



MNCs' offshore R&D networks in host country's regional innovation system: The case of Taiwan-based firms in China

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ABSTRACT

China has become a hot spot of R&D internationalization and a growing number of Taiwan-based firms have indeed set up R&D units in China. Taking into account China's substantial regional variations in economic development, innovation capacity, and knowledge productivity, such notions as regional innovation system (RIS) and local innovative milieu may become more relevant to the study on relationships between China and its inward R&D internationalization. Therefore, the key issue for this paper is what locational advantages of an RIS within a host country affect the network linkages and networking strategy of multinational corporations' (MNCs') offshore R&D units. The paper aims to enrich the current understanding of R&D internationalization in several ways. First, the paper attempts to examine the R&D networking underlying R&D internationalization by Taiwan-based firms in China, with particular reference to the sub-national level inside China. Second, the paper tries to establish a link between the literature of R&D internationalization and that of RIS, with a modified version of Dunning's eclectic paradigm. Efforts are made to map the relationship between foreign subsidiaries' local R&D networks and their host RISs inside China. Third, the paper takes advantage of a government databank to adopt a quantitative approach, the Seemingly Unrelated Bivariate Probit Regression model, with foreign subsidiaries as the unit of analysis, to highlight the role played by some aspects of the RIS in determining the local R&D networking of Taiwanese subsidiaries in China. Our evident shows that MNCs' offshore R&D units that pursue home-based technology exploitation strategy, the mainstream strategy regarding the developing host country, tend to be located in a host region with a strong knowledge application and exploitation subsystem, while an RIS with a strong knowledge generation and diffusion subsystem, within such a developing country as China, may induce MNCs' local R&D units to pursue home-base technology augmenting strategy. On balance, not only the location choice but also the local R&D linkages of MNCs' offshore subsidiaries are related to appropriate fits between the RIS and the subsidiaries' innovation network inside the host country.

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1. Introduction

Offshore R&D by multinational corporations (hereafter MNCs) has become an important element of globalization of innovation (see for example Casson and Singh, 1993; Howells et al., 2003; OECD, 1997; Ernst, 2006). Even such a catch-up economy as Taiwan has been involved in this trend, in terms of both outward and inward R&D internationalization (Chen, 2004, 2007; Chen et al., 2009; Liu and Chen, 2005, 2007a,b; Liu and Liu, 2009). More importantly, offshore R&D of MNCs has recently shifted towards the developing world, India and China in particular (Bruche, 2009; Gassmann and Han, 2004; National Science Foundation, 2005; Xue

and Wang, 2001; Chen et al., 2009; Chen, 2008; Han, 2006; Reddy, 2000; Walsh, 2003), and even bringing about a certain portion of R&D internationalization taking place outside the developed world (UNCTAD, 2005).

The existing literature tends to focus mainly on the MNCs' strategies and locational decision-making in deploying offshore R&D (Fors and Zejan, 1996; Cornet and Rensman, 2001; Westney, 1992; Paoli and Guercini, 1997; Narula, 2000), while neglecting the perspective of the host countries. However, as a growing number of catch-up and emerging economies are fitting into the global landscape of R&D internationalization, it is essential to incorporate insights from this new part of the jigsaw in order to enrich the current understanding of R&D internationalization (Chen, 2007; Chen et al., 2009; von Zedtwitz, 2004).

As a host country of MNCs' offshore R&D with growing significance, one important feature of China is about its sheer geographical size and more importantly, substantial regional

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variations in economic development, innovation capacity, and knowledge productivity (Guan et al., 2009; Li, 2009; Chi and Jing, 2007; Chen and Guan, 2012; Guan and Chen, 2010a,b). Taking into account the above-mentioned regional variations, one may in many cases need to go beyond the mainstream analyses of the interplay of foreign R&D and national innovation system (Chen, 2007), as far as China is concerned. It then follows that such notions as regional innovation system (hereafter RIS) (Asheim and Isaksen, 2002; Autio, 1998; Cooke, 2001), regional advantages (Saxenian, 1994) and local innovative milieu (Camagni, 1991) may become more relevant to the study on the relationship between China and its inward R&D internationalization.

In this paper, MNCs' R&D networks refer to the offshore R&D units' relationships with external parties locally in the host countries, including research institutes, other firms, and other organizations (Helble and Chong, 2004). The offshore R&D strategies of foreign R&D facilities vary across host countries. Diez and Berger (2005) indicate that MNCs in a country with abundant R&D resources tend to be involved more in home-based technology augmenting, whereas MNCs in other (developing) countries are more oriented towards home-based technology exploiting. It can therefore be argued that R&D networks organized by MNCs in a specific host country are related to not only their internal resources but also the location-specific advantages within the host country (Chen, 2004; Dunning, 1993). However, much research on MNCs' R&D in China tends to ignore the significant difference in R&D endowments and hence the type of R&D networks of the MNCs' R&D units across regions within China.

Against the above backdrop, the key issue for this paper is what locational advantages (Dunning, 1993) of an RIS within a host country affect the network linkages and networking strategy of MNCs' offshore R&D units; more specifically, in what way R&D subsidiaries of Taiwan-based firms in different Chinese regions interact with their local innovative milieu (Camagni, 1991), in terms of local knowledge linkages. In doing so, the paper aims to enrich the current understanding of R&D internationalization in several ways. First, the paper attempts to examine the R&D networking underlying offshore R&D from Taiwan to China, with particular reference to the sub-national level inside China. Second, taking into account China's substantial regional variations, the paper intends to establish a link between the literature of R&D internationalization and that of RIS, with a modified version of Dunning's eclectic paradigm. In terms of international R&D networking of MNCs' offshore R&D (Helble and Chong, 2004; Westney, 1990), we refer to the classification of technology exploitation and technology augmentation (Bas and Sierra, 2002; Kuemmerle, 1999a,b; von Zedtwitz and Maximilian, 2002). In parallel, an RIS arguably may consist of two subsystems: a knowledge generation and diffusion subsystem (hereafter KGDS) and a knowledge application and exploitation subsystem (hereafter KAES) (Asheim and Coenen, 2005; Autio, 1998; Tödtling and Trippel, 2005). In the paper, efforts will be made to map the relationship between foreign subsidiaries' local R&D networking and their host RISs in China. Third, unlike the main body of the literature upon similar issues, which largely takes the form of case studies or are intensive by nature (Westney, 1990; Chen et al., 2009; von Zedtwitz, 2004), the paper takes advantage of a government databank to adopt a quantitative approach to spotlight the role played by some aspects of an RIS in determining the local R&D networking of Taiwan-based firms in China. The study first measures Taiwan-based MNCs' R&D networking indexes at a subsidiary level. MNCs' R&D networks are measured quantitatively by synthesizing the ideas of Zander (1999) and Kuemmerle (1999a,b). Based on the approach of Tödtling and Trippel (2005), the paper also measures various RIS indexes for three broadly defined regions in China, including the Beijing–Tianjin–Hebei Region (hereafter BTH), the Yangtze River Delta (hereafter YRD), and the Pearl

River Delta (hereafter PRD). It further statistically examines the relationships between the R&D networking of Taiwan-based MNCs and their host RISs in China, with the Seemingly Unrelated Bivariate Probit Regression model.

The rest of the study is organized as follows. The next section reviews the literature on international R&D networks of MNCs' offshore subsidiaries and RIS to propose our modified version of Dunning's eclectic paradigm. Section 3 discusses the way in which some key indexes are measured. Section 4 presents descriptive statistical analyses to compare Taiwan-based firms' cross-border technology linkages and offshore local R&D network indexes, regarding three Chinese regions. Section 5 goes further to explore the issues concerned with statistical robustness and to present the empirical findings. Section 6 discusses and elaborates on our empirical findings. The final section draws conclusions.

2. Conceptual framework: MNCs' offshore R&D networks and the host country's regional innovation system

R&D internalization is a topic of growing importance and interest. Several studies have focused on the location of offshore R&D (Fors and Zejan, 1996; Cornet and Rensman, 2001), while other studies have explored its motivations (Westney, 1992; Paoli and Guercini, 1997; Narula, 2000), and still some others have addressed the management and organization of offshore R&D (Westney, 1990; Asakawa, 2001). Considering offshore R&D as an extension of MNCs' home R&D bases, apart from the evolutionary perspective (Ferdows, 1997), some previous studies have sought to figure out the internationalization strategy of firms' innovation networks (Zander, 1999; Kuemmerle, 1999a,b) in terms of their technology application overseas and technology sourcing (Voelker and Stead, 1999; Kumar, 2001; Zander, 1999; Bas and Sierra, 2002) or the locations of their offshore R&D units (Kuemmerle, 1999a,b). On the one hand, the mandates of MNCs' R&D units in their global innovation networks can vary across countries (Cantwell, 1992; Cantwell and Janne, 1999). On the other hand, MNCs can be a nexus of knowledge flows across the home and host countries (Gupta and Govindarajan, 1991). As they pursue certain specific purposes, MNCs organize specific R&D networks with local firms, research institutes, or universities in the host countries. It should be noted that the location-specific R&D strategies of MNCs' offshore R&D and hence the patterns of offshore R&D networks can also be referred to the intra-country context of a host economy.

However, few studies have directly mapped patterns of offshore R&D networks in terms of their R&D partners in the host countries/regions. Since MNCs represent only half the R&D internationalization story, what the host countries/regions possess as the locational advantages arguably should form the other side of the coin for R&D internationalization (Liu and Chen, 2005; Dunning, 1993), thus bringing about the interplay of the MNCs' offshore R&D and the host countries' innovation system, leading to the interaction of MNCs' offshore R&D facilities with the host countries' RISs and local stakeholders in one way or another. The study will touch upon the literature of RIS¹ below in detail.

2.1. Patterns of MNCs' offshore R&D networks

The goals and characteristics of offshore R&D activities can be summarized in two broad categories: (1) market seeking, or home-base exploiting, supporting the development of new markets and foreign production sites and (2) asset-seeking or home-base

¹ Our review of the literature of RIS is not meant to be comprehensive, but aims to establish a constructive dialogue between the literature of RIS and that of R&D internationalization.

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