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A regional approach to study technology transfer through foreign direct investment: The electronics industry in two Mexican regions

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ARTICLE INFO

Article history:

Received 26 June 2007

Received in revised form 16 January 2008

Accepted 14 March 2008

Keywords:

Foreign direct investment

Technology transfer

Region

Electronics industry

Mexico

ABSTRACT

This paper develops a conceptual framework and presents empirical evidence to examine technology transfer from foreign direct investment (FDI) to host regions, from a systemic perspective that integrates micro- (the firm) and meso (the region)-level analyses. This approach helps identify four different levels at which technology transfer may occur. Comprehensive fieldwork in Mexico was undertaken to collect evidence of an FDI-led, large industry (electronics) in two regions. The empirical evidence collected in this research shows that technology transfer derived from FDI may impact diverse actors of the host region (local firms, universities, research centres, industry associations), but also that its occurrence is neither automatic nor homogenous across regions.

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1. Introduction

International technology transfer is central for developing countries, which traditionally lack indigenous capabilities to generate new technologies. Technology transfer occurs through several mechanisms such as foreign direct investment (FDI), joint ventures, licensing, import of goods, co-operative alliances, subcontracting, export of goods, mobility of personnel and development assistance (Radosevic, 1999). FDI in particular has played a central role in developing countries. Multinational enterprises (MNEs) have been a very important source of production and technological resources, including capital goods, new product and process technologies, and new knowledge and managerial skills, whose potential effects on the host economy are enormous (Cantwell, 1995; Dunning, 1993).

Technology transfer from MNEs to host countries has been studied from a micro-level perspective, i.e. a pro-

cess that occurs at firm level (Alonso et al., 2000; Carrillo and Hualde, 1998; Hobday, 1995). Inter- and intra-firm processes have been analysed, but have rarely considered the role of interactions between firms and other agents within an institutional framework. Technology transfer from MNEs has been also studied at the macro-level, examining its impact on the whole country through macroeconomic data (Blomström and Person, 1983; Blomström and Kokko, 1998; Kokko, 1994; Kugler, 2006). Although the importance of local factors and efforts has been recognised, few efforts have been made to develop conceptual tools and methodologies to study the impact of MNEs on host regions.

This paper aims to study how MNEs, through their subsidiaries, transfer technology to host regions. Micro- and meso-level analyses are integrated, and the various levels at which technology transfer occur are studied: from parent companies to foreign subsidiaries; to local personnel within foreign subsidiaries; from foreign subsidiaries to local firms; and from foreign subsidiaries to local organisations (technical education schools, universities, public research centres and industry associations). The framework

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here developed is applied to compare systematically technology transfer in two regions.

Technology transfer is one side of the story in the process of developing indigenous capabilities through global–local interactions. This research acknowledges the importance of local efforts and absorption capabilities to study the impact of FDI on host regions. However, it is not the aim of this paper to analyse the capability building process. As said, this research integrates micro- and meso-level factors to study technology transfer to host regions.

Comprehensive fieldwork in Mexico was undertaken between September 2004 and January 2005. Two regions within Mexico were selected and a survey of firms was conducted involving 80 foreign subsidiaries and locally owned firms, in addition to interviews with 30 local organisations.

Mexico is an interesting case to study given the large amount of FDI that has taken place there. Over the last two decades, Mexico has been outstanding among developing countries in terms of the amount of FDI it has attracted. Between 1985 and 2005, it received \$US 211 billion of FDI, the fourth highest level of investment among developing countries, after China, Hong Kong and Brazil (UNCTAD, 2006). Considering that there are important differences between industrial sectors in terms of sources of technological knowledge, the actors involved in innovation processes and the links and relationships among actors, this research focuses on one industry: electronics. In Mexico, the electronics industry is an interesting case study given its size, participation in manufacturing exports, large number of firms, strong presence of MNEs and its geographical agglomeration in regions across Mexico. One region in northern Mexico – Baja California – and one in central Mexico – Jalisco – were selected for the fieldwork.

The paper is divided into four sections. The following section presents the conceptual framework and the methodology here developed to study the impact of FDI from a systemic perspective. Section 3 examines the empirical evidence collected in two regions in Mexico. Section 4 presents the conclusions.

2. The conceptual framework

This section develops a theoretical framework to study technology transfer from FDI to host regions (sub-national regions), drawing on the existing literature and findings from the empirical evidence collected in this research. First of all, technology transfer is understood as the reception and utilisation by one country of technology developed in another (Graham, 1982, p. 55). The forms that technology can take vary from the disembodied (patents, licences) to embodied technology, i.e. the technology embodied in machines or people (especially tacit knowledge). There are several different mechanisms that a MNE can use to transfer technology to the host country. These include arm's length sales of technology to independent purchasers (e.g. through technical service or licensing agreements), through a range of cooperative alliances to equity investments (Dunning, 1993, p. 311).

From an operational perspective, parent companies transfer technology to their subsidiaries in order to ensure

the latter can perform their duties.¹ However, technology transfer mechanisms and the type of knowledge differ significantly among MNEs. Scott-Kemmis and Bell (1988) identify three different categories of technology transfer. The first category includes capital goods and technological services to expand the production capacity of the importing firm or industry. The second consists of operating and maintenance skills and know-how, which are transferred through information codified in manuals, formulae and blueprints and through training and instruction which may contribute to increasing the human capital of the recipient country. The third category encompasses the knowledge and expertise required to generate and manage technical change and takes place mainly through both codified information and specialized training.

The nature of the technology, and the technological capabilities and characteristics of the transferor and recipient are factors that influence the mechanisms used by MNEs to transfer technology, as well as the complexity of technological knowledge transferred. Radically new technologies and those where the perceived risk of loss of proprietary rights is the highest are less likely to be transferred to subsidiaries (Dunning, 1993). MNEs also differ in their willingness to transfer technology and the mechanisms to do it, according to their corporate strategy.² The capabilities of the host countries are also a factor that affects the type and complexity of technology transfer. If a MNE finds skilled workforce, high levels of managerially and technologically skilled employees and access to knowledge and research facilities, it will be more interested in investing in knowledge-intensive activities (such as R&D) and consequently in transferring technological knowledge related to those activities (Cantwell and Iammarino, 2003; Kuemmerle, 1999; O'Donnell and Blumentritt, 1999; UNCTAD, 2005).

Technology transfer from FDI to host economies has been widely studied in the literature on spillovers (Blomström and Kokko, 1998; Caves, 1974; Grossman and Helpman, 1991; Kokko, 1994; Kugler, 2006). However, the spillovers approach focuses on the interaction between foreign subsidiaries and local firms, and assumes that technology spills over freely to everybody and no clear distinction is made between information and knowledge (Padilla-Pérez, 2006).

Although the existing literature on technology transfer through MNEs (e.g. Dunning, 1993, 1994; Radosevic, 1999; Romo Murillo, 2005) has recognised the role of local actors, few efforts have been made to develop conceptual tools and methodologies to study the impact of MNEs at the meso level. The conceptual framework devel-

¹ The existing literature identifies several motivations for an MNE to transfer technology: economic, operational, strategic and social, among others. See, for instance, Kumar et al. (1996) and Reisman (2005).

² For instance, the literature recognises that technology transfer strategies differ according to whether firms from the US and Europe, or Asia are being considered. Empirical analyses show that Asian firms, in comparison with European and US firms, in general have a less internationalised R&D activities structure (Meyer-Krahmer and Reger, 1999; Molero and Heijs, 2002; Reger, 2001, 2002).

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