensified in the new economy. Understanding the sources of human capital specificity is particularly important in labor markets in which flexibility often relies on individual ability to respond to risk of unemployment or displacement (Magnani, 2001). In this context, human capital specificity can reduce its transferability, thus endangering workers' ability to flexibly responding to work opportunities elsewhere. Interestingly, this is the approach that Hiscox takes in exploring the relationship between factor mobility and technology change across US industries between 1820 and 1990 (Hiscox, 2002). To examine differences in the way the two dimensions of technological change, namely innovation and diffusion, impact on human capital transferability it is useful to refer to Silverberg et al. (1988), who formally derive a shortening of the distance between internal (firm-specific) and external (general) skills as a consequence of technology diffusion. This is the intuition that inspires the following theoretical framework.

2.1. Technology and workers' mobility: sketching the relationship

To draw the implications of technological innovation and diffusion on workers' mobility I use a simple model, fully described in Magnani (2003) and inspired by Mortensen and Pissarides (1994) and adapted to focus on

² Note that because the general skills accumulated in R&D intensive industries are useful to all employers, all wage offers from other employers will reflect this increased productivity and should theoretically be identical to the current wage, making the worker indifferent between moving and staying in the current employment situation.

³ This distinction was important because while workers had a full incentive to invest optimally in general human capital, there were potential incentive problems in financing firm-specific human capital.

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