



Technology transfer, institutions and development



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ABSTRACT

In the recent decades, the flows of trade, capital, and technology across the national borders of developing countries have increased, and have produced the conditions for a faster transmission of knowledge. While the economic literature has mainly focused on how international technology transfer may affect standard economic performances, less attention has been paid to a broader development perspective. This paper fills this gap by addressing two main issues. First, it investigates whether the technology transfer conveyed by international trade flows has positively influenced the development paths of less advanced economies. Second, it focuses on whether country-specific structural features may support the impulse of technology transfer on development. Our results show that technology accumulated in rich countries may help poor countries achieve higher development levels more rapidly, and that well functioning institutions may improve the capacity to transform the imported technology into domestic development opportunities.

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1. Introduction

The globalization process has led to a greater integration of developing countries in the world economy. In recent decades, the flows of trade, capital, labor, technology, and information across their national borders have increased and produced the conditions for a faster economic growth and for the transmission of knowledge. However, the distribution of these positive impulses among countries is far from being homogeneous. Even though it has been recognized that international relations may enhance economic growth (Dollar and Kraay, 2004), more controversies arise in the scientific and political debate when a development framework is adopted (Milanovic, 2006). In particular, it is thought that the impact of globalization on income distribution and social development may be strongly

uneven depending on the domestic ability to transform economic integration into development opportunities (Deaton, 2005; Stern and Deardorff, 2006).

With regard to the specific process of technology and knowledge diffusion, Eaton and Kortum (1996) suggest that international knowledge spillovers are crucial factors in explaining the growth of advanced economies. There is indeed a growing consensus on the positive role that is played by both trade and foreign direct investments (FDI) as potential channels of knowledge transfer (Hu and Jaffe, 2007; Saggi, 2000), and as an engine for economic growth (Hansen and Rand, 2006), even though their relative importance is far from being fully identified. In general, this lack of knowledge limits the ability to understand the role of policy settings in favoring international technology transfer among developed countries; even less is known in the case of developing countries, where specific national features may assume an even greater role in explaining the capacity to handle the imported knowledge.

According to Lall (2000), for example, the positive effects of economic integration for the underdeveloped world are

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strongly affected by the quality content of trade and FDI flows, especially with regard to the consistency between the type of knowledge transfer and the capacity to absorb it. Furthermore, according to Maskus and Reichman (2004) and Stiglitz (1999), the *public good* property of the knowledge stock (as it can be used in multiple locations simultaneously) would suggest that the role of the public sector may have been overlooked in empirical settings, and its role in helping the knowledge absorptive capacity of less developed economies significantly underestimated. Finally, while most contributions have concentrated on the impact of technology transfer on economic growth and productivity performances, the relevance of technology diffusion for a broader definition of economic development has been less frequently addressed.

Within this framework, this paper will discuss three major points. The first is to what extent the accumulated technology transferred from rich to poor countries via international trade flows has influenced the path of development of these latter countries. The second point concerns the potential role of the proximity between technology-producing developed countries and technology-adopting developing countries in transforming foreign innovation into development opportunities. The third point is related to what extent the pro-development effect of technology transfer is affected by the institutional quality of the receiving country.

The structure of the paper is as follows: Section 2 provides a review of the literature on technology transfer and development. Section 3 describes the modeling strategy for the empirical analysis. Section 4 introduces some innovations in the measurement of technology transfer and discusses the econometric strategy. Results will be presented in Section 5. Section 6 provides concluding remarks.

2. International technology transfer, development and institutions

2.1. International technology transfer

It is well known that productivity differences account for a large part of the variation in incomes across countries, and that technology plays a key role in determining productivity (Fagerberg, 1994). For most countries, foreign sources of technology are estimated to account for up to 90% of the domestic productivity growth (Keller, 2009). However, since most of the world's technology creations occur in developed countries, *technology transfer* may significantly affect the pattern of the technological change in those countries with strong constraints on technology creation. This means that the still ongoing and enhanced integration process might lead to significant gains for the underdeveloped world, where the marginal productivity gains related to technology transfer may be higher than those obtained in the developed world.

However, the positive influence that technologies produced abroad may exert on the domestic production capacity is strictly dependent on the actual absorptive capacity of the adopter country (Cohen and Levinthal, 1989). This means that the availability of a considerable level of technological capabilities, especially in developing countries, represents a crucial factor to benefit from technology imitation and spillovers (Archibugi and Coco, 2004; Archibugi and Pietrobelli, 2003; Bell, 1984; Bell

and Pavitt, 1993, 1995; Filippetti and Peyrache, 2011; Fu et al., 2011; Kumar et al., 1999; Lall, 1992).

Hence, pre-existing conditions of technological capabilities, and the quality of human capital and institutions in developing countries, may represent key elements in explaining how the globalization process can impact the structure and the performance of the economic systems involved. Fagerberg and Verspagen (2002, p. 1292), for example, have argued that the “technological catch-up is not a question of replacing an outdated technological set up with a more modern one, but to continually transform technological, economic and institutional structures”. In addition, as emphasized by Barbosa and Faria (2011), institutional differences play an important role in shaping innovation intensity and technological patterns.

Since the overall available technical progress for a given economy might be better defined as a technological paradigm, while the “technological trajectory [represents] the direction of advance within a technological paradigm” (Dosi, 1982, p. 148), several features can be considered jointly crucial for explaining to what extent and along which direction the international knowledge stock might foster economic development. First, there is the need to take into account the available technological paradigm, which is a combination of embodied and disembodied technical change (Tang and Coveos, 2008). As suggested by Shih and Chang (2009), the embodied technology diffusion can be measured by multilateral trade, while disembodied technology diffusion can be measured by patent citations, a feature that will prove useful also in our analysis.

Second, the technological paradigm can be implemented in different ways, which give rise to different technological trajectories. It is in the selection of this trajectory that the role of economic, institutional and social factors is particularly relevant when a broad development perspective is taken.

Third, and most relevant for our analysis, the way in which technology is diffused across countries needs to be identified. In general terms, the diffusion of technology may involve both market transactions and externalities.¹ Although information on the former may be more easily recovered through royalty payments for the use of patents, licenses, and copyrights, it is widely believed that the most effective channel of technology diffusion is given by externalities.² Externalities, however, may be differently received in developed and developing countries. In developed economies, FDI is recognized as the main channel, since face-to-face contacts or procedural production standards may encompass transfer problems related to the tacit nature of technology (Gholami et al., 2006; Markusen and Venables, 1999). With regard to developing countries, instead, there is a

¹ The terms “international technology diffusion” and “technology transfer” are both used to refer to the movement of technological knowledge among firms or sectors located in different countries. The term “diffusion” describes a wider effect, which is not strictly related to the productive sector, whereas the term “transfer” may suggest a more intentional approach. Throughout the paper, we will use diffusion and transfer as synonymous, where a broader diffusion concept is implicitly assumed.

² The literature on market failures that explains the rise of technology spillover is quite extensive and rich, and an exhaustive treatment is not the aim of this paper. Rather, our focus is to understand which are the most significant drivers enforcing the diffusion and the adoption of foreign technology.

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