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The 'technological' dimension of structural change under market integration

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ABSTRACT

This paper explores the relationships between technological and productive structures. It attempts to show that, during market integration processes, when changes in productive structures are expected, the changes in national technological specialization are less linked to technological cumulativeness and opportunity. The paper uses patent data for 15 European, 6 Asian and 4 Latin American countries. It concludes that market integration is associated with elevated rhythms of catching up and converging, but also with higher levels of concentration of technological structures. Besides that, there is evidence that the concentration of innovative efforts is not always persistent. A reasonable part of the newly built competences is not the consequence of cumulative processes; therefore, there are reasons to think that quite a large part of mobility is strongly associated with productive structural change.

1. Introduction

The usual concept of structural change refers to changes in the productive structure due to changes in the sectoral composition of employment or, in a general sense, in the sectoral composition of production inputs (Kuznets, 1973). This concept has implicitly incorporated one technological dimension from a neoclassical point of view. According to this view, technology is defined as the set of all possible combinations of inputs for each level of production or as the set of possibilities of production for a given state of the art of technical knowledge. This view implies that changes in the input and output composition may be seen as a result of technological change. Nevertheless, the concept of technology goes beyond this simple approach. Schumpeterian theory shows that technology is the result of a continuous process of production/creation of knowledge that has an impact on the productive structure in a more powerful way. It can originate the creation of new activities and the destruction of old ones. So, from an evolutionary point of view, the technological dimension of structural change consists of the way in which technical change impacts on productive and commercial structures through continuous processes of 'creative destruction' or 'creative accumulation' (Schumpeter, 1943; Nelson and Winter, 1982; Abernathy and Clark, 1985).

The two approaches have in common the prevailing idea that technical change has an autonomous character, that is, it follows its own dynamics of evolution and is not affected by the economic dynamics at all. As a consequence, even though the endogenous nature of technical change is recognized by both approaches, the technological factor is usually introduced in empirical and theoretical works as an explanatory variable of the economic dynamics. There are only exceptional empirical analyses of structural

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change linking productive and technological structures (Stolpe, 1995). With regard to the commercial dimension of structural change studies, technological specialization is considered to be a factor that determines the levels of competitiveness of specific products and industries, which would be reflected in the exports structure (Laursen, 1999; Lall, 2000; Huang and Miozzo, 2004; Montobbio and Rampa, 2005). In this kind of study, endogeneity is usually dealt with as an econometric problem solved through statistical tools.

Nevertheless, there are theoretical reasons to believe that the economic phenomena that usually involve changes in the sectoral composition of inputs also have as great an impact on technological structures as technical change has on productive and commercial ones. Globalization and the integration of markets are among these phenomena. The 1990s represented a crucial decade in the 'globalization process'. During this decade, the European Communities became a monetary union; America registered different processes of commercial integration, like MERCOSUR, NAFTA or the 'Pacto Andino'; Brazil, the giant of Latin America, began a slow and growing process of commercial liberalization; Eastern Europe opened its markets after the fall of the Berlin Wall; and, in Asia, old and new *tigers* (China, India and South Korea) began to increase their presence aggressively in the international markets. Finally, also in this decade, the Uruguay Round negotiations took place under the recently created WTO with the aim of establishing progressive liberalization of the world trade of goods and services. During these processes, many of these economies registered deep structural transformations in their productive bases and export structures that have been widely studied (Dalum et al., 1998; Shafaeddin, 2005; Song Tan and Ee Khor, 2006; Meyer, 2008). However, there are no theoretical or empirical works to associate the integration phenomena with the changes in national technological structures considered as a third dimension of structural change.

In order to understand the changes in technological structures (specializations) as a dimension of structural change, this work aims: (i) to establish a relationship between market integration and technological structural change; (ii) to evaluate the main changes observed in the national technological specialization (NTS) by countries involved in deep market integration processes throughout the 1990s; and (iii) to explain these changes in the light of the new theoretical considerations. To test the principal changes registered in their technological structures between pre- and post-market integration periods, a group of countries was chosen. More specifically, the paper considers fifteen European countries related to the pre- and post-monetary union period, four Latin American countries and six Asian countries, pertaining to the 1990s liberalization policies, which marked the decade for the openness of these markets and their exposure to higher international competition.

2. Theoretical background

The neo-Schumpeterian approach points out that specific distributions of national technological competences and capabilities are determined by two sets of forces. The first one, of *autonomous character*, represents the forces conducted by the technical change dynamics itself. The second one, of *inductive character*, is represented by the national innovation systems, including the role of the institutions that, to some extent, lead the autonomous paths of technical change.

To these forces should be added another, of *structural character*, which emerges from the relationship between the technical, the productive and the commercial structure. This paper advocates the recognition of changes in technological structures as another dimension of structural change. This recognition allows a better understanding of the nature of unexpected changes in technological structures and specializations under changing environments like market integration processes.

2.1. The autonomous forces of technical change

The autonomous forces of technical change are the elements that compose 'technological regimes'. *Technological regimes* are a theoretical tool that allows the identification of technological rhythms and paths according to the characteristics of each technology in terms of appropriability, opportunity, cumulativity and demand, under strong hypotheses regarding the variety and specificity of knowledge (Nelson and Winter, 1977; Dosi, 1988; Cohen, 1995). Among those factors, the main reason given by neo-Schumpeterians as explicative of NTS evolution is technological opportunity, as responsible for mobility and technological accumulation as it is responsible for persistency (Mancusi, 2003).

Technological opportunity depends on the emergence of technological paradigms (Dosi, 1988; Cohen, 1995). The opening of technological windows of opportunity and the apparition of new micro-paradigms in the international scenario can stimulate the full advantage of national competences, leading to a reallocation of resources from some technologies to others, that is, to *mobility*. In this way, mobility represents changes towards a new distribution of technological inputs across technical fields and, therefore, technological structural change. This effect of technological opportunity on NTS has led to the idea that 'correct' or 'wrong' initial specializations can determine the future profiles of specialization and technological dynamism. Correct specializations are related to technologies with a high degree of pervasiveness or to technological fields with a fast rate of growth of patents through time, that is, with elevated technological opportunities (Meliciani, 2002; Huang and Miozzo, 2004; Montobbio and Rampa, 2005). Specialization in this kind of technology represents some advantages for technological dynamism in order to gain greater potential for application of new scientific and generic knowledge in other activities (pervasiveness) and to develop further learning processes (Huang and Miozzo, 2004). At the same time, specialization in 'inferior' technical fields (low opportunity) presents some difficulty in moving to 'superior' technical fields (high opportunity), especially if there are no proper institutional framework and public policies to stimulate the 'social process of learning' (Vertova, 2001; Jungmittag, 2004). Nevertheless, the