



# What determines the location choice of R&D activities by multinational firms?

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## ARTICLE INFO

### Article history:

Received 11 October 2010

Received in revised form 14 January 2013

Accepted 11 June 2013

Available online 16 July 2013

### JEL classification:

F23

O32

R38

### Keywords:

Foreign direct investment

Internationalisation of R&D

Location choice

Conditional logit models

Nested logit models

European Union

## ABSTRACT

We analyse 446 location decisions of R&D activities by multinational firms incorporated in the European Union over 1999–2006. Our results suggest that on average, the location probability of a representative R&D foreign affiliate increased with agglomeration economies from foreign R&D activities, human capital, proximity to centres of research excellence and the research and innovation capacity of the region. Further, our evidence suggests that in comparison to European multinational firms, the effects of patents intensity and proximity to centres of research excellence were stronger in the case of North American multinational firms. While government R&D expenditure intensity increased the probability of location of R&D activities by European multinational firms in the region, it did not have a significant effect on the probability of location of R&D activities by North American multinational firms.

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## 1. Introduction

There has been a growing internationalisation of enterprise R&D activities over the last two decades. Multinational enterprises (MNEs) are the main drivers of this growing internationalisation of enterprise R&D and in many countries foreign affiliates carry out more R&D than domestic firms (OECD, 2007; Abramovsky et al., 2008). While traditional cross-border R&D enterprise activities have tended to locate in developed economies, an increasing amount of R&D outward investment in recent years has gone to emerging economies (OECD, 2007; European Commission, 2008; Sachwald, 2008). The type and motivations of R&D investment vary depending on whether R&D activities by multinationals were located in developed or emerging economies (Thursby and Thursby, 2006; Shimizutani and Todo, 2008; Sachwald, 2008).

In recent years, the speed and extent of the internationalisation of R&D have increased (von Zedtwitz and Gassmann, 2002;

UNCTAD, 2005; Abramovsky et al., 2008). This increased mobility of R&D and innovation activities has been linked to increased global competition, technological change, in particular the use of information and communication technologies (ICT) and the availability and costs of skills (Abramovsky et al., 2008; OECD, 2008). In addition to the traditional role of R&D foreign investment in diffusing technology (demand-driven) related to adapting products and services to local market conditions and supporting MNEs local manufacturing operations, R&D foreign investment is being increasingly motivated by tapping into worldwide centres of knowledge (supply-driven) as part of firms strategies to source innovation globally (Wortmann, 1990; Hakanson and Nobel, 1993; Florida and Kenney, 1994; Florida, 1997; Patel and Vega, 1999; Le Bas and Sierra, 2002; Iwasa and Odagiri, 2004; von Zedtwitz and Gassmann, 2002; Ambos, 2005; Abramovsky et al., 2008; OECD, 2008).

Over the period 1995–2005, the share of foreign affiliates in total business R&D expenditure has increased substantially in almost all European Union's countries (European Commission, 2008). In 2005, this share was over 70% in Ireland, over 50% in Belgium and the Czech Republic, over 40% in Austria and Sweden. In contrast, the share of R&D expenditure by foreign affiliates was lower, less than

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25% in Slovakia and Finland. The European Union (EU) is the largest recipient of R&D investment by US multinationals. In 2005, the EU accounted for 62.5% of the R&D expenditure of affiliates of US parent companies abroad. [Abramovsky et al. \(2008\)](#) show that in comparison to 1990, over the period 2000–2004, the average level of innovative activity of multinational firms from EU countries located abroad grew faster than their innovative activity conducted in the home country. This dynamics has led to a growing share of the innovative activity located abroad in the total innovative activity of multinational firms.

This increasing internationalisation of R&D activity in the EU raises a number of questions which are interesting and relevant for both research and policy making: Where are the R&D activities of multinational enterprises located? Who are the main foreign investors in R&D activity? What factors drive the location choice of multinational R&D activity?

To answer these questions, we analyse the determinants of the location choice of R&D activities by multinational firms across regions in the European Union. By considering regions as location choices we account for heterogeneity of locations within countries and avoid the aggregation bias which might arise when using country averages in cross-country analyses. We use a large firm-level data set<sup>1</sup> which enables us to consider a wide range of location choices of R&D activities by multinational firms. Specifically, we analyse the location choice of R&D activities of 446 new foreign affiliates incorporated in the European Union over the 1999–2006 period. The large number of location choices (233 regions) enables us to obtain robust estimates of determinants of the attractiveness of regions to foreign investment in R&D activity.<sup>2</sup>

The traditional theory of multinational firms has modelled the location decision of multinational firms assuming that R&D activity is located where production takes place and it has not addressed specifically the case of the location choice of R&D activities by multinational firms.<sup>3</sup> Notable exceptions are [Markusen \(2002\)](#) and [Ekholm and Hakkala \(2007\)](#). These latter theoretical contributions allow the geographical separation of knowledge-based (R&D) activities and production facilities in a two-country general equilibrium setup. The theoretical model proposed by [Markusen \(2002\)](#) known as the “knowledge capital model” of multinationals firms predicts that when trade costs are low, international production is likely to locate in large economies while knowledge-intensive activities will concentrate in small skills-intensive economies. The model developed by [Ekholm and Hakkala \(2007\)](#) allows agglomeration forces to arise in both production and R&D activities and predicts that international production will locate in a larger economy while R&D activities by multinationals will locate in a smaller economy to benefit from R&D spillovers.

In contrast to the slow development of the theoretical literature on the location choice of R&D activities by multinational firms, a growing number of empirical studies have analysed the internationalisation of R&D and the development of R&D global networks ([Florida and Kenney, 1994](#); [Patel and Vega, 1999](#); [Frost, 2001](#); [Ambos, 2005](#); [Abramovsky et al., 2008](#); [Sachwald, 2008](#)).

Given that multinational enterprises are concentrated in R&D-intensive industries, many factors driving the location choice of foreign affiliates are also relevant and important in the case of R&D

activities of multinationals. However, as documented in a number of recent studies in international business, in addition to demand-side factors, such as market access, factors specific to the R&D sector such as knowledge-sourcing have become increasingly important as a motivation for establishing R&D units abroad ([Florida, 1997](#); [Patel and Vega, 1999](#); [Frost, 2001](#); [Le Bas and Sierra, 2002](#); [von Zedwitz and Gassmann, 2002](#); [Ambos, 2005](#); [Ito and Wakasugi, 2007](#); [Belderbos et al., 2008](#)). Most existing studies analyse determinants of the location choice of foreign R&D in a single country setup. [Cantwell and Iammarino \(2000\)](#) analyse the location patterns of multinational networks for innovation in the UK regions. [Frost \(2001\)](#) examines the origin of external sources of innovation of US greenfield subsidiaries. [Ito and Wakasugi \(2007\)](#) and [Shimizutani and Todo \(2008\)](#) investigate determinants of Japanese R&D investments abroad and [Iwasa and Odagiri \(2004\)](#) analyse determinants of Japanese R&D investment in the US. [Ambos \(2005\)](#) analyses motivations of German-owned multinational enterprises with international R&D activities.

This paper builds on and extends these two strands of literature, namely the existing theoretical and empirical literatures, on international trade and investment on one hand, and on the internationalisation of R&D and global R&D networks on the other hand. We add to the empirical literature on the location choice of multinational enterprises in three ways. First, in contrast with most existing empirical studies mentioned above which consider both demand-driven (market access) and supply-driven (knowledge sourcing) motivations for foreign direct investment in R&D in a single country setup, we estimate location choice models in a multi-country setup. Second, in contrast to existing cross-country analyses, we account for heterogeneity of locations within countries and avoid aggregation bias in the estimates of the location choice determinants. Third, in contrast to previous studies, we use an improved econometric methodology to account for spatial correlation among location alternatives and firms due to unobserved location-specific characteristics.

Our results suggest that on average, the probability to locate in an EU region increased with agglomeration economies from foreign R&D activities, human capital, proximity to centres of research excellence and the research and innovation capacity of regions. There is also evidence of a geographical structure in the location choice of R&D multinational firms across the European Union. Further, our evidence suggests that in comparison to European multinational firms, the effects of patents intensity and proximity to centres of research excellence were stronger in the case of North American multinational firms. While government R&D expenditure intensity increased the probability of location of R&D activities by European multinational firms it had no significant effect on the location of R&D activities by North American multinational firms.

The remainder of this paper is organised as follows. Section 2 describes the empirical methodology and testable hypotheses. Section 3 presents our data and summary statistics. The results of our econometric analysis are presented in Section 4. Finally Section 5 summarises our results and concludes.

## 2. Empirical methodology

### 2.1. Modelling location choice

The background for our analytical framework is the literature on the behaviour of multinational firms ([Dunning, 1977, 1981](#); [Cantwell, 1994](#); [Krugman, 1991](#); [Horstmann and Markusen, 1992](#); [Markusen, 1995](#)). This literature models a multinational firm's location decision as part of a three-step decision-making process which starts with the firm's decision to serve a foreign market and follows with the choice to undertake foreign direct investment

<sup>1</sup> The *Amadeus* data set provided by Bureau van Dijk contains information on over 18 million firms located in 43 countries in Europe. We discuss in more detail our data in Section 3.

<sup>2</sup> Data on regions is taken from the Regio data set of the Eurostat and the European Regional Database provided by Cambridge Econometrics. We discuss in more detail these data in Section 3.

<sup>3</sup> For reviews of this literature see [Fujita et al. \(1999\)](#) and [Markusen \(2002\)](#).

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