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Ensayos sobre inversión extranjera directa: el caso español

Tesis Doctoral presentada por **Dña. Paula Gutiérrez Portilla** para obtener el título de Doctor con Mención Internacional.

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Essays on foreign direct investment: the Spanish case

Doctoral Thesis presented by **Ms. Paula Gutiérrez Portilla** to obtain the degree of Doctor of Philosophy with the International Distinction.

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A mis padres

Contents

Contents

List of Tables

List of Figures

Introducción

Introducción

Las últimas décadas han estado marcadas por un flujo creciente de inversión extranjera directa (de ahora en adelante IED) alimentado por el proceso de globalización, la progresiva reducción en los costes de transporte y la eliminación de barreras comerciales. Se espera que la IED desempeñe un papel fundamental a través de la internacionalización de la actividad económica, la mejora del desarrollo económico y los potenciales efectos positivos sobre el empleo, las exportaciones y la producción.

Los flujos de entrada de IED se consideran una fuente esencial de capital humano y adquisición de capacidades, promoción de tecnologías avanzadas, e incrementos en la productividad y la formación laboral. En consecuencia, en vista de los potenciales beneficios de la IED sobre el país receptor, resulta fundamental estudiar los factores explicativos de su atracción.

Otra cuestión de gran relevancia es el impacto que la IED puede tener sobre el proceso de crecimiento económico de la economía receptora. Aunque ha sido un tema ampliamente tratado en la literatura (De Mello, 1997; Ozturk, 2007; Clark et al., 2011), los estudios empíricos en su mayoría adoptan un enfoque nacional. Sin embargo, considerar una perspectiva regional resulta más realista y adecuado que un enfoque nacional. Por otro lado, casi todos los estudios previos pasan por alto la existencia de efectos spillover, cuya importancia se ha subrayado en la literatura teórica reciente (Barrios et al., 2005; Driffield, 2006; Capello, 2009). El papel de estos efectos spillover espaciales resultan de gran relevancia cuando se realiza un análisis regional.

La economía española despierta especial interés ya que se ha convertido en un líder en la economía mundial no sólo como destino sino también como emisor de inversión (Myro, 2015). Gracias a su incorporación a la Comunidad Europea en 1986, hoy Unión Europea, los flujos de inversión extranjera directa de entrada y salida registraron enormes incrementos desde la segunda mitad de los años noventa (Maté Rubio, 1996; Campa y Guillén, 1996; Gordo et al., 2008; Bajo-Rubio y Torres, 2001). En esa época las empresas españolas empezaron a internacionalizarse y el país pasó a ser un exportador neto de IED desde principios del nuevo siglo. La inversión española en el exterior actualmente constituye una parte sustancial de la IED global.

Desde el punto de vista de la entrada de IED en España, se puede apreciar que existe una distribución de la IED entre las regiones españolas que dista mucho de ser homogénea. Madrid y Cataluña se desvelan como los dos grandes focos de atracción de IED. Por consiguiente, parece apropiado llevar a cabo un análisis a nivel regional. Otro aspecto importante ligado al hecho de considerar una perspectiva regional que surge al examinar el efecto de la IED sobre el crecimiento es el llamado 'efecto sede', es decir, el hecho de que la IED no se contabiliza donde efectivamente tiene lugar la inversión sino en aquella región en la que está localizada la sede de la empresa. Pese a su relevancia, este aspecto no ha sido abordado en la literatura hasta la fecha. Una de sus consecuencias directas es que puede afectar a la fiabilidad de los resultados obtenidos acerca de la relación entre IED y crecimiento económico a nivel regional.

Por otro lado, ni que decir tiene que la Gran Recesión económica que estalló en el año 2008 ha modificado de forma notable los patrones y la evolución de los flujos de IED a nivel mundial. El caso español no ha sido una excepción. Las empresas españolas se han visto profundamente afectadas por la crisis. A pesar de que la falta de demanda doméstica llevó a las empresas españolas a expandir sus negocios en el exterior (Eppinger et al., 2018), los flujos de inversión directa en el exterior descendieron. Por lo tanto, en lo que respecta a la inversión directa española en el exterior, sería oportuno analizar cómo han evolucionado sus determinantes con el estallido de la Gran Recesión y si se ha producido un cambio en la estrategia de inversión directa española en el exterior. Debemos tener en cuenta el papel de la dependencia espacial en el análisis puesto que, de lo contrario, las estimaciones serían sesgadas e inconsistentes (Anselin, 1988; LeSage y Pace, 2009).

Asimismo, la progresiva liberalización de las relaciones económicas internacionales ha suscitado interés por la dinámica de comercio e inversión. Determinar si la IED de salida y las exportaciones son sustitutivos o complementarios es fundamental para el diseño de políticas económicas que fomenten la inversión directa en el exterior. Este asunto ha despertado inquietudes acerca de las potenciales consecuencias sobre la balanza de pagos. Aunque la relación entre IED de salida y exportaciones ha generado debate, no existe acuerdo en la literatura sobre este tema (Eaton y Tamura, 1994; Lin, 1995; Pfaffermayr, 1996; Clausing, 2000; Hejazi y Safarian, 2001; Pantulu y Poon, 2003; Türkcan, 2007).

En este contexto, la presente Tesis Doctoral profundiza en el estudio de diferentes aspectos de la IED en España, así como la dinámica de la inversión directa española en el exterior. Este trabajo se compone de cuatro capítulos independientes pero estrechamente relacionados que abordan el análisis de los determinantes de la IED en las regiones españolas, su impacto sobre el crecimiento económico, el efecto de la Gran Recesión sobre la inversión directa española en el exterior y la relación existente entre esta inversión y las exportaciones.

En el Capítulo 1 se presenta un análisis de los determinantes de los flujos de IED en España. Debido a las diferencias regionales existentes y dado que el atractivo de una localización no depende únicamente de sus propias ventajas sino también de las características específicas de la empresa y del sector (Barba-Navaretti y Venables, 2004), adoptamos una perspectiva regional y sectorial. Con respecto a la estrategia econométrica empleada, el modelo de IED propuesto se estima en primer lugar por el Método de Momentos Generalizados para abordar potenciales problemas de endogeneidad, y a continuación por Mínimos Cuadrados Generalizados. Además, con el objetivo de determinar si los factores explicativos de la IED difieren en función del ciclo económico y del lugar de origen de la IED, este capítulo también estudia los factores determinantes de los flujos de IED durante los subperiodos de pre-crisis y crisis, y de aquellos procedentes de Europa y América.

Para completar el estudio anterior, el Capítulo 2 estudia el papel de la IED a la hora de impulsar el crecimiento económico de las regiones españolas. Para ello, se propone un método para estimar la magnitud del descuidado efecto sede en los datos de IED. De este modo, se obtienen nuevos datos de IED descontado el efecto sede. A continuación, se testa la hipótesis de si el hecho de pasar por alto el efecto sede subestima los efectos spillover espaciales de la IED sobre el crecimiento económico. Se estima un modelo Durbin espacial de crecimiento con datos primarios de IED y se vuelve a estimar este modelo con los nuevos datos de IED libres del efecto sede. Este modelo permite detectar la existencia de spillovers espaciales derivados tanto de la variable dependiente como de las explicativas.

Centrándonos ahora en la IED de salida en lugar de entrada, el Capítulo 3 examina si la estrategia de inversión directa española en el exterior se ha visto afectada significativamente por la Gran Recesión. En concreto, se estudian los determinantes de la IED y la estrategia predominante durante los periodos pre-crisis y crisis. Debido a la relevancia de las interacciones espaciales en la IED, se considera la influencia de terceros países en el análisis. Esto ha dado lugar a estrategias de IED más complejas, como la de tipo export-platform (Yeaple, 2003; Ekholm et al., 2007) y complex vertical (Baltagi et al., 2007). El análisis de panel espacial se lleva a cabo tanto a nivel agregado como desagregado, para los sectores industrial y servicios, con el objetivo de determinar posibles diferencias entre estos sectores.

El último capítulo se ocupa de estudiar la relación entre la inversión directa española en el exterior y las exportaciones. Se lleva a cabo un análisis en panel heterogéneo y se emplean estimadores que son robustos a la existencia de dependencia de sección cruzada para estimar la relación de largo plazo entre inversión directa en el exterior y exportaciones. Asimismo, se estudia la causalidad entre estas variables en el corto y largo plazo por medio de la estimación de un modelo de corrección de error. Además, se aplica el procedimiento de filtrado espacial desarrollado por Getis (1995) para eliminar la dependencia espacial de las variables. De esta forma, podemos confirmar que existen otros factores, además de los geográficos, detrás de la dependencia de sección cruzada.

Diferentes versiones de los cuatro capítulos se han presentado en diversos congresos y seminarios especializados tanto nacionales como internacionales. Asimismo, algunos de los resultados obtenidos en esta Tesis Doctoral han sido publicados y otros tienen superada la primera fase del proceso de revisión en diferentes revistas académicas, todas ellas de impacto *JCR*. En particular, el Capítulo 1 se ha publicado (en colaboración) en *Journal of Regional Research*.

Introduction

Introduction

Over the last decades, there has been a surge in foreign direct investment (henceforth FDI) fueled by the process of globalization, the progressive reduction in transport costs and the removal of trade barriers. FDI is expected to play an essential role through the internationalization of the economic activity, the enhancement of economic development and the potential positive effects on employment, exports and output.

Inward FDI flows are considered to be a crucial source of human capital and skill acquisition, promotion of advanced technologies, and increases in productivity and labor training. Consequently, due to the potential benefits of FDI in the host economy, it seems instrumental to understand the factors behind its attraction.

Another aspect that deserves particular attention is the impact that FDI could have on the process of economic growth of the host economy. Although this issue has been largely discussed in the literature (De Mello, 1997; Ozturk, 2007; Clark et al., 2011), most empirical analyses are developed at the country level. However, considering a regional perspective is more realistic and suitable than a national one. Apart from that, most of the previous studies overlook the presence of spatial spillovers, which importance has been highlighted in the recent theoretical literature

(Barrios et al., 2005; Driffield, 2006; Capello, 2009). The role of these spatial spillovers turns out to be of utmost importance in the case of a regional analysis.

The Spanish economy is especially relevant since it has become a leading player in the global economy not only as a destination but also as a source of foreign investment (Myro, 2015). Thanks to its integration into the European Community in 1986, nowadays the European Union, FDI inflows and outflows registered massive increases since the second half of the nineties (Maté Rubio, 1996; Campa and Guillén, 1996; Gordo et al., 2008; Bajo-Rubio and Torres, 2001). At that time Spanish firms began to internationalize and the country became a net FDI exporter since the beginning of the new century. Spanish FDI outflows currently account for a substantial part of global FDI.

Focusing the attention on inward FDI coming to Spain, it can be appreciated that FDI distribution across Spanish regions is far from being homogeneous. Madrid and Cataluña stand out as the most dynamic areas of investment. Thus, it seems pertinent to conduct the analysis at the regional level. Linked to the fact of adopting a regional approach, another crucial issue arises when the effect of FDI on growth is examined. It is the so-called ‘headquarters effect’, that is, the fact that FDI is not always registered where it is effectively made but in the region in which the firm’s headquarters is located. Despite its importance, this effect has been largely disregarded in FDI literature so far. One of its direct implications is that it can seriously affect the reliability of the results obtained about the links between FDI and economic growth at the regional level.

Additionally, it goes without saying that the global economic crisis that erupted in the year 2008 has remarkably altered the patterns and evolution of FDI flows all over the world. The Spanish case has not been an exception. Spanish firms have been deeply affected by the crisis. Despite the lack of domestic demand forced Spanish firms to expand their business abroad (Eppinger et al., 2018), FDI outflows dropped. Therefore, with regards to outward FDI from Spain, it would be valuable to examine how its driving factors have evolved with the outbreak of the Great

Recession and whether there has been a change in the Spanish direct investment strategy abroad. It is essential to take into account the role of spatial dependence in the analysis as, otherwise, estimates would be biased and inconsistent (Anselin, 1988; LeSage and Pace, 2009).

Furthermore, the progressive liberalization of international economic relations has raised increasing interest in the dynamics of trade and investment. Knowing whether outward FDI and exports are substitutes or complements is imperative for the design of policies aiming to foster FDI abroad. This issue has raised concern about the potential consequences that engaging in outward FDI could have over the balance of payments. Although the relationship between outward FDI and exports has been subject to debate, there is still no agreement in the literature on this issue (Eaton and Tamura, 1994; Lin, 1995; Pfaffermayr, 1996; Clausing, 2000; Hejazi and Safarian, 2001; Pantulu and Poon, 2003; Türkcan, 2007).

In this context, the aim of this Doctoral Thesis is to delve into the understanding of different aspects of FDI in Spain as well as the dynamics of Spanish direct investment abroad. It comprises four independent but connected chapters dealing with the study of the determinants of inward FDI in the Spanish regions, its effect on economic growth, the impact of the crisis on the Spanish direct investment abroad and the link between this investment and exports.

Chapter 1 investigates the main determinants of inward FDI flows in Spain. In view of the existing regional differences and because the attractiveness of a location does not only depend on its own advantages but also on firm' and sector characteristics (Barba-Navaretti and Venables, 2004), we adopt a regional and sectoral perspective. Concerning the econometric approach, the FDI model proposed is estimated firstly by Generalized Method of Moments to deal with the potential endogeneity bias and then, by Generalized Least Squares. Additionally, with the aim to examine whether FDI determinants differ depending on the business cycle and the place of origin of FDI, this chapter also explores the primary drivers of FDI flows over pre-crisis and crisis subperiods, and those coming from Europe and America.

To complement the previous study, Chapter 2 analyzes the role of FDI in fostering economic growth in the Spanish regions. To address this issue, it proposes a method to estimate the magnitude of the commonly overlooked headquarters effect in FDI data. Thereby, new FDI data free from this effect is obtained. Then, the hypothesis of whether neglecting the headquarters effect underrates the spatial spillovers of FDI on economic growth is tested. A spatial Durbin growth model is estimated by employing raw FDI data and later, this model is re-estimated with the new FDI data free from the headquarters effect. This model allows for the emergence of spatial spillovers derived not only from the dependent variable but also from the independent ones.

Shifting the focus now from inward to outward investment, Chapter 3 examines whether the Spanish direct investment strategy abroad has been significantly affected by the Great Recession. Specifically, FDI determinants and the predominant strategy are analyzed over pre-crisis and crisis periods. Due to the relevance of spatial interactions in FDI, third-country effects are incorporated into the analysis. This has added to the traditional horizontal and vertical FDI strategies some other more complex strategies, such as the export-platform (Yeaple, 2003; Ekholm et al., 2007) and the complex vertical FDI (Baltagi et al., 2007). The spatial panel analysis is performed at an aggregate but also at a disaggregate level, for industry and services, to unveil potential differences across these sectors.

The last chapter assesses the link between Spanish direct investment abroad and exports. It follows a heterogeneous panel approach and uses estimators that are robust to the presence of cross-section dependence to estimate the long-run relationship between outward FDI and exports. In addition, the long- and short-run causality between these two variables is examined through the estimation of an error correction model. Moreover, we apply the spatial filtering procedure proposed by Getis (1995) to remove the spatial dependence embedded in the variables. In so doing, we confirm that there are other factors, apart from those of geographical nature, causing cross-section dependence.

Note that different versions of the four chapters have been presented in a variety of national and international conferences and seminars. Besides, some of the results obtained in this Doctoral Thesis have been published and others have passed the first stage of the review process in academic journals with JCR impact factor. Particularly, Chapter 1 has been published (in collaboration) in *Journal of Regional Research*.

Chapter 1

Foreign direct investment in the Spanish regions: what are the influencing factors?

1.1 Introduction

Within a context of ongoing liberalization and internationalization of business activities there has been a process of increasing international capital movements over the last few decades. FDI has not been an exception to this process. In fact, FDI flows have grown dramatically over this time, despite a temporary contraction during the global crisis (OECD, 2011).[1] Understanding the factors behind FDI has become an interesting research issue, mainly because, although with some misgivings, FDI is considered to be a key driver of economic growth. Consequently, there is a vast literature devoted to the study of FDI determinants and to explain the existence of significant disparities in the distribution of FDI flows across countries.

Until recently, developed countries were the largest recipients of FDI; however, in 2012 developing countries surpassed developed countries (UNCTAD, 2013). At present, more than half of global FDI flows (54%) concentrate in developing economies, 39% goes to developed countries, and 7%, to transition economies (UNCTAD, 2014).

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[1] In any case, global FDI flows in 2011 exceeded the mean value for the period 2005-2007, reaching $1.5 trillion (UNCTAD, 2012).

FDI distribution within countries is also characterized by prominent regional disparities and, in this respect, the case of Spain clearly stands out. Spain became a highly attractive destination for worldwide FDI during the mid-eighties (Bajo-Rubio and López-Pueyo, 2002; Roca, 2010), but FDI inflows have never been equally distributed among regions. The richest ones have always been the principal recipients of foreign capitals so, unlike in the FDI distribution across countries, there has not been any change in this pattern. Consequently FDI, far from promoting regional economies' harmonious development, might have helped to increase regional inequalities in Spain (Díaz-Vázquez, 2003).

With these considerations in mind, studying the factors influencing FDI decisions in Spain seems to be of paramount interest. Only when these determinants are known, policies focused on FDI attraction can be correctly designed and implemented. Additionally, knowing the determinants of FDI is helpful to ascertain how FDI-fueled development policies can affect the extent and evolution of regional inequalities.

Most of the papers analyzing these FDI determinants have adopted a national perspective (Bajo-Rubio, 1991; Egea and López-Pueyo, 1991a; Bajo-Rubio and Sosvilla-Rivero, 1992, 1994; Martín and Velázquez, 1996, 1997; Muñoz-Guarasa, 1999; Bajo-Rubio and López-Pueyo, 2002; Allard and Pampillón, 2005; Chislett, 2014). By comparison, little attention has been paid to regional aspects. To the best of our knowledge, the only exceptions are the papers by Egea and López-Pueyo (1991b), Pelegrín (2002), Pelegrín and Bolancé (2008), Rodríguez and Pallas (2008), and Villaverde and Maza (2012).

This paper tries to contribute to this branch of the literature by providing additional insights into the main determinants behind inward FDI flows in Spain (for the period 1997-2013) from a regional and sectoral perspective. On the one hand, because the extant regional differences deserve special attention. On the other because, according to the theoretical literature on FDI, the attractiveness of a location does not only depend on its own advantages but also on firm' and sector characteristics (Barba-Navaretti and Venables, 2004). Apart from that, with the aim to examine whether FDI determinants differ depending on the business cycle and/or the place of origin, we also perform our analysis for two sub-periods (pre-crisis (1997-2007) and crisis (2008-2013)) and the two main places of origin (Europe and America).

The remainder of the paper is organized as follows. In Section 1.2 a review of the theoretical and empirical literature on inward FDI determinants is performed. Afterward, Section 1.3 outlines basic patterns of the FDI distribution across Spanish regions. Then, in Section 1.4, the model to uncover the FDI determinants is specified, estimated, and the results are presented. Finally, some concluding remarks are offered in Section 1.5.

1.2 FDI determinants: theory and empirical evidence

1.2.1 Theoretical approaches

Here we present a short theoretical survey on FDI determinants to gain some insight into the motivation for firms to invest abroad. To start with, it should be noted that there is no a generally accepted theory on the issue, so the need to delve into the different approaches analyzing FDI from the locational perspective arises.[2]

The earliest attempt to explain FDI is based on the *MacDougall-Kemp model* in the context of the neoclassical trade theory. MacDougall (1960) and Kemp (1964) underlined the importance of differences in capital returns in favor of FDI. In this vein, *Kojima's theory* of foreign investment (the so-called model of pro-trade-oriented FDI) appeared as an extension of the neoclassical theory that includes cross-border transactions of intermediate products (Kojima, 1973).

[2] For a thorough literature review on FDI determinants readers are referred to Blonigen (2005), Faeth (2009) and Assunçao et al. (2013).

Hymer (1976)[3] criticized this approach claiming that FDI cannot exist in a context of perfect competition. Hymer, together with Kindleberger (1969) and Caves (1971), developed the *monopolistic advantage theory*. This theory states that multinational enterprises (MNEs) are monopolistic rent seekers and it insists on the fact that firms operating abroad have to compete with domestic firms that keep an advantageous position in terms of culture, legal system, consumer's preference and so forth. Accordingly, foreign firms have to compensate these disadvantages with a higher market power so as to make international investment profitable. This can be done, among other ways, by resorting to the superior technology possessed by MNEs (Kindleberger) or product differentiation (Caves).

Considering the issue of firm rivalry, Vernon (1966) puts forward the *production cycle theory*,[4] according to which the FDI location might change as firms move from the innovatory to the standardized stage of production.

The *Internalization theory* is of great interest as well. This theory (Coase, 1937; Buckley and Casson, 1976; Hennart, 1982), tries to explain the growth of transnational companies and their motivations for investing abroad.[5] It shows that MNEs organize their internal activities to develop and exploit specific advantages related to the two types of integration: vertical and horizontal. While vertical FDI positively responds to factors such as the cost and quality of production factors or the endowments of natural and technological resources, horizontal FDI is more sensitive to market characteristics.

An alternative framework for analyzing FDI is offered by the *new trade theory* (Markusen and Venables, 1998). It combines ownership and location advantages

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[3] Hymer's dissertation, presented in 1960, was published in 1976 as a book entitled "*The international operations of national firms: a study of direct foreign investment*".

[4] It seems convenient to mention that this theory has been mainly used to explain certain types of FDI, mainly FDI made by U.S. companies in Western Europe manufacturing industry after the Second World War.

[5] This theory focuses on external market failures when explaining FDI instead of on MNEs' advantages (Hymer, 1976).

with technology and country characteristics to analyze both horizontal and vertical FDI.[6] The first type of FDI is explained using the proximity-concentration hypothesis while the second one uses the factor-proportions hypothesis.

This strand of literature was complemented by *Markusen's knowledge-capital model* (Markusen, 1997, 2002), in which vertical and horizontal motivations for FDI are integrated. Thereby, similarities in market size, factor endowments and transport costs are determinants of horizontal FDI, whereas differences in relative factor endowments explain vertical FDI.

Within this framework, the *eclectic paradigm* coined by Dunning (1980, 1988, 2001) emerges as a combination of previous theories of FDI into a more comprehensive model. Dunning suggests that a firm becomes multinational to exploit ownership, location and internalization (OLI) advantages. Ownership advantages refer to the existence of firm-specific assets, such as superior technology, specific know-how and managerial competences, which provide foreign investors with essential advantages over local firms. As its very name implies, locational advantages refer to the peculiarities of a particular location that make it more attractive for foreign investment. Finally, internalization advantages refer to those kinds of advantages that make more profitable for a firm to carry out transactions within it rather than outsourcing.

Focusing on locational advantages, Dunning identifies four main motives for FDI: market seeking, resource seeking, efficiency seeking and strategic assets seeking. Market seeking investors are attracted by the host market size, its per capita income and the consumer demand in order to take advantage of the economies of scale. For its part, resource seeking investment is aimed basically at gaining access to cheap natural resources and/or raw materials. Efficiency seeking investment is designed to promote a more efficient division of labor or specialization of assets by MNEs. Finally, strategic asset seeking investment is designed to protect or augment the

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[6] New trade models were empirically tested by Brainard (1997), who found strong support for horizontal FDI.

ownership advantages of the investing firms and reduce those of their competitors (Dunning, 2000).

1.2.2 Empirical evidence for Spain

At this point we present a brief overview of the most relevant studies analyzing the determinants of foreign direct investment in Spain, both at a national and regional level. Now then, it is worth mentioning that studies carried out at national level have been the most prolific.

From a national perspective the first noteworthy paper, by Bajo-Rubio (1991), performs both a time series and a cross-section analysis for the period 1961-1988. He finds that FDI is linked to market size and unit labor costs, but also that the qualification of the workforce plays a key role in FDI location in manufacturing industry. In the same vein, Bajo-Rubio and Sosvilla-Rivero (1992, 1994), using a cointegration analysis for the periods 1961-1989 and 1964-1989, find a long-run relationship between FDI inflows and variables such as the level of real GDP, the inflation rate, trade barriers and the lagged foreign capital stock.

With reference to the period 1986-1989 and performing a factor and cluster analysis, Egea and López-Pueyo (1991a) conclude that the sectors receiving most FDI are characterized by a huge dynamism in both production, internal demand and exports. Bajo-Rubio and López-Pueyo (2002), using data for manufacturing sectors for the period 1986-1992 and estimating by Ordinary Least Squares (OLS) with fixed effects, stress the role played by labor skills, product differentiation, productivity and domestic demand. For their part, Martín and Velázquez (1996, 1997) study the determining factors in the bilateral direct investment flows between OECD countries, particularly those received by Spain. These authors, using OLS, OLS with fixed effects and Generalized Least Squares (GLS) estimators, conclude that the supply of skilled labor, a large and dynamic market, the availability of good transport infrastructure and liberal regulations with respect to FDI are essential factors in attracting foreign capital. Likewise, Muñoz-Guarasa (1999) estimates a model by OLS for the period 1987-1995 obtaining similar results: market size, labor costs and the quality of the work force are factors attracting FDI into Spain.

Although no so abundant, the regional perspective has also been brought to the forefront of this field of research. For example, in the study by Egea and López-Pueyo (1991b) a cluster analysis for the period 1985-1989 is carried out, identifying per capita and per employee income, human capital and the productive structure as main determinants of the FDI location; however, the unemployment rate, infrastructure endowment and subsidies are not found significant. Pelegrín (2002), for the period 1993-1998 and using different methods of estimation, shows that market size, the quality labor force and aid and official incentives positively influence the regional location of FDI flows. On the contrary, infrastructure is not found to be a significant driver for FDI. Pelegrín and Bolancé (2008) paper, using a model estimated by GLS, reveals that agglomeration economies and the concentration of research and development activities are important drivers for manufacturing FDI. Nevertheless, the importance of FDI location determinants varies across industries. Rodríguez and Pallas (2008), for the period 1993-2002 and employing GLS (with cross-section weights) and by weighted two-stage Least Squares (W2SLS), make clear that demand factors, the evolution of human capital, the export potential of the sectors, and the differential between labor productivity and the cost of labor play a vital role in attracting flows of FDI.

Finally, Villaverde and Maza (2012), adopting quite a novel methodological approach, analyze the regional distribution of FDI in Spain and its main determinants between 1995 and, depending on the case, 2005/2008. They perform an explanatory factor analysis which leads to four extracted factors labelled as economic potential, labor conditions, market size and competitiveness. The econometric analysis, by GLS and two stage GLS, reveals that economic potential, labor conditions and competitiveness are important for attracting FDI, both at aggregate and sectoral levels. Additionally, when extending the analysis to take into account spatial effects, they find negative geographical spillovers associated to the economic potential and competitiveness factors.

Overall, although the results of the empirical evidence are somewhat mixed, a preliminary conclusion can be drawn from the above literature review: the main factors attracting FDI inflows in Spain are those linked to market-seeking FDI (market size) and resource-seeking FDI (human capital, labor conditions and physical infrastructure endowment). The next two sections, adopting a regional (and also sectoral) perspective, will try to reinforce, or qualify, this conclusion.

1.3 FDI in Spain: regional and sectoral distribution

As the starting point for our empirical analysis, this section offers an overview of the distribution of inward FDI flows across Spanish regions and sectors over the period 1997-2013. To do so, we collect raw information from DataInvex (Spanish Ministry of Economy and Competitiveness).

Table 1.1 provides three main results. First, foreign investment is highly concentrated in just a few regions. For the whole sample period, Madrid and Cataluña received, on average, 79.5% of total FDI, although the amount got by the first is four times that of the second. Besides, should we add the volume picked up by País Vasco and Comunidad Valenciana, the amount received by these four regions would reach nearly 87.5% of total FDI. So, we can see that the distribution of inward foreign investment is very heterogeneous across the Spanish regions. Besides, FDI inflows are very volatile over time, as the coefficient of variation (CV) clearly shows; in any case, differences are quite remarkable across regions, with Aragón, Murcia and Asturias standing out. Second, considering a broad sectoral breakdown (agriculture, industry, construction and services), it can be appreciated that the distribution of inward FDI is not homogeneous either, as industry and service sectors concentrate, on average, 41.4% and 54%, respectively, of total. And third, regarding the main places of origin, it should be noted that FDI coming from Europe and America accounts, on average, for 54.2% and 32.8%, respectively, of total FDI.

To get a great insight into the regional distribution of FDI, we compute the so-called *Inward FDI Performance Index*, proposed by UNCTAD (2001).[7] This index, allowing us to benchmark the extent to which Spanish regions succeed in attracting FDI, is defined as the ratio of a region's share in FDI inflows to its share in GDP (collected from INE):

$$Performance\ Index_i = \frac{FDI_i/\sum_{i=1}^{17} FDI}{GDP_i/\sum_{i=1}^{17} GDP} \tag{1.1}$$

Table 1.2 shows the value of the index over the period 1997-2013. It is important to note that Madrid is in the first position, being the only region with an index greater than one; in particular, the index reveals that FDI inflows in Madrid are more than three and a half times its share of GDP. The disparity between the percentages of FDI and GDP in the case of Madrid could be due to the so-called headquarters effect.[8] For its part, Cataluña gets a bit less than expected according to its share of GDP. The rest of regions receive lower shares of FDI with respect to GDP. Finally, the last column of the table unveils the fact that that there is a large volatility of the index over time for all regions, although in this case Madrid stands out for being the region with the lowest volatility.

[7] UNCTAD also proposes the so-called FDI Potential Index. A new version of this index can be seen in Maza and Villaverde (2015).

[8] Although we are well aware of the relevance of this effect, it is virtually impossible to remove it from the analysis.

Table 1.1 Inward FDI in Spanish regions and sectors. Flows (million euros of 2000). Average 1997-2013.

	Total			Sectoral distribution				Main places of origin	
Regions	Total	CV	%	Agriculture	Industry	Construction	Services	Europe	America
Andalucía	406.00	0.44	2.15	10.26	132.35	83.52	179.88	259.06	83.06
Aragón	446.45	2.43	2.37	0.76	316.05	2.31	127.32	65.35	369.58
Asturias	235.36	1.65	1.25	0.01	224.29	1.37	9.70	209.69	26.06
Baleares	225.15	0.56	1.19	3.80	1.88	58.60	160.88	160.66	16.76
Canarias	518.76	0.83	2.75	9.20	265.78	13.38	230.40	58.90	338.50
Cantabria	13.52	1.17	0.07	0.45	6.94	0.80	5.33	9.34	3.71
Castilla y León	65.66	1.04	0.35	0.81	21.07	2.74	41.04	51.64	6.23
Castilla-La Mancha	85.13	1.33	0.45	1.62	34.32	10.73	38.46	49.29	26.75
Cataluña	2,836.52	0.37	15.04	26.24	1,232.80	109.42	1,468.07	1,737.33	600.02
C. Valenciana	714.91	1.18	3.79	1.52	509.09	15.72	188.59	372.73	309.48
Extremadura	19.40	1.01	0.10	1.73	16.37	0.07	1.23	9.89	6.62
Galicia	165.28	0.99	0.88	1.43	98.23	8.97	56.65	133.38	20.35
Madrid	12,154.16	0.66	64.45	62.83	4,329.99	334.10	7,427.24	6,706.50	3,950.39
Murcia	104.81	1.80	0.56	1.40	86.25	5.22	11.95	48.24	52.97
Navarra	54.78	0.78	0.29	0.48	37.74	3.34	13.21	37.77	7.44
País Vasco	798.54	0.89	4.23	1.74	492.02	75.73	229.05	291.90	369.47
Rioja (La)	14.62	1.21	0.08	0.07	10.74	0.05	3.76	10.92	0.36
Spain	18,859.06	0.50	100	124.34	7,815.89	726.06	10,192.76	10,212.59	6,187.29

Note: CV = coefficient of variation

Table 1.2 Regional distribution of FDI and GDP in Spain. Average 1997-2013.

	$FDI_i/\sum_{i=1}^{17} FDI$ (%)	$GDP_i/\sum_{i=1}^{17} GDP$ (%)	Performance Index	CV
Andalucía	2.24	13.63	0.16	0.58
Aragón	2.46	3.15	0.78	2.34
Asturias	1.30	2.19	0.59	1.80
Baleares	1.24	2.50	0.50	0.65
Canarias	2.86	4.11	0.70	0.82
Cantabria	0.07	1.24	0.06	0.84
Castilla y León	0.36	5.44	0.07	0.81
Castilla-La Mancha	0.47	3.49	0.13	1.33
Cataluña	15.63	18.54	0.84	0.40
C. Valenciana	3.94	9.73	0.40	0.97
Extremadura	0.11	1.67	0.06	1.00
Galicia	0.91	5.29	0.17	0.81
Madrid	66.95	17.84	3.75	0.20
Murcia	0.58	2.52	0.23	1.74
Navarra	0.30	1.72	0.18	0.92
País Vasco	4.40	6.18	0.71	0.83
Rioja (La)	0.08	0.75	0.11	1.12

1.4 Empirical analysis

After the descriptive study of the distribution of FDI flows across the Spanish regions, in this section we address the analysis of its determinants. Our basic regression equation (all variables, apart from the dummy, are expressed in logs) is as follows:

$$fdi_{ij,t} = \alpha + \rho_1 fdi_{ij,t-1} + \beta_1 MS_{i,t-1} + \beta_2 W_{ij,t-1} * HC_{ij,t-1} + \beta_3 RI_{i,t-1} + \beta_4 d_{Madrid} + \varepsilon_{ij,t} \quad (1.2)$$

where the subscripts i, j and t denote region, sector and time, respectively, and ε is the error term.

Table 1.3 Variables, measures and data sources.

Variable	Measurement(*)	Data source
Dependent variable		
Host region sector inward FDI (*FDI_{ij}*)	Flows of inward gross FDI as percentage of GDP	Spanish Ministry of Economy and Competitiveness (DataInvex) and Spanish National Statistical Institute (INE)
Independent variables		
Host region market size (*MS_i*)	GDP, expressed in constant thousand euros of 2000	Spanish National Statistical Institute (INE)
Host region sector wages in interaction with human capital (*$W_{ij}*HC_{ij}$*)	*W_{ij}*: Monthly remuneration per employee, expressed in constant thousand euros of 2000	Cambridge Econometrics
	HC_{ij}: Education index(**) computed with data of employed population by educational attainment	Valencian Institute of Economic Research (IVIE)
Host region infrastructure endowment (*RI_i*)	Kilometers of motorways per 1000 km^2	Eurostat
Dummy for Madrid (d_{Madrid})	A dummy variable for Madrid	Author's own

Notes: (*) the monetary variables are expressed in constant thousand euros of 2000; (**) the education index for each sector is defined as $HC = \sum_{i=1}^{7} \varphi_i A_i$ where φ_i indicates the weight associated with each level of human capital i over the total employed population and A takes the values 0, 6, 10, 12, 14, 15 and 17 for i = 1, 2, 3, 4, 5, 6 and 7. The levels of human capital are as follows: i = 1 = illiterate, i = 2 = without studies and primary education, i = 3 = compulsory secondary education, i = 4 = high school and middle-level training program, i = 5 = higher level training program, i = 6 = previous to superior and i = 7 = superior studies.

The information about the variables used in our econometric model, their units of measure and the statistical sources are concisely provided in Table 1.3. Some additional comments about the inclusion of these explanatory variables are pertinent:

(1) *MS:* According to theory, the characteristics of the market of the recipient economies greatly influence the decision of an MNE to invest. In particular, market-seeking investors are attracted to regions with large markets because they provide more opportunities for sales and profits. Then, a positive relationship between FDI and market size is expected.

(2) $W * HC$: As it is well known, wages have traditionally been considered as a variable influencing the decision of where to invest. Skill intensity, measured by the level of human capital, is as well a key variable to consider as a potential explanation for inward FDI flows (Dunning, 1980, 1988). Although according to theory wages and human capital could be included separately, we found out, in a preliminary estimation, that the wage variable was picking up the effect of human capital on FDI. Accordingly, we include both variables as an interaction one.

(3) *RI:* Good infrastructure allows faster transport and communication, increasing the productivity of investment and, therefore, stimulating FDI inflows.[9]

(4) d_{Madrid}: We include a dummy for Madrid because we try to somewhat capture the headquarters effect.

After specifying the model, here we would like to make some comments about the estimation technique. As for our econometric strategy, we should take into account that there are concerns about potential endogeneity problems between some variables in Equation (1.2); that is, causality might run in both directions and the explanatory variables may not be strictly exogenous (correlated with past and possibly current realizations of the error). For this reason, and in order to correct the potential endogeneity bias, we firstly decided to use the Generalized Method of Moments (GMM) developed by Arellano and Bond (1991) and Arellano and Bover (1995), a dynamic panel data technique that provides unbiased and efficient estimates. These authors propose first-differencing the model in order to eliminate the individual specific effects, and using valid instruments (lagged values of the

[9] For a comprehensive study about spillovers and infrastructures in Spain see Roca and Sala (2006).

instrumented variables) to tackle the problem of the new error being correlated with the lagged dependent variable. Additionally, the instruments are required to control for the potential endogeneity of the explanatory variables.

The difference GMM estimator has, however, a drawback. With highly persistent data (a trait of some of our variables), the lagged levels of the regressors may be poor instruments for the first-differenced regressors. So, to solve this problem Arellano and Bover (1995) and Blundell and Bond (1998) proposed the system GMM estimator, which builds a system of two equations: the regression in differences in addition to the regression in levels with lagged differences as instruments. A further assumption of no correlation between the variables in differences and the fixed effects is required, although there might be correlation between the levels of the explanatory variables and the fixed effects. This allows the introduction of more instruments and can dramatically improve efficiency.

Given these considerations in mind, firstly a one-step system GMM model is, for the whole sample, estimated. The results are reported in the first column of Table 1.4.[10] As can be seen, the two specification tests (bottom of this column) reinforced our decision: neither the null hypothesis of no second-order serial correlation (AR(2) test) nor the validity of the instruments used in the estimation can be rejected (Hansen test). It should also be noted that standard errors robust to heteroskedasticity and autocorrelation are considered.[11]

As for the coefficients included in Equation (1.2), it can be seen that the one linked to the lag *fdi* is positive and statistically significant, this result supporting the presence of inertia in FDI flows. Furthermore, market size turns out to be an important driver for FDI attraction, a finding that is in line with that obtained by Egea and López-Pueyo (1991b) and Pelegrín (2002). Besides, the coefficient of the

[10] The instruments for the equation in differences used for the System-GMM estimation are the second and third lags of *fdi* and *MS*. For the equation in levels, the instruments are the first difference of the two variables mentioned.

[11] The presence of heteroskedasticity is confirmed by Breusch-Pagan test.

interaction variable is positive and statistically significant, indicating that FDI is attracted by regions with high levels of human capital that, accordingly, pay high wages; although not explicitly using this same variable, this finding is in tune with previous literature (see, e.g. Egea and López-Pueyo, 1991b). Additionally, transport infrastructure endowment does not seem to be a factor helping to attract FDI flows into the Spanish regions. Though somewhat counterintuitive, this result picks up the idea that infrastructure is a less relevant determinant of FDI in developed countries compared to developing ones (Porter, 1991); there is also empirical evidence supporting it (Pelegrín, 2002). As regards the dummy for Madrid, its coefficient turns out to be positive and statistically significant, meaning that the own characteristics of the capital region (including the headquarters effect) help to attract FDI.

As mentioned above, the purpose of the paper is to unveil FDI determinants not only for the whole sample but also to assess whether the results change when splitting the sample into pre-crisis (1997-2007) and crisis (2008-2013) periods. Additionally, and both for the whole period and the two sub-periods, we are also interested in evaluating whether there are some changes depending on the place of origin, for which we disentangle the FDI coming from Europe and America.[12] For these reasons, we performed the same estimates for sub-periods and places of origin. In these cases, however, the specification tests did not support the use of a GMM estimator, so we decided to employ, in order to address the presence of heteroscedasticity, a GLS estimator. To be precise, we estimate the following equation:

$$fdi_{ij,t} = \alpha + \rho_1\, fdi_{ij,t-1} + \rho_2\, fdi_{ij,t-2} + \beta_1 MS_{i,t-1} + \beta_2\, W_{ij,t-1} * HC_{ij,t-1} + \beta_3\, RI_{i,t-1} + \beta_4\, d_{Madrid} + \varepsilon_{ij,t} \tag{1.3}$$

[12] Europe is made up of 55 countries, and America of 48 countries. For specific names we refer the reader to the DataInvex website.

in which all variables have the aforementioned meanings. As can be seen, in this case two lags of the dependent variable are included, this decision being guided by the Akaike's Information Criterion (AIC).

The results are shown in the rest of columns of Table 1.4. First of all, it must be pointed out that the findings obtained for the whole sample are roughly the same to those obtained by GMM: this implies that our results are robust regardless of the econometric approach. As for the business cycle, it is shown that agglomeration effects are greater during the pre-crisis period than during the crisis; just the opposite happens with market size. Additionally, the intensity of the interaction variable's effect is much stronger during the crisis than before, and something similar occurs with the dummy for Madrid.

In general terms, the results for aggregate FDI are maintained regardless of place of origin, with the exception of the interaction variable that becomes non-significant for the FDI coming from America. There are also some variations in the intensity of the FDI determinants' effects depending on the FDI origin. The market size of the recipient regions is more relevant for the FDI coming from America, mainly during the pre-crisis period. As for the dummy for Madrid, it seems that the attractiveness of this region is also larger in the case of FDI coming from America, both during the whole period and the pre-crisis sub-period.

Table 1.4 Estimation results.

Dependent variable: $FDI_{ij,t}$	One-step System-GMM	GLS			GLS			GLS		
	Aggregate FDI	Aggregate FDI			FDI from Europe			FDI from America		
	All period	All period	Pre-crisis period	Crisis period	All period	Pre-crisis period	Crisis period	All period	Pre-crisis period	Crisis period
Constant	-16.657**	-5.287**	-4.653**	-7.873**	-4.911**	-4.737**	-6.776**	-6.039**	-8.545**	-10.807**
	(4.590)	(1.004)	(1.148)	(2.046)	(1.143)	(1.223)	(2.361)	(1.734)	(2.566)	(2.884)
$FDI_{ij,t-1}$	0.448**	0.387**	0.385**	0.388**	0.382**	0.376**	0.275**	0.408**	0.417**	0.282**
	(0.105)	(0.032)	(0.039)	(0.055)	(0.032)	(0.040)	(0.056)	(0.038)	(0.046)	(0.059)
$FDI_{ij,t-2}$	—	0.299**	0.334**	0.218**	0.313**	0.367**	0.308**	0.264**	0.225**	0.335**
		(0.031)	(0.039)	(0.048)	(0.031)	(0.038)	(0.050)	(0.038)	(0.047)	(0.050)
$MS_{i,t-1}$	0.892**	0.257**	0.213**	0.341**	0.245**	0.228**	0.384**	0.318**	0.417**	0.394**
	(0.281)	(0.058)	(0.067)	(0.113)	(0.068)	(0.073)	(0.140)	(0.105)	(0.123)	(0.151)
$W_{ij,t-1}$* $HC_{ij,t-1}$	0.464**	0.195**	0.194*	0.370*	0.218**	0.209**	0.197	-0.019	0.110	0.294
	(0.165)	(0.072)	(0.085)	(0.144)	(0.075)	(0.077)	(0.153)	(0.105)	(0.301)	(0.228)
$RI_{i,t-1}$	-0.282	-0.032	0.046	0.059	-0.153	-0.070	-0.381	-0.195	-0.160	0.399
	(0.256)	(0.101)	(0.110)	(0.249)	(0.108)	(0.116)	(0.278)	(0.191)	(0.249)	(0.336)
d_{Madrid}	1.197*	0.666**	0.488**	0.786*	0.546**	0.415*	0.922**	1.114**	0.984**	1.064*
	(0.462)	(0.156)	(0.184)	(0.323)	(0.164)	(0.184)	(0.348)	(0.259)	(0.290)	(0.435)
AR(2) test	0.29	—	—	—	—	—	—	—	—	—
Hansen test	0.98	—	—	—	—	—	—	—	—	—
Adjusted R^2	—	0.45	0.50	0.38	0.45	0.49	0.35	0.42	0.41	0.47

Note: robust standard errors in parentheses; the values for AR(2) and Hansen tests are *p*-values; ** (*) Significant at 1% (5%) respectively.

1.5 Conclusions

This paper provides new insights into some key factors influencing FDI location choices in the Spanish regions. Specifically, it develops a study of the determinants of FDI using regional and sectoral data over the period 1997-2013, and two sub-periods (pre-crisis and crisis). The study also provides evidence on the main determinants of FDI flows coming from Europe and America.

As its starting point, the paper reviews the main theoretical models trying to explain FDI location. Then, it delves into an examination of empirical studies on inward FDI determinants devoted to the Spanish case. According to this review, market size, human capital, labor conditions and infrastructure endowments are the main drivers for FDI in Spain.[13]

The next section of the paper offers an overview of the distribution of inward FDI flows. It can be noted that the evolution of inward FDI over GDP has been very volatile over the sample period. Additionally, it has been shown that Madrid concentrates the bulk of the foreign investment received in Spain. In fact, the *Performance Index* indicates that Madrid gets a much greater share of Spanish FDI than that of GDP. Finally, the sectoral breakdown shows that industry and service sectors concentrate, on average, 95% of total FDI, although with a huge regional dispersion.

The central part of the paper is devoted to exploring the main drivers of FDI over the 1997-2013 period. To do so, an FDI model is specified based on the theoretical and empirical literature on the topic. Then, the FDI equation is firstly estimated by GMM and then by GLS. The results show that the main determinants of the FDI location patterns in the Spanish regions are market size, human capital in interaction with wages, and the own characteristics of Madrid. These results are, as a general rule, maintained for the FDI coming from Europe and America, but for the interaction variable.

[13] These results are in line with those obtained by most empirical studies for other countries.

Regarding the two sub-periods of the sample the most relevant traits are the increase in the intensity of the effects of market size, interaction variable and the dummy for Madrid during the crisis.

Chapter 2

A spatial approach to the FDI-growth nexus in Spain: dealing with the headquarters effect

2.1 Introduction

The nexus between FDI and economic growth has been extensively studied at both theoretical and empirical levels. From a theoretical point of view, in the neoclassical growth model FDI enhances growth through increases in investment (Solow, 1956; Swan, 1956), whereas in the endogenous growth theories it happens through knowledge and technology diffusion (Romer, 1986; Lucas, 1988). From the empirical perspective, there is such a vast literature that it is nearly impossible to acknowledge all researchers that have been dealing with this issue. As a short reference to some recent surveys, see Ewe-Ghee (2001), Ozturk (2007) and Clark et al. (2011).[1]

However, standard empirical analysis, mostly carried out at country level, overlooks the presence of spatial spillovers, which importance has been underlined in recent theoretical literature (see Barrios et al., 2005; Driffield, 2006 or Capello,

[1] The last Global Investment Competitiveness Report 2017-2018 (World Bank, 2018) addresses this issue from the point of view of developing countries.

2009; among others). This represents, therefore, a strong drawback, as the exclusion of spatial effects in the model may lead to biased results (Anselin, 1988).

The key point is that this drawback becomes instrumental when the analysis shifts the focus from a national to a regional perspective. When adopting a regional approach, much more insightful than the national one, the role played by spatial spillovers can be very relevant and, therefore, must be incorporated into the analysis. To the best of our knowledge, there are just a few recent papers on the link FDI-growth dealing with spatial spillovers at regional level for China: Madariaga and Poncet (2007), Wen (2014), Ma and Jia (2015) and Mitze and Özyurt (2014).

Adopting a regional approach to address the effect of FDI on growth involves, in any case, a problem of statistical nature related to what we coin as the headquarters effect. This effect pertains to the fact that, as a rule, FDI tends to be registered in the region in which the headquarters of the firm is located rather than in the place where the foreign investment is really made. As a result, it happens that there is an artificial concentration of FDI in certain regions. This problem can seriously affect the reliability of the results about the links between FDI and growth at regional level.

To try to overcome this problem, the paper proposes a way of estimating the magnitude of the headquarters effect on FDI data. By doing this, we are able to produce new FDI data free from this effect and test an important hypothesis: whether neglecting (disregarding) the headquarters effect severely underrates the spatial spillovers of FDI on economic growth. To the best of our knowledge, this is the first paper dealing with this issue.

The paper also departs from previous ones and, therefore, attempts to contribute to the FDI-growth literature from a methodological point of view. Once the growth equation is specified, it focuses on modeling spatial spillovers arising not only from the dependent variable but also from FDI and the remaining independent variables; in other words, the paper estimates a full Spatial Durbin Model (SDM).

Furthermore, it computes partial derivatives to obtain more accurate estimates of the impact of FDI (and the other independent variables) on growth; we are referring to the so-called average direct, indirect and total effects (LeSage and Pace, 2009).[2] Finally, and to gain even more insight about how FDI affects growth, it is important to stress that this is the first paper to compute the direct and indirect effects for each pair of regions.

To examine the role of FDI in fostering economic growth, the paper uses Spanish NUTS-2 regions,[3] over the period 1996-2013, as a sort of laboratory. There are two main reasons to justify this choice. First, that Spain has been a highly attractive destination for FDI since at least the mid-eighties (Bajo-Rubio and López-Pueyo, 2002) and has experienced a growth process clearly differentiated at regional level. Second that, although relatively long and detailed series on FDI at the regional level are available, there are not many studies investigating the effect of FDI on growth in Spain, the most relevant ones are Bajo-Rubio and Sosvilla-Rivero (1992; 1994) and Bajo-Rubio et al. (2010), and none of them considers spatial dependence.

To provide some insights into the case study, Table 2.1 displays the distribution of inward FDI flows (obtained from the Spanish Foreign Investment Registry (DataInvex)) across Spanish regions and sectors over the sample period. Data show that FDI is highly concentrated in just two regions. Madrid and Cataluña received, on average, about 80% of total FDI, although Madrid received more than four times the amount of Cataluña; as the capital of Spain is located in the region of Madrid, it seems there is little doubt about the existence and relevance of the headquarters effect. Second, FDI inflows are highly volatile in all regions, particularly in Aragón, Murcia and Asturias (see coefficient of variation figures in Table 2.1). Third, FDI sectoral distribution across regions is very heterogeneous, but mainly concentrated in industry and services. On average, more than 80% (60%) of the inward FDI

[2] As far as we know, Mitze and Özyurt (2014) is the only paper that looks at partial derivatives.

[3] This is the finest disaggregation possible because no FDI data exist for the Spanish provinces (NUTS-3).

received by Asturias, Extremadura and Murcia (Baleares, Madrid and Castilla-León) goes to the industrial (service) sector.

Table 2.1 Inward FDI in Spanish regions and sectors. Flows (million euros 2000). Average 1996-2013.

	Total			Sectoral distribution (%)			
Regions	Total	CV	%	Agriculture	Industry	Construction	Services
Andalucía	397.41	0.44	2.19	2.61	31.93	21.33	44.12
Aragón	424.88	2.48	2.34	0.17	70.66	0.52	28.65
Asturias	223.02	1.70	1.23	0.00	95.25	0.61	4.13
Baleares	219.12	0.57	1.21	1.67	0.88	26.31	71.14
Canarias	496.35	0.87	2.73	1.88	51.11	2.59	44.42
Cantabria	13.08	1.18	0.07	3.29	50.54	5.89	40.29
Castilla y León	64.14	1.03	0.35	1.19	34.23	4.04	60.55
Castilla-La Mancha	82.05	1.35	0.45	1.94	40.21	12.41	45.45
Cataluña	2,765.96	0.38	15.24	0.90	43.75	3.83	51.51
C. Valenciana	683.33	1.21	3.76	0.21	70.94	2.29	26.56
Extremadura	19.09	1.00	0.11	8.59	84.87	0.37	6.18
Galicia	157.49	1.03	0.87	0.87	59.42	5.51	34.20
Madrid	11,671.85	0.69	64.30	0.52	35.69	2.77	61.02
Murcia	99.5	1.86	0.55	1.46	82.13	4.95	11.46
Navarra	55.5	0.75	0.31	1.06	68.92	6.79	23.23
País Vasco	765.73	0.92	4.22	0.22	61.52	9.42	28.85
Rioja (La)	14.45	1.19	0.08	0.48	74.55	0.35	24.62
Spain	18152.95	0.53	100	0.67	41.48	3.90	53.96

Note: CV = coefficient of variation.

The remainder of the paper is organized as follows. Section 2.2 specifies the benchmark growth model and estimates it by employing raw FDI data. Section 2.3 addresses the computation of the headquarters effect and estimates the model by using FDI data free from that effect; additionally, it takes a step forward by computing the matrix of effect estimates. Section 2.4 presents some robustness tests by using a) an alternative computation of the headquarters effect, b) different spatial weight matrices and c) FDI data at the sectoral level. Finally, Section 2.5 offers the main conclusions.

2.2 FDI and growth: model specification and results

2.2.1 Model specification

As mentioned in the Introduction, for the reasons already given but also for theoretical reasons supporting the use of an SDM in a spatial growth model specification (see LeSage and Fischer, 2008), our baseline spatial growth model is an SDM. As for the independent variables, we initially considered a set of potential determinants of growth in line with standard literature in order to use a simple forward selection procedure.[4] As a result, we estimate the following SDM to analyze the impact of FDI on economic growth:

$$\begin{aligned}\Delta Y_{it} = {} & \rho \textstyle\sum_j w_{ij}\ \Delta Y_{jt} + \beta\, Y_{it-1} + \theta \textstyle\sum_j w_{ij}\, Y_{jt-1} + \sigma_1\, FDI_{it-1} + \sigma_2 \textstyle\sum_j w_{ij}\, FDI_{jt-1} + \\ & \delta_1\, Agr_{it-1} + \delta_2 \textstyle\sum_j w_{ij}\, Agr_{jt-1} + \lambda_1\, Ind_{it-1} + \lambda_2 \textstyle\sum_j w_{ij}\, Ind_{jt-1} + \varphi_1\, Ser_{it-1} + \\ & \varphi_2 \textstyle\sum_j w_{ij}\, Ser_{jt-1} + \pi\, d_{crisis} + \mu_i + u_{it} \qquad (2.1)\end{aligned}$$

where the dependent variable is the growth rate of per capita GDP in region i at year t (ΔY_{it}), expressed in thousand euros of 2000 and proxied by the first difference of log-levels; GDP and population (as well as the Consumer Price Index used to deflate nominal values) are extracted from the Spanish National Statistics Institute. As for the independent variables, we include a battery of them, as well as their spatial lags and the spatial lag of the dependent variable. The list of independent variables is as follows:

[4] Variables such as physical and human capital were finally excluded from the model.

Y_{it-1}. Following the standard β-convergence analysis (Mankiw et al., 1992; Barro and Sala-i-Martin, 1992), we include per capita GDP in the previous year. We expect a negative relationship between ΔY_{it} and Y_{it-1}.

FDI_{it-1}. As we want to analyze the impact of FDI on growth, we enlarge the neoclassical model by introducing FDI (lagged one period) as independent variable[5] (Ma and Jia, 2015). It is computed as the accumulated flows[6] of inward gross FDI as a percentage of GDP. Data on FDI flows are obtained from the Spanish Foreign Investment Registry (DataInvex). We expect a significant and positive coefficient for this variable since FDI is considered a relevant factor promoting economic growth through technology transfer, employment and export promotion, capital accumulation and human capital improvement (De Mello, 1997).

Agr_{it-1}, Ind_{it-1} and Ser_{it-1}. To take into account industry-mix differences between Spanish regions, we add the shares of agriculture, industry and service sectors[7] in the previous year as control variables. They are computed as the percentage of employment in each sector over total employment (taken from Cambridge Econometrics). A positive (negative) sign is expected in the case of industry and services (agriculture).

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[5] The use of lagged *FDI* helps tackle potential endogeneity concerns. For the sake of robustness, as *FDI* (even lagged one period) could be considered as an endogenous variable, we ran the same equation but taking additional lags as instruments; specifically, the number of lags was limited from two to four. There were no significant changes in the results obtained.

[6] We follow Bajo-Rubio et al. (2010, p. 377), who claimed that '*a stock, rather than a flow, measure of FDI should be used in order to capture the permanent character of FDI rather than the fluctuations associated with flows'*. As in Bajo-Rubio et al.'s paper, and due to the fact that data on FDI stock for each year are not available, we proxy it by using the accumulated sum of gross FDI inflows from 1995 to that particular year.

[7] We leave aside the construction sector to avoid multicollinearity problems. We chose the combination of sectors for which the goodness of fit was higher.

d_{crisis}.[8] A dummy variable, capturing the crisis period and taking on a value of 1 from 2008 onward and 0 otherwise. A negative sign is obviously expected due to the adverse effect of the economic crisis on growth.

μ_i. Regional fixed effects (supported by the Hausman test results).

It is worth noting that all the independent variables, except for the dummy, are expressed in logs. To compute the corresponding spatial lags we multiply each variable by the elements (w_{ij}) of the row-standardized spatial weight (so-called distance) matrix W. This matrix gives more weight to nearby than to distant observations, and here is defined as the inverse of the distance.[9] Spatial lags capture, therefore, spatial interactions reflecting that per capita GDP growth in a region is not only affected by (lagged values of) per capita GDP, FDI and sectoral structure in that region, but also by these variables in nearby regions and neighboring growth experiences.

Once we have specified the model, and before presenting its results, it is pertinent to take a pause to clarify two important points. First, to stress that we tested whether our SDM could be simplified into a Spatial Error Model (SEM) or a Spatial Autoregressive Model (SAR) (Elhorst, 2014a). To do so, we estimated Equation (2.1) and computed the corresponding Likelihood Ratio (LR) tests. The results, displayed in Table 2.2, clearly point to the SDM.

Table 2.2. Likelihood Ratio (LR) tests for spatial dependence.

	Statistic	p-value
LR test for Spatial Autoregressive Model	51.18	0.00
LR test for Spatial Error Model	22.72	0.00

[8] In this case we do not include any spatial lag for obvious reasons.

[9] We consider the shortest Euclidean distance in kilometers between the centroids of regions i and j.

Second, that it is essential to keep in mind that the interpretation of the estimated coefficients in an SDM requires careful attention. The coefficients (point estimates) cannot be interpreted directly because according to a Leontief expansion of the inverse matrix, $(I_n - \rho W)^{-1} = I_n + \rho W + \rho^2 W^2 + \cdots$, they are no longer marginal effects. This is so since the feedback effects derived from the dependence relationship in the spatial lags complicate their interpretation. Therefore, point estimates have to be considered as a preliminary step that is needed to calculate, through the computation of the matrix of effect estimates, the so-called average direct, indirect (what we consider spatial spillovers) and total effects (LeSage and Pace, 2009). In our model, for instance, the *average direct effect* of FDI measures the average impact on the economic growth rate of a particular region caused by a change in FDI of that region. On the other hand, the *average indirect effect* or *spatial spillover*[10] reflects the cumulative average effect of the changes in FDI of neighboring regions on the growth rate of a specific region. The *average total effect* is the sum of both, the average direct and indirect effects.

2.2.2 Results

With these considerations in mind, we now present and discuss the results. Table 2.3 displays the point estimates of Equation (2.1), obtained by maximum likelihood. As stated above and to gain knowledge about the real effect of any variable on growth, we present the average direct, indirect and total effects in Table 2.4.

The spatial autoregressive parameter is positive and statistically significant ($\hat{\rho} = 0.74$), supporting the existence of important connections between regional growth experiences. In addition, the coefficient linked to per capita GDP lagged one period is negative and statistically significant, indicating that there exists a process of conditional β convergence. This is confirmed by its statistically significant and negative direct effect. The annual speed of convergence (the rate at which regions

[10] Spatial spillovers produced by the SDM are global; that is, they include feedback effects arising because of impacts passing through neighboring regions and back to the region where the change originated from (Halleck Vega and Elhorst, 2015).

approach their steady-state) is 6.67%, which leads to a half-life (time necessary to cover half the distance separating regions from their steady state assuming that the current convergence speed keeps over time) of 10.38 years.[11]

Table 2.3 Per capita GDP growth. Spatial Durbin model.

Variables	Point estimates
$\sum_j w_{ij}\, \Delta Y_{jt}$	0.740*** (0.042)
Y_{it-1}	-0.131*** (0.021)
$\sum_j w_{ij}\, Y_{jt-1}$	0.139*** (0.038)
FDI_{it-1}	0.004*(0.002)
$\sum_j w_{ij}\, FDI_{jt-1}$	0.0003 (0.003)
Agr_{it-1}	0.001 (0.006)
$\sum_j w_{ij}\, Agr_{jt-1}$	-0.010 (0.020)
Ind_{it-1}	0.114*** (0.017)
$\sum_j w_{ij}\, Ind_{jt-1}$	0.127** (0.060)
Ser_{it-1}	0.022 (0.043)
$\sum_j w_{ij}\, Ser_{jt-1}$	0.406*** (0.123)
d_{crisis}	-0.035*** (0.005)
Speed of convergence	6.672
Half-life	10.389
R-squared	0.785
LIK	926.424
AIC	-1826.849
SC	-1778.442

Notes: standard errors in parentheses. *** (**) (*) Significant at 1% (5%) (10%) respectively. Results obtained by using the row-standardized inverse distance matrix.

As regards the impact of FDI on growth, the coefficient and the direct effect are positive and statistically significant; this indicates that, as expected, FDI received in a particular region positively contributes to economic growth in that region. The

[11] The annual speed of convergence and half-life have been computed using the direct effect of Y_{it-1} rather than the point estimate.

spatial lag of FDI and the indirect effect do not result statistically significant, which implies that, apparently, there are no FDI spatial spillovers.

As for the industry-mix, direct and indirect effects indicate that higher economic growth in a specific region is expected if the weight of both the industrial and service sectors in that region is relevant and, to a greater extent, if the region is surrounded by regions with a high share of these two sectors. Finally, it is also important to note that the dummy estimate confirms the negative impact that the crisis has had on per capita GDP growth.

Table 2.4 Per capita GDP growth. Spatial Durbin model. Average direct, indirect and total effects.

	Direct effects	Indirect effects	Total effects
Y_{it-1}	-0.124*** (0.017)	0.154 (0.131)	0.030 (0.134)
FDI_{it-1}	0.004* (0.002)	0.011 (0.007)	0.015** (0.008)
Agr_{it-1}	0.000 (0.008)	-0.043 (0.093)	-0.043 (0.098)
Ind_{it-1}	0.154*** (0.021)	0.806*** (0.204)	0.960*** (0.218)
Ser_{it-1}	0.108** (0.044)	1.571*** (0.445)	1.679*** (0.465)

Notes: standard errors in parentheses. *** (**) (*) Significant at 1% (5%) (10%) respectively. Results obtained by using the row-standardized inverse distance matrix.

2.3 Addressing the headquarters effect

After presenting the results with raw FDI data, the aim of this section is threefold. First, it proposes a method to compute the headquarters effect and uses it to calculate FDI data free from this effect. Then, it uses the new data to re-estimate the growth model and shows the results obtained. Finally, and to gain more insights into the effect of FDI on growth and learn about the effects for each pair of regions, it computes the matrix of effect estimates associated to the FDI variable.

2.3.1 Computation of the headquarters effect

As indicated in the Introduction, the hypothesis to be tested is that if FDI data are 'dirty' in that the headquarters effect is not taken into account, the indirect effect of

FDI on economic growth can be underrated. The so-called headquarters effect arises when the production site(s) and the headquarters of a company are located in different regions (let's say *a* and *b*) and FDI received by this company is recorded in region *b*.

In the case of Spain, as previously reported, FDI is highly concentrated in Madrid: on average for the sample period and according to raw data, it receives 64% of total FDI flows. This exceptionally high share might be partially due to the headquarters effect. This being so, the remaining regions have less registered inward FDI than what they have actually received. This fact presents major statistical challenges for the researcher, as it might affect the reliability of the results obtained.

To address this issue, we proceed to estimate the headquarters effect and re-estimate Equation (2.1) once it has been removed. As for the first, we proceed in three steps: 1) We estimate a somewhat traditional model of FDI determinants but with spatial effects.[12] In this model, we include a dummy for Madrid in an attempt to capture the inward flows of FDI registered in this region that are not explained by standard FDI determinants. In other words, we compute FDI flows that can be explained by Madrid idiosyncratic factors, among which the fact that the region is the site of the capital of the country, so that the official headquarters of many international companies are located there. 2) By using the coefficient linked to the dummy, we approximate the headquarters effect. 3) We subtract from the raw FDI data of Madrid the amount corresponding to the headquarters effect and then redistribute it among the rest of the Spanish regions.

Accordingly, we first estimate an FDI model. As for the selection of independent variables, we use a forward selection procedure as done for the growth model. Regarding the type of spatial model, once again we follow the general-to-specific approach (Elhorst, 2014a), turning out now that the SDM can be simplified into a

[12] The role of space has already been highlighted in the literature of FDI determinants (Blonigen et at., 2007; Baltagi et al., 2007; Regelink and Elhorst, 2015; Castellani et al., 2016).

SAR model (results available upon request). Therefore, we estimate the following SAR model of FDI determinants[13] (the results obtained are included in Tables A1.1 and A1.2 in Appendix 1):

$$fdi_{it} = \beta_1 \sum_j w_{ij}\, fdi_{it} + \beta_2\, GDP_{it} + \beta_3\, (WAGE * Hc)_{it} + \beta_4\, RI_{it} + \beta_5\, d_{Madrid} + \theta_t + \varepsilon_{it} \qquad (2.2)$$

where fdi denotes FDI flows as a percentage of GDP; $\sum_j w_{ij}\, fdi_{jt}$ is the spatial lag of fdi; GDP is taken as a proxy for market size and the level of development of the region; $WAGE * Hc$ is an interaction variable between monthly remuneration per employee ($WAGE$), in thousand euros of 2000 (taken from Cambridge Econometrics), and human capital (Hc), an education index[14] computed with data of employed population by educational attainment (obtained from the Valencian Institute of Economic Research (IVIE));[15] RI is the endowment of road infrastructure, expressed in kilometers of motorways per 1000 km^2 (from Eurostat); d_{Madrid} is the dummy variable for Madrid; and, finally, θ_t are time fixed effects. Note that all variables, except the dummy, are expressed in logs.

Second, using the estimated coefficient associated to the dummy, we proxy for every year the amount of annual FDI inflows registered in Madrid due to the headquarters effect. Taking into consideration that the fdi variable is expressed in logs and in terms of GDP, we first apply the exponential function to the estimated

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[13] A similar specification, although without taking into account spatial dependence, is used in Gutiérrez-Portilla et al. (2016).

[14] This index is defined as $Hc = \sum_{i=1}^{7} \varphi_i A_i$, where φ_i indicates the weight associated with each level of human capital *i* (computed as the ratio between the employed population by education level and the total employed population) and *A* denotes the number of years necessary to achieve each level of education and takes the values 0, 6, 10, 12, 14, 15 and 17 for *i*=1, 2, 3, 4, 5, 6 and 7. The levels of human capital are: *i*=1=illiterate, *i*=2=without studies or primary education, *i*=3=compulsory secondary education, *i*=4=high school and middle-level training program, *i*=5=higher level training program, *i*=6=previous to superior and *i*=7=superior studies.

[15] We include an interaction variable because, although their components could be incorporated separately, we found out in a preliminary estimation that wages were picking up the effect of human capital on FDI.

coefficient of the dummy, and then, we multiply this result by the GDP of Madrid in each year. Although the headquarters effect changes every year, on average it accounts for 29.37% of the FDI registered in Madrid.

Next, we deduct from the annual FDI data of Madrid the percentage corresponding to the headquarters effect, so that we obtain the 'new' FDI data for Madrid, free from the headquarters effect. Finally, we distribute these flows of FDI due to the headquarters effect among the remaining Spanish regions. Given the undeniable connections between FDI and exports[16] we do it, year by year, according to their corresponding shares of total (excluded Madrid) exports (data were collected from the Ministry of Economics and Finance (DataComex databank)).

2.3.2 New results for the growth model

By using the new FDI data,[17] Equation (2.1)[18] is re-estimated. Point estimates and average direct, indirect and total effects are reported in Tables 2.5 and 2.6, respectively. The spatial autoregressive coefficient ($\hat{\rho} = 0.73$) points, once again, to the existence of significant connections among the various regional growth experiences. As for convergence, the negative and significant β coefficient and the direct effect associated to per capita GDP lagged one year reinforce that there has been a process of convergence across Spanish regions. Results for industry mix and the dummy crisis are also in line with those obtained in Section 2.2.

Remarkable differences arise, however, with regard to the effect of FDI on economic growth. Now, when we use the new FDI data, there exists a positive and statistically significant spatial spillover associated to FDI, which more than doubles

[16] The correlation between regional FDI inflows and exports, excluding Madrid, is 0.81, which gives support to the criterion validity.

[17] Having obtained the amount of annual FDI flows corrected by the headquarters effect, we compute, as previously, the accumulated sum of these FDI flows as a percentage of GDP to re-estimate Equation (2.1).

[18] As before, Hausman test supported the inclusion of fixed effects. With regard to the specification of the model we again computed the LR tests, just in case new FDI data changed the results. The preferred model, however, kept being the same, so that the same SDM is estimated.

the direct one. This finding indicates that Spanish regions take advantage not only of their own FDI but also of FDI received by neighboring regions; this is in accordance with the results found by Madariaga and Poncet (2007) for Chinese cities and by Mitze and Özyurt (2014) for Chinese provinces. It is worth mentioning that the difference between the point estimate (0.0002) linked to the spatial lag of FDI ($\sum_j w_{ij} \, FDI_{jt-1}$) and the indirect effect (0.014) reveals the existence of positive feedback effects; these effects arise as a result of impacts passing through neighboring regions and coming back to the region where they originated from. In other words, the hypothesis about the headquarters effect is confirmed: neglecting this effect implies that spatial spillovers of FDI on economic growth are underestimated.

Table 2.5 Per capita GDP growth. Spatial Durbin model. FDI data free from the headquarters effect.

Variables	Point estimates
$\sum_j w_{ij} \, \Delta Y_{jt}$	0.733*** (0.042)
Y_{it-1}	-0.135*** (0.021)
$\sum_j w_{ij} \, Y_{jt-1}$	0.134*** (0.037)
FDI_{it-1}	0.005*(0.002)
$\sum_j w_{ij} \, FDI_{jt-1}$	0.0002 (0.003)
Agr_{it-1}	0.001 (0.006)
$\sum_j w_{ij} \, Agr_{jt-1}$	-0.010 (0.020)
Ind_{it-1}	0.113*** (0.017)
$\sum_j w_{ij} \, Ind_{jt-1}$	0.016** (0.061)
Ser_{it-1}	0.016 (0.043)
$\sum_j w_{ij} \, Ser_{jt-1}$	0.474*** (0.124)
d_{crisis}	-0.037*** (0.005)
Speed of convergence	6.792
Half-life	10.206
R-squared	0.784
LIK	926.415
AIC	-1827.631
SC	-1779.224

Notes: standard errors in parentheses. *** (**) (*) Significant at 1% (5%) (10%) respectively. Results obtained by using the row-standardized inverse distance matrix.

Table 2.6 Per capita GDP growth. Spatial Durbin model. Average direct, indirect and total effects with FDI data free from the headquarters effect.

	Direct effects	Indirect effects	Total effects
Y_{it-1}	-0.127*** (0.017)	0.160 (0.115)	0.033 (0.117)
FDI_{it-1}	0.006* (0.003)	0.014* (0.007)	0.020** (0.008)
Agr_{it-1}	-0.001 (0.007)	-0.042 (0.081)	-0.043 (0.085)
Ind_{it-1}	0.158*** (0.020)	0.916*** (0.205)	1.074*** (0.218)
Ser_{it-1}	0.110*** (0.042)	1.772*** (0.396)	1.882*** (0.412)

Notes: standard errors in parentheses. *** (**) (*) Significant at 1% (5%) (10%) respectively. Results obtained by using the row-standardized inverse distance matrix.

2.3.3 Toward a deeper knowledge of feedback effects: matrix of effect estimates

To gain further insight into the impact of FDI on growth, we compute the matrix of effect estimates associated to FDI (Table 2.7). This matrix, which contains the responses of economic growth to a change in FDI for each pair of regions, takes the following form in our SDM model (Equation 2.1):

$$S(W) = V(W) * (I_n\sigma_1 + W\sigma_2) \tag{2.3}$$

where $V(W)$ stands for the spatial multiplier:

$$V(W) = (I_n - \rho W)^{-1} \tag{2.4}$$

being ρ the spatial autoregressive coefficient, σ_1 and σ_2 the estimated coefficients of the FDI variable and its spatial lag, and I_n the identity matrix (of order 17*17 in this case). The main-diagonal elements of the matrix $S(W)$ are the own-partial derivatives and their average is the average direct effect, while its off-diagonal elements are the cross-partial derivatives and by averaging their cumulative sum for each region we obtain the average indirect effect.

Two main conclusions can be drawn from the analysis of this matrix. On the one hand and as expected, the direct effect of FDI on growth in each region is always higher than any individual indirect effect. However, as previously seen, when the indirect effects are taken together, the resulting effect in each region plays a higher role than the direct one. On the other hand, the highest values of the individual indirect effects in each region always correspond to its nearest neighbors.

Table 2.7 $S(W)$ matrix of effect estimates for the FDI variable.

	Andalucía	Aragón	Asturias	Baleares	Canarias	Cantabria	Castilla y León	Castilla-La Mancha	Cataluña	C. Valenciana	Extremadura	Galicia	Madrid	Murcia	Navarra	País Vasco	Rioja (La)
Andalucía	0.00573	0.00095	0.00081	0.00056	0.00022	0.00097	0.00106	0.00124	0.00067	0.00094	0.00105	0.00066	0.00122	0.00098	0.00106	0.00110	0.00119
Aragón	0.00067	0.00595	0.00074	0.00062	0.00018	0.00099	0.00097	0.00105	0.00089	0.00105	0.00068	0.00056	0.00108	0.00084	0.00142	0.00128	0.00142
Asturias	0.00070	0.00091	0.00584	0.00050	0.00020	0.00129	0.00130	0.00099	0.00064	0.00080	0.00081	0.00097	0.00112	0.00073	0.00110	0.00123	0.00127
Baleares	0.00072	0.00114	0.00075	0.00562	0.00021	0.00095	0.00095	0.00105	0.00109	0.00111	0.00071	0.00059	0.00106	0.00094	0.00116	0.00115	0.00123
Canarias	0.00085	0.00097	0.00087	0.00062	0.00531	0.00101	0.00105	0.00106	0.00073	0.00091	0.00087	0.00074	0.00111	0.00087	0.00109	0.00114	0.00121
Cantabria	0.00066	0.00095	0.00101	0.00050	0.00018	0.00599	0.00126	0.00099	0.00065	0.00080	0.00073	0.00068	0.00113	0.00072	0.00122	0.00149	0.00146
Castilla y León	0.00071	0.00092	0.00102	0.00050	0.00018	0.00126	0.00599	0.00107	0.00063	0.00081	0.00083	0.00072	0.00130	0.00075	0.00112	0.00125	0.00133
Castilla-La Mancha	0.00083	0.00100	0.00077	0.00055	0.00018	0.00098	0.00106	0.00600	0.00068	0.00099	0.00081	0.00060	0.00149	0.00096	0.00110	0.00114	0.00126
Cataluña	0.00068	0.00128	0.00075	0.00086	0.00019	0.00097	0.00095	0.00102	0.00573	0.00105	0.00069	0.00058	0.00105	0.00086	0.00125	0.00120	0.00129
C. Valenciana	0.00075	0.00118	0.00073	0.00069	0.00019	0.00094	0.00096	0.00117	0.00083	0.00588	0.00072	0.00057	0.00112	0.00115	0.00115	0.00114	0.00125
Extremadura	0.00100	0.00092	0.00089	0.00053	0.00022	0.00102	0.00117	0.00115	0.00065	0.00086	0.00576	0.00075	0.00125	0.00084	0.00106	0.00113	0.00121
Galicia	0.00075	0.00091	0.00127	0.00052	0.00022	0.00114	0.00121	0.00101	0.00065	0.00081	0.00089	0.00568	0.00112	0.00076	0.00108	0.00118	0.00123
Madrid	0.00077	0.00097	0.00082	0.00052	0.00018	0.00105	0.00122	0.00140	0.00065	0.00088	0.00082	0.00062	0.00605	0.00083	0.00112	0.00119	0.00132
Murcia	0.00086	0.00104	0.00075	0.00064	0.00020	0.00093	0.00098	0.00126	0.00075	0.00127	0.00077	0.00059	0.00116	0.00582	0.00109	0.00111	0.00120
Navarra	0.00063	0.00120	0.00076	0.00054	0.00017	0.00107	0.00099	0.00098	0.00073	0.00086	0.00066	0.00056	0.00106	0.00074	0.00613	0.00161	0.00173
País Vasco	0.00062	0.00102	0.00080	0.00050	0.00017	0.00124	0.00104	0.00096	0.00067	0.00081	0.00066	0.00058	0.00106	0.00071	0.00153	0.00620	0.00183
Rioja (La)	0.00063	0.00106	0.00078	0.00051	0.00017	0.00114	0.00104	0.00100	0.00067	0.00083	0.00067	0.00057	0.00111	0.00072	0.00154	0.00172	0.00626

Notes: results obtained by using the row-standardized inverse distance matrix. The cells of the main diagonal are shaded.

2.4 Robustness checks

Having shown that the FDI effectively received by regions promotes growth and that spatial spillovers are remarkable, here we provide a robustness analysis from three different perspectives: first, by considering that the headquarters effect comes about not only in Madrid but also in Cataluña; second, by employing alternative spatial weight matrices; and, third, by considering FDI at sectoral level.[19]

2.4.1 Headquarters effect in Madrid and Cataluña

In line with the figures quoted in the Introduction, we address here the possibility that a significant number of foreign firms whose headquarters are located in Cataluña can also operate in other regions. For this reason, we estimate a new version of Equation (2.2), in which we include an additional dummy variable for Cataluña ($d_{Cataluña}$):

$$fdi_{it} = \beta_1 \sum_j w_{ij}\, fdi_{it} + \beta_2\, GDP_{it} + \beta_3\, (WAGE * Hc)_{it} + \beta_4\, RI_{it} + \beta_5\, d_{Madrid} + \beta_6\, d_{Cataluña} + \theta_t + \varepsilon_{it} \tag{2.5}$$

Then, we proceed as before. Using the estimated coefficients associated to the dummy variables for Madrid and Cataluña, we proxy for each year the amount of annual FDI inflows that are registered in each of these regions due to the headquarters effect. Afterward, we deduct these amounts from the annual FDI data for Madrid and Cataluña to obtain the free FDI data for these two regions. Finally, the annual amount of FDI inflows due to the headquarters effect in Madrid and Cataluña is distributed among the rest of the Spanish regions.

The results are in line with those previously obtained (Table 2.8), thus reinforcing the existence of remarkable positive spatial spillovers of FDI on economic growth.

[19] For the sake of simplicity, we only show average direct, indirect and total effects.

Table 2.8 Robustness check for the spatial growth model. Headquarters effect in Madrid and Cataluña.

	Direct effects	Indirect effects	Total effects
Y_{it-1}	-0.130*** (0.017)	0.171 (0.123)	0.041 (0.126)
FDI_{it-1}	0.006* (0.003)	0.015* (0.008)	0.022** (0.009)
Agr_{it-1}	0.000 (0.008)	-0.043 (0.088)	-0.043 (0.093)
Ind_{it-1}	0.162*** (0.020)	1.003*** (0.213)	1.166*** (0.226)
Ser_{it-1}	0.119*** (0.044)	1.903*** (0.434)	2.022*** (0.454)

Note: standard errors in parentheses. *** (**) (*) Significant at 1% (5%) (10%) respectively. Results obtained by using the row-standardized inverse distance matrix.

2.4.2 Alternative spatial weight matrices

Now, we change the perspective and focus our attention on the SDM (Equation 2.1). To avoid repetition, as we have seen that there are no significant differences depending on the inclusion or not of Cataluña when it comes to computing the headquarters effect, henceforth we use the new FDI series obtained in Subsection 2.3.1 (only considering Madrid).

The specification of the weight matrix is a sensitive point in spatial econometric modeling since the choice of spatial weights can have a substantive impact on the results. For this reason, we replicate the previous estimations with two alternative spatial weight matrices. First, we change the definition of the matrix to the five-nearest neighbor spatial weight matrix.[20] Second, we employ a different standardization technique: instead of a row-standardized inverse distance matrix, we normalize the inverse distance matrix by its largest eigenvalue (Kelejian and Prucha, 2010; Elhorst, 2014b).

Focusing our attention on FDI, the results obtained (Table 2.9) are again very much in line with the former estimates, thus confirming the positive effect of FDI on growth. As regards its decomposition into direct and indirect effects, there are

[20] In any case, results are very similar when considering alternative numbers of neighbors.

neither significant differences, so that the importance of FDI in neighboring regions outweighs (as a whole) that of FDI in a particular region.

Table 2.9 Robustness check for the spatial growth model. Alternative spatial weight matrices.

	Five nearest neighbor spatial weight matrix			Inverse distance matrix standardized by its largest eigenvalue		
	Direct effects	Indirect effects	Total effects	Direct effects	Indirect effects	Total effects
Y_{it-1}	-0.137***	0.012	-0.124*	-0.117***	0.149	0.032
	(0.021)	(0.067)	(0.068)	(0.015)	(0.103)	(0.107)
FDI_{it-1}	0.006**	0.011*	0.017**	0.007***	0.012*	0.019**
	(0.002)	(0.006)	(0.007)	(0.002)	(0.007)	(0.008)
Agr_{it-1}	-0.004	-0.032	-0.037	0.002	-0.038	-0.035
	(0.007)	(0.045)	(0.050)	(0.008)	(0.072)	(0.077)
Ind_{it-1}	0.117***	0.278***	0.395***	0.145***	0.838***	0.983***
	(0.018)	(0.098)	(0.108)	(0.020)	(0.195)	(0.209)
Ser_{it-1}	0.036	0.535***	0.571***	0.164***	1.490***	1.655***
	(0.046)	(0.183)	(0.202)	(0.046)	(0.370)	(0.390)

Notes: standard errors in parentheses. *** (**) (*) Significant at 1% (5%) (10%) respectively.

2.4.3 Sectoral breakdown

The aim of this subsection is twofold: first, to determine whether the results obtained using aggregate FDI keep when disaggregated FDI data by sector are considered; and second, to add information on whether the growth impact of FDI differs across sectoral branches.

To do this, we take our growth model (Equation 2.1) and, following Alfaro (2003), disaggregate the independent FDI variable into different branches of the industry and service sectors.[21] We use FDI in each branch (corrected by the headquarters effect[22]) as a percentage of GDP. The new specification is as follows:

$$\Delta Y_{it} = \rho \sum_j w_{ij}\ \Delta Y_{jt} + \beta\, Y_{it-1} + \theta \sum_j w_{ij}\, Y_{jt-1} + \sum_k \sigma_k\ FDI_{it-1}^{k} + \sum_k \sum_j \tau_k\, w_{ij}\, FDI_{jt-1}^{k} + \delta_1\, Agr_{it-1} + \delta_2 \sum_j w_{ij}\, Agr_{jt-1} + \lambda_1\, Ind_{it-1} + \lambda_2 \sum_j w_{ij}\, Ind_{jt-1} + \varphi_1\, Ser_{it-1} + \varphi_2 \sum_j w_{ij}\, Ser_{jt-1} + \pi\, d_{crisis} + \mu_i + u_{it} \quad (2.6)$$

where *k*=1,2 denotes the branches of industrial sector (*k*=1 for manufacturing, which accounts, on average during the sample period, for 60.4% of FDI in industry; and *k*=2 for mining, quarrying and energy supply, accounting for the remaining 39.6%), while *k*=3,4,5 refers to the branches of service sector (*k*=3 for transport, storage and communications, which receives on average 30.4% of FDI in services; *k*=4 for financial intermediation, accounting for 18.9%; and *k*=5 for distribution, accounting for 29.8%).

Based on a similar approach to Alfaro (2003), the sectoral analysis is carried out in three steps: first, we estimate Equation (2.6) including FDI for the industrial branches (*k*=1,2); then, we only include the branches for services (*k*=3,4,5); finally, we perform the same estimation including the five branches (*k*=1,2,3,4,5), so that potential interactions among them, which could affect the results, are properly addressed.

The first panel of Table 2.10 reports the results of estimating Equation (2.6) with FDI in two broad branches of the industrial sector. As can be seen, FDI received in manufacturing has a positive effect on growth and the spatial spillover effect

[21] We exclude FDI in agriculture and construction sectors since they account for only 4.5% of total FDI received in Spain.

[22] Once the total headquarters effect is computed for each year of our sample period, we distribute it at sectoral level by using the percentage of each branch of industry and services on total FDI received by Madrid. That is, if the headquarters effect were 100 in a given year and the share of a particular branch over total FDI in Madrid were 30%, the headquarters effect for this branch would be 30. This amount would now be distributed across the remaining regions taking into account the weight of each region in the FDI of the branch under consideration, excluding Madrid. Here we have to use the weight of each region in branches' FDI rather than the weight of each region in branches' exports since data on regional exports for the three branches of service sector are not available.

prevails over the direct effect; in contrast, FDI in mining, quarrying and energy supply does not contribute to economic growth.

As for the service sector (second panel of Table 2.10), FDI in transport, storage and communications as well as financial intermediation enhances economic growth, while that in distribution is not statistically significant. It is also worth highlighting the positive and significant spatial spillover of FDI in transport, storage and communications.

Finally, the third panel of Table 2.10 shows the results when considering all branches simultaneously. The results of sectoral FDI on growth also strengthen previous findings, but with one important additional insight: the role of services and industry branches changes significantly; they are now higher in the former (above all transport, storage and communications) and smaller in the latter.

Table 2.10 Robustness check for the spatial growth model. Sectoral breakdown.

	Industry			Services			Industry and services		
	Direct effects	Indirect effects	Total effects	Direct effects	Indirect effects	Total effects	Direct effects	Indirect effects	Total effects
Y_{it-1}	-0.1252***	0.1528	0.0276	-0.1268***	0.1390	0.0122	-0.1259***	0.2139*	0.0880
	(0.0182)	(0.1126)	(0.1162)	(0.0175)	(0.1021)	(0.1020)	(0.0177)	(0.1159)	(0.1165)
$FDI_{it-1}^{k=1}$	0.0018*	0.0105*	0.0123**				0.0007*	0.0017*	0.0024*
	(0.0010)	(0.0062)	(0.0062)				(0.0004)	(0.0010)	(0.0014)
$FDI_{it-1}^{k=2}$	0.0003	0.0007	0.0010				0.0002	0.0005	0.0007
	(0.0006)	(0.0015)	(0.0022)				(0.0007)	(0.0016)	(0.0022)
$FDI_{it-1}^{k=3}$				0.0009*	0.0090*	0.0099*	0.0005*	0.0149*	0.0154*
				(0.0005)	(0.0054)	(0.0058)	(0.0003)	(0.0086)	(0.0092)
$FDI_{it-1}^{k=4}$				0.0009*	0.0021	0.0030*	0.0011**	0.0025*	0.0036**
				(0.0005)	(0.0013)	(0.0018)	(0.0005)	(0.0013)	(0.0017)
$FDI_{it-1}^{k=5}$				0.0007	0.0016	0.0023	0.0001	-0.0106	-0.0105
				(0.0012)	(0.0031)	(0.0043)	(0.0014)	(0.0113)	(0.0123)
Agr_{it-1}	-0.0022	-0.0469	-0.0491	0.0054	-0.0429	-0.0375	0.0067	-0.0106	-0.0039
	(0.0070)	(0.0803)	(0.0842)	(0.0078)	(0.0707)	(0.0757)	(0.0081)	(0.0756)	(0.0794)
Ind_{it-1}	0.1538***	0.7687***	0.9225***	0.1553***	0.8946***	1.0499***	0.1622***	1.0586***	1.2208***
	(0.0216)	(0.2227)	(0.2371)	(0.0239)	(0.2477)	(0.2642)	(0.0228)	(0.2597)	(0.2753)
Ser_{it-1}	0.0992**	1.5011***	1.6003***	0.1469***	1.7029***	1.8498***	0.1616***	2.0125***	2.1741***
	(0.0462)	(0.4594)	(0.4788)	(0.0513)	(0.4719)	(0.5023)	(0.0603)	(0.5103)	(0.5493)

Notes: k: branches of industrial (*k* =1,2) and service sectors (*k*=3,4,5). Standard errors in parentheses. *** (**) (*) Significant at 1% (5%) (10%) respectively. Results obtained by using the row-standardized inverse distance matrix.

2.5 Conclusions

The paper examines the impact of inward FDI on economic growth across the Spanish regions over the period 1996-2013. In this respect, the paper makes two contributions. First, it deals with the so-called headquarters effect; that is, the fact that FDI data collection in Spain is biased to the capital region (Madrid). We propose a method to compute this effect to obtain new FDI data free from it. Second, the paper also offers a contribution of methodological nature in three respects. It models spatial spillovers derived not only from the dependent variable but also from the independent ones; it computes average direct, indirect and total effects to obtain more accurate results; it goes one step further and computes the matrix of effect estimates associated to FDI to examine direct and indirect effects for each pair of regions. To accomplish these aims, a panel Spatial Durbin Model is estimated.

In any case, for the sake of comparison and to reveal the importance of the issue at hand, the paper initially estimates the proposed growth model with raw FDI data. The results show a positive direct effect of FDI on economic growth but no evidence of spatial spillovers. Given this, the question arises as to whether there is any connection between the headquarters effect and the lack of regional spatial spillovers. To answer this question, we compute the headquarters effect and obtain a new set of FDI data. The re-estimation of the model with these new data reveals the presence of strong FDI spatial spillovers. Thus, our findings provide evidence on the fact that economic growth in a region is positively affected not only by the inward FDI in that region (direct effect) but also by the FDI received by neighboring regions (indirect effect). Furthermore, the computation of the matrix of effect estimates associated to FDI offers new insights: on the one hand that the direct effect turns out to be the greatest one when all the effects are considered individually; on the other, that the closer the regions to the one under consideration, the higher the spillover effects.

The main result of the paper, the emergence of FDI spatial spillovers on growth once you have properly addressed the headquarters effect, is proved robust to the inclusion of Cataluña in its computation and to the use of different specifications of the spatial weight matrix. Besides, the results from the sectoral breakdown of FDI data tend to reinforce the aggregate ones, but also unveil that the service sector (especially the transport, storage and communications branch) is, regarding foreign capital inflows, the key enhancer of regional growth.

To conclude based on the results obtained, it is evident that one cannot rely on raw FDI data since they are clearly biased due to the relevance of the headquarters effect. In other words, the fact that a part of the total FDI is wrongly registered in the region in which the firm's headquarters is located rather than where it is really made leads to misleading results: FDI spillovers, despite being instrumental to foster economic growth, are not detected. Therefore, there is no doubt that, from a policy-oriented point of view, regional-level joint strategies should be implemented to attract FDI and, consequently, promote economic growth.

Chapter 3

Has the crisis affected Spanish investment strategy abroad? A spatial panel data approach

3.1 Introduction

Over the last few decades, FDI has registered growth rates well above those of global output and trade, fostering economic growth and development in recipient countries and, gradually, changing the landscape of the global economy. No wonder, then, that this rapid increase in FDI has motivated the interest in the study of its determinants.

Although the literature on this issue is very large and insightful (for a review, see Blonigen (2005), Faeth (2009), Assunção et al. (2013) or Blonigen and Piger (2014)), it suffers, however, from a significant drawback: it has been mostly developed within a two-country framework, thus assuming independence of FDI flows across host countries. No doubt, our understanding of FDI has been so far hampered by overlooking this instrumental point and, hence, the existence of spatial interactions in FDI flows. And this is so despite the fact that the new economic geography literature (Krugman, 1991; Fujita et al., 1999) indicates that agglomeration effects must be considered in the FDI attraction process, since FDI in a country is expected to depend not only on its own characteristics but also on those of its neighbors. Additionally, it must be reminded that the increasing participation in global value chains relies on the fragmentation of production around the globe, which heightens the interdependence between firms and supply chain partners in different countries (Gereffi et al., 2005). As if this were not enough to take into account the role of spatial dependence in FDI analysis, we can add another point from a methodological perspective: this is that the omission of spatial dependence can lead to serious econometric problems in the estimation, such as biased, inconsistent or inefficient estimates as well as inaccurate inferences (Anselin, 1988).

Accordingly, due to the undoubted relevance of spatial interactions in FDI, recent theoretical contributions have incorporated third-country effects into models dealing with the analysis of FDI determinants. This has added to the traditional horizontal and vertical FDI strategies some other more complex strategies, such as the export-platform (Yeaple, 2003; Ekholm et al., 2007) and the complex vertical FDI (Baltagi et al., 2007).

Despite this fact, the existence of spatial dependence in the empirical analysis of FDI decisions has been only recognized recently (see, e.g., the pioneers Baltagi et al., 2007 and Blonigen et al., 2007) and, therefore, it is in need of further developments. On the one hand, because the most popular method to tackle spatial dependence is based on spatial Autoregressive models (SAR), which circumscribe spatial dependence to FDI and not to its determinants. On the other, because the majority of previous studies use point estimates for inferences and interpretation of the parameters of the spatial regression models, which, according to LeSage and Pace (2009), may give rise to wrong results; instead, partial derivatives of the dependent variable with regards to each independent variable should be employed.

Against this backdrop, this paper adopts a spatial approach to analyze FDI determinants and examine the predominant FDI strategy. The first contribution of the paper is that it estimates a panel spatial Durbin model (SDM), which has clear advantages over SAR approaches, among them the consideration of spillovers arising not only from FDI but also from its potential determinants in neighboring host countries. Moreover, it computes the own- and cross-partial derivatives and reports scalar summary measures of the direct and indirect effects of the impact of a change in each of the FDI determinants, which is much more accurate than the point estimates (LeSage and Pace, 2009).

To deal with this issue, Spanish direct investment abroad is taken as case study. Although Martínez-Martín (2011) also studied Spanish FDI, by using a spatial approach, over 1993-2004, this present paper focuses on a longer sample period (1996-2014) that combines a sub-period of economic expansion (which we call pre-crisis (1996-2007)) with the aftermath of the economic downturn (what we call crisis (2008-2014)). Taking advantage of this, we investigate, and this is another contribution of the paper, a quite interesting issue: whether FDI determinants and the FDI strategy depend on the business cycle. In addition, we not only perform the analysis at an aggregate but also at a disaggregate level, mainly for industry and services to unveil potential differences across these sectors.

It has to be mentioned that the Spanish case is worth studying. We referred before to the change of landscape in the world economy due to FDI, being one of the new features that Spain became a significant player. Thanks to its integration into the European Union in 1986, Spanish FDI outflows registered notable increases since the second half of the nineties (Maté Rubio, 1996; Campa and Guillén, 1996; Gordo et al., 2008).[1] With the outbreak of the economic crisis, however, and despite the fact that the lack of domestic demand forced Spanish firms to expand their business abroad (Eppinger at al., 2018), FDI outflows plummeted. Additionally, the crisis pushed Spanish firms to be more selective in their international endeavors (Gil-Pareja et al., 2013), which makes the comparison between the pre-crisis and crisis periods especially interesting. Furthermore, Spanish experience provides an

[1] Spanish MNEs took advantage of Europe's external openness to trade and investment, derived from the implementation of the European Monetary Union and the ongoing process of globalization. They started to internationalize and take advantage of the growth potential of certain markets and sectors. Consequently, outward FDI flows surpassed inward FDI flows, Spain becoming a net FDI exporter.

appealing case study from the policy makers' point of view. Considering that Spanish firms have been deeply affected by the crisis and internationalization can be perceived as a way of improving their situation, our findings could help them to implement adequate policies to stimulate outward FDI and, then, to foster the positive effects of Spanish investment abroad upon the Spanish economy; as Myro (2014, 2015) notes, by boosting GNP growth, increasing employment and exports, raising efficiency and improving labor skills and technological effort of Spanish firms.[2]

The remainder of the paper is structured as follows. Section 3.2 provides a brief overview of the spatial FDI literature. Section 3.3 outlines the pattern of the geographical and sectoral distribution of Spanish FDI. Section 3.4 specifies the model and describes data used for the empirical analysis. Section 3.5 estimates the model and presents the results. Section 3.6 conducts a robustness check by employing sectoral FDI data and alternative specifications of the distance matrix. Finally, Section 3.7 offers the main conclusions.

3.2 FDI determinants: a literature review of spatial models

In this section, we briefly review the empirical literature on FDI determinants at the country level that takes into account spatial dependence (see Table 3.1 for a short reference focused on the treatment of spatial effects). Two different approaches to model FDI spillovers can be distinguished.[3] The less common one implies the inclusion in the model of spatial lags of the factors driving FDI to consider not only

[2] This result is not exclusive for Spain as pointed out by World Bank (2018): *"FDI brings benefits not only to destination markets but also to source economies ("home country effects")"*.

[3] There is a third, recent and less investigated approach. It incorporates interdependencies across origin and destination countries in the analysis of FDI determinants. Leibrecht and Riedl (2014) and Alamá-Sabater et al. (2016a) include the possibility that FDI from every origin country to any destination country depends on the volume of FDI flowing from an origin country's neighbors to the same destination country, and the volume of FDI flowing from the same origin country to a particular destination country's neighbors. Needless to say, this approach is not applicable to our case study.

the impact of the host country characteristics on FDI but also those of its neighbors. This strategy is followed by Baltagi et al. (2007), who include spatially weighted explanatory variables (as well as spatial interactions in the error term) to examine the determinants of US outward FDI to 51 countries over the period 1989-1999; their findings show the importance of third-country effects. Similarly, Hall and Petroulas (2008) confirm the existence of spatial dependence in the determinants of FDI for 476 country-pairs during the period 1994-2004. Likewise, Uttama and Peridy (2009) analyze US outward FDI to the main ASEAN countries over the period 1995-2007 and find that third-country determinants are relevant to explain FDI.

Table 3.1 Papers on FDI determinants modeling spatial spillovers.

Paper	Spatial variables included in the model	Point estimates / Partial derivative effects
Baltagi et al. (2007)	Bilateral size, similarity in size, relative physical capital endowments, relative skilled and unskilled labor endowments, interaction of relative physical capital endowments and bilateral size, interaction of relative endowments and distance	Point estimates
Hall and Petroulas (2008)	Market potential, similarity index, capital ratio, skill difference, trade costs	Point estimates
Uttama and Peridy (2009)	The variables included in Baltagi et al. (2007), and market potential	Point estimates
Blonigen et al. (2007)	FDI, market potential	Point estimates
Garretsen and Peeters (2009)	FDI, market potential	Point estimates
Poelhekke and van der Ploeg (2009)	FDI, market potential, investment potential	Point estimates
Martínez-Martín (2011)	FDI, market potential	Point estimates
Nwaogu and Ryan (2014)	FDI, market potential	Point estimates

Regelink and Elhorst (2015)	FDI, market potential	Point estimates and partial derivative effects
Alamá-Sabater et al. (2016b)	FDI	Point estimates
Siddiqui and Iqbal (2017)	FDI, market potential, infrastructure, governance	Point estimates and partial derivative effects

The other approach, followed by most empirical studies, consists of including the spatial lag of FDI to take account of spatial linkages in FDI across neighboring countries. That is the case of Blonigen et al. (2007). This paper, by estimating a gravity model extended to include the spatial lag of FDI -and a weighted average of the market potential of neighboring host countries-, analyzes US outward FDI to 35 host countries for the period 1983-1998. As we will see below, it develops a theoretical framework distinguishing different FDI strategies. As for the results, no matter the sub-samples used, the paper points to significant spatial interactions. On the other hand, Garretsen and Peeters (2009), analyzing Dutch outward FDI into 18 OECD host countries between 1984 and 2004, and Poelhekke and van der Ploeg (2009), using US affiliates' sales in 76 foreign countries during the period 1984-1998, conclude that third-country effects matter, although in this case they point to agglomeration in FDI. In the same vein, Martínez-Martín (2011) finds evidence of positive spatial linkages for Spanish outward FDI over the period 1993-2004, and so do Nwaogu and Ryan (2014) for US FDI into Africa, Latin America and the Caribbean over the period 1995-2007. On the contrary, Regelink and Elhorst (2015), by computing direct and indirect effects of FDI determinants, offer evidence of the existence of competition among European countries when attracting US FDI from 1999 to 2008. Alamá-Sabater et al. (2016b), focusing on bilateral FDI between the 27 EU member countries in 2007, find again positive spatial dependence across neighboring FDI host countries. More recently, Siddiqui and Iqbal (2017), employing partial derivatives in line with Regelink and Elhorst (2015), investigate

US FDI in the MENA countries over the period 2002-2014. These authors find no effect of the spatially-lagged FDI (nor of the surrounding market potential).

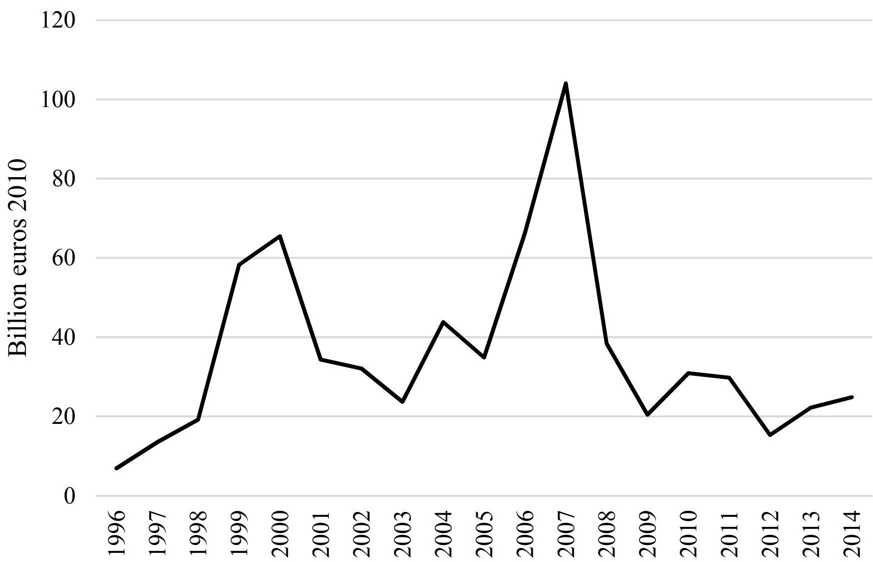
This paper, as we will explain in Section 3.4, merges both approaches. It considers spillovers arising not only from FDI in neighboring countries but also those derived from their own characteristics. Besides, and as mentioned in the Introduction, we compute the average direct and indirect effects, in line with Regelink and Elhorst (2015) and Siddiqui and Iqbal (2017), to boost the reliability of the results.

3.3 Distribution of Spanish outward direct investment

This section gives an insight into the geographical and sectoral distribution of Spanish direct investment outflows during the period under study (1996-2014), for which data are extracted from the Spanish Foreign Investment Registry (DataInvex).

First of all, Figure 3.1 displays the evolution of Spanish direct investment outflows. From its consideration, two main results emerge: first, that the series is very volatile and, second, that the financial crisis has severely affected the volume of direct investment abroad.

Figure 3.1 Spanish FDI outflows, 1996-2014.



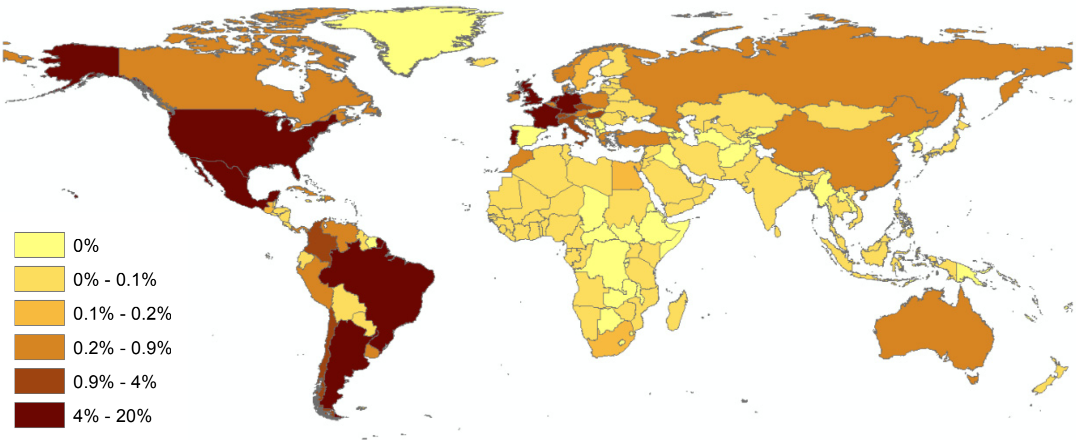
With regard to the geographical distribution, Table 3.2 shows how Spanish direct investment outflows evolved over the period 1996-2014. On average, it can be appreciated that more than half (51.5%) of them went to Europe, 45% to America (35.5% to Latin America) and the remaining 3.5% to Asia, Africa and Oceania (grouped into 'others'). Apart from this, four main characteristics can be highlighted. First, the golden age of Spanish direct investment in Latin America was in the second half of the nineties; second, Europe has been the main recipient of Spanish direct investment during most of the first decade of the new century; third, the US is consistently the main recipient of the Spanish direct investment in North America; and fourth, it seems that the outbreak of the economic and financial crisis resulted in an increase of almost 6% of FDI going to North America and 2.2% to Asia, Africa and Oceania to the detriment of that going to Latin America.

Figure 3.2 provides additional insights into the FDI geographical distribution, both for the pre-crisis (a) and crisis (b) periods. During the pre-crisis period, the main European destinations were Portugal, France, United Kingdom, the Netherlands and Germany, while some countries such as Serbia, Macedonia and Montenegro did not receive FDI from Spain. Regarding America, the top recipient countries were United States, Brazil, Argentina and Mexico. As for the crisis period, the most significant changes occurred in countries such as Ireland, Turkey, Libya, Saudi Arabia, India and China, which gained relevance with respect to the previous time span. Apart from this, an important feature that can be drawn from the figure is that there seems to exist spatial dependence in the distribution of Spanish direct investment outflows. So this is something to be considered later and, once tested, introduced in the model to explain the pattern of outward direct investment from Spain.

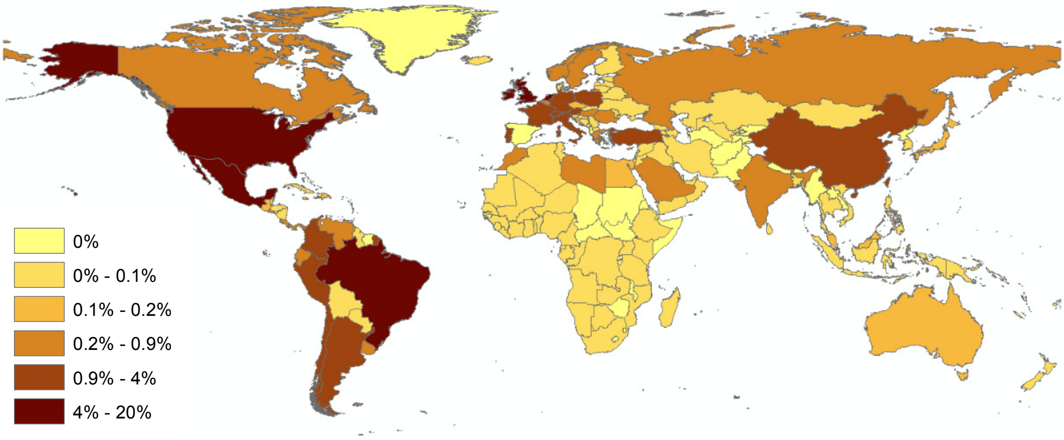
Table 3.2 Destination of Spanish FDI outflows (%), 1996-2014.

Year	Europe	Main recipient	North America	Main recipient	Latin America	Main recipient	Others
1996	25.86	Portugal 10.46	10.07	US 10.04	62.80	Argentina 24.69	1.27
1997	28.35	Netherlands 12.72	5.39	US 5.38	65.51	Argentina 26.80	0.74
1998	28.73	Netherlands 7.04	9.13	US 9.12	60.49	Brazil 32.48	1.65
1999	21.05	Netherlands 7.17	2.06	US 1.32	75.61	Argentina 36.73	1.28
2000	32.22	Portugal 7.02	14.94	US 14.92	52.05	Brazil 28.57	0.79
2001	57.47	Netherlands 27.75	6.64	US 6.57	35.23	Mexico 8.08	0.67
2002	59.88	Germany 26.17	7.13	US 6.36	25.05	Brazil 8.67	7.95
2003	55.68	UK 18.57	3.77	US 3.47	31.03	Chile 9.91	9.51
2004	76.28	UK 37.66	4.11	US 2.69	18.85	Mexico 10.66	0.76
2005	73.19	France 18.78	7.51	US 6.40	16.49	Argentina 6.99	2.82
2006	81.54	UK 51.62	10.66	US 10.54	16.49	Brazil 2.26	1.88
2007	78.81	UK 30.48	10.22	US 10.12	8.90	Mexico 3.96	2.08
2008	50.69	UK 13.59	21.89	US 21.68	20.12	Mexico 9.92	7.30
2009	43.05	UK 15.55	28.42	US 27.21	24.69	Mexico 11.38	3.84
2010	64.48	Netherlands 27.19	10.11	US 9.47	18.42	Mexico 12.89	6.99
2011	57.09	Turkey 14.91	10.48	US 10.17	27.80	Brazil 15.59	4.64
2012	48.52	Netherlands 11.53	6.84	US 4.53	41.28	Chile 14.55	3.36
2013	55.13	Germany 17.13	3.78	US 3.29	37.72	Peru 20.07	3.36
2014	37.23	Ireland 15.92	11.71	US 10.91	46.63	Brazil 14.12	4.43
Period average	51.33	UK 17.21	9.73	US 9.32	35.50	Brazil 9.48	3.44
Pre-crisis average	51.59	UK 19.01	7.63	US 7.24	38.16	Brazil 10.06	2.62
Crisis average	50.89	UK 12.31	13.32	US 13.13	30.95	Brazil 7.90	4.85

Figure 3.2 Share of Spanish FDI outflows (pre-crisis and crisis).



(a) Pre-crisis 1996-2007



(b) Crisis 2008-2014

As for the sectoral distribution of Spanish direct investment abroad (reported in Table 3.3), it is important to highlight that industry and services concentrated, on average, 94.7% of the total, the latter concentrating more than twice as much as the former. Besides, in the crisis period, services share increased by 4 percentage points, while the industry sector lost importance. Needless to say that agriculture and construction represented a slight share of the Spanish direct investment abroad over the sample period.

Table 3.3 Sectoral distribution of Spanish FDI outflows (%), 1996-2014.

Year	Agriculture	Industry	Construction	Services
1996	0.59	23.34	2.68	73.40
1997	0.97	38.13	0.96	59.95
1998	0.32	29.92	4.05	65.71
1999	0.12	62.40	0.68	36.80
2000	0.13	19.28	0.54	80.05
2001	0.36	41.42	1.92	56.30
2002	0.25	31.98	4.10	63.67
2003	0.14	60.14	2.23	37.49
2004	0.14	18.31	1.49	80.05
2005	0.29	23.03	16.14	60.55
2006	0.22	16.10	8.19	75.49
2007	0.20	33.57	3.93	62.30
2008	0.31	38.45	5.41	55.84
2009	0.30	28.93	7.49	63.28
2010	0.24	15.06	6.94	77.77
2011	0.24	21.78	7.43	70.56
2012	0.27	26.83	7.73	65.17
2013	0.42	21.77	5.77	72.03
2014	0.47	27.98	7.45	64.09
Period average	0.32	30.44	5.01	64.24
Pre-crisis average	0.31	33.13	3.91	62.64
Crisis average	0.32	25.83	6.89	66.96

3.4 Data and model specification

This section is devoted to studying the determinants of Spanish direct investment abroad. To do so, the sample consists of the top-50 host countries, which received, on average, 96.75% of total outflows over the period 1996-2014 (see the countries considered in the Appendix 2). It has to be mentioned that the Chow test confirms, in line with Figure 3.1, the presence of a structural break with the outbreak of the crisis, which justifies the splitting of the period into pre-crisis (1996-2007) and crisis (2008-2014) sub-periods.[4]

Regarding the specification of the model, we draw on Blonigen et al. (2007) as, apart from identifying FDI determinants, we are also interested in unveiling FDI strategies. In Blonigen et al.'s model, FDI to country *i* in year t (FDI_{it}) is regressed on a group of traditional host-country determinants ($Host\ Determinants_{it}$), the surrounding market potential (proxied by a weighted average of the GDP of all other countries, $\sum_j W_{ij}\, GDP_{jt}$), and the spatial lag of the direct investment (a weighted average of the investment received by the remaining countries other than *i*, $\sum_j W_{ij}\, FDI_{jt}$). So, the model is as follows:

$$FDI_{it} = \beta\ Host\ Determinants_{it} + \theta \sum_j W_{ij}\, GDP_{jt} + \rho \sum_j W_{ij}\, FDI_{jt} + \varepsilon_{it} \quad (3.1)$$

where W denotes the spatial weight matrix, whose elements reflect the intensity of the interdependence between countries *i* and *j*. Then, Blonigen et al.'s model includes the spatial lag of the dependent variable, as the investment decision in a host country may be influenced by the investment going to neighboring countries; that is, spatial spillovers, derived from direct investment, may arise. The inclusion of the surrounding-market potential is, on the other hand, instrumental in their model since, together with the spatial lag of the investment abroad, allows to determine the investment strategy.

The problem with Blonigen et al.'s model is that there are still spatial interdependencies that are overlooked. It seems likely that the decision to invest in a foreign market may depend on other characteristics of neighboring countries, apart from the market potential. For this reason, once the variables acting as host determinants are selected on the basis of existing studies on the determinants of FDI (along with market potential (GDP), variables such as population (POP), trade costs

[4] To run this test, we used the FDI models of Equations (2) and (3) presented in this section. The results, with no exception, confirm the existence of a structural break in 2008.

(TC), human capital (HC) and regulatory quality (RQ)), we extend Blonigen et al.'s model by including also their spatial lags. Then, our model, namely the resulting SDM, is as follows:

$$FDI_{it} = \rho \sum_j W_{ij} \, FDI_{jt} + \beta_1 GDP_{it} + \theta_1 \sum_j W_{ij} \, GDP_{jt} + \beta_2 POP_{it} + \theta_2 \sum_j W_{ij} \, POP_{jt} + \beta_3 TC_{it} + \theta_3 \sum_j W_{ij} \, TC_{jt} + \beta_4 HC_{it} + \theta_4 \sum_j W_{ij} \, HC_{jt} + \beta_5 RQ_{it} + \theta_5 \sum_j W_{ij} \, RQ_{jt} + \mu_t + \mu_i + u_{it} \quad (3.2)$$

where the spatial weight matrix (W) is defined here as the (row-normalized) inverse distance matrix and the dependent variable FDI denotes gross outflows of Spanish direct investment abroad (in logs), i refers to the host country, j to the remaining countries, and t denotes time. Time fixed effects (μ_t) are included to control for shocks affecting all or most of our set of countries. Besides, country fixed effects (μ_i) are included to account for time-invariant unobserved heterogeneity across countries. In any case, and as the influence of some variables could be absorbed by the inclusion of country fixed effects, we also specify an alternative model by including two potential time-invariant factors affecting FDI: the geographical distance of hosting countries with Spain ($DIST$), as well as a variable capturing cultural links, which is proxied by the share of a common language ($LANG$). Needless to say, when these two variables are included in the equation, country fixed effects are dropped from the model to avoid perfect multicollinearity. Thus, we also estimate the following SDM:

$$FDI_{it} = \rho \sum_j W_{ij} \, FDI_{jt} + \beta_1 GDP_{it} + \theta_1 \sum_j W_{ij} \, GDP_{jt} + \beta_2 POP_{it} + \theta_2 \sum_j W_{ij} \, POP_{jt} + \beta_3 TC_{it} + \theta_3 \sum_j W_{ij} \, TC_{jt} + \beta_4 HC_{it} + \theta_4 \sum_j W_{ij} \, HC_{jt} + \beta_5 RQ_{it} + \theta_5 \sum_j W_{ij} \, RQ_{jt} + \beta_6 DIST + \beta_7 LANG + \mu_t + u_{it} \quad (3.3)$$

At this point it is mandatory to make some comments about the variables included in the model, whose metrics and data sources are reported in Table 3.4. These variables are:

(1) GDP_{it} as a proxy for market potential. Income of the host country is usually considered as a determinant for market-seeking FDI; the higher the income level of the host country, the more FDI is expected to go to that country.

(2) POP_{it}. Population is included to control for the known tendency for FDI to move towards wealthy countries (Blonigen et al., 2007). Holding GDP constant, an increase in country's population reduces its per capita GDP, and so does FDI. Hence, a negative sign is expected.

(3) TC_{it}. Trade costs between Spain and potential host countries capture tariffs and other components such as currency barriers, informational costs and bureaucratic red tape.[5] With regard the expected sign of the coefficient associated to this variable, it all depends on the motivation for investing. In the case of horizontal investment, which serves as a substitute for exports, higher trade costs to the host country would promote it. In contrast, vertical investment is considered as a complement to trade and thus increases if the trade costs are reduced. As for the export-platform investment, it could be discouraged if trade costs are high in the host country. Finally, in the case of complex-vertical investment, predictions on the expected sign of the *TC* coefficient are less clear-cut because they could depend on the stage of the chain of production of the host country (Fugazza and Trentini, 2014). Therefore, we do not expect a priori a specific sign in the relationship between *TC* and *FDI*.

(4) HC_{it}. Human capital is proxied by the gross enrollment rate in tertiary education. The expected sign is, again, indeterminate. A positive sign is consistent with investment looking for skilled labor force in the destination country. However, if investment is searching for cheap unskilled labor, a negative sign of the coefficient would be expected.

[5] See Novy (2013) for the computation of this measure of bilateral trade costs. We consider it is a better proxy for trade costs than the one commonly used in the literature (inverse of the degree of trade openness).

(5) RQ_{it}. Regulatory quality, as essential dimension of the institutional quality, is included to account for the impact of regulatory risks on direct investment abroad. It captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. It is an index ranging from -2.5 (weak governance performance) to 2.5 (strong).[6] In general, direct investment tends to go to countries with good institutions since they guarantee property rights and minimize transaction costs, thus creating a favorable climate for investment. Accordingly, a positive sign is expected.

(6) $DIST$. Distance between Spain and potential host countries is computed as the great circle distance between capital cities. A priori, distance discourages FDI. Therefore, if distance captures somehow the costs of investing abroad, we expect a negative sign.

(7) $LANG$, as a proxy for cultural proximity. We use a dummy variable taking a value of 1 if the official language of the host country is Spanish, and 0 otherwise. Strong cultural ties between home and host countries are likely to increase direct investment flows among them, so a positive sign is predicted.

Regarding the expected signs of the spatial lags of the dependent variables, we focus our attention on what Blonigen et al.'s paper says when it comes to defining FDI strategies. To be precise, the paper distinguishes four FDI strategies, depending on the expected signs of the coefficients of the spatial lag of FDI and the surrounding-market potential variable: horizontal, vertical, export platform and complex vertical FDI. Table 3.5 reports the expected signs.

[6] To see the variables used in the construction of RQ_{it} please refer to the Worldwide Governance Indicators.

Table 3.4 Variables, measures and data sources.

Variable	Measurement	Data source
Dependent variable		
FDI_{it}	Ln(Gross outflows of Spanish FDI), expressed in thousands of euros of 2010	Spanish Foreign Investment Registry (DataInvex)
Independent variables		
Market potential (GDP_{it})	Ln(GDP), expressed in millions of dollars of 2010	World Development Indicators (World Bank)
Population (POP_{it})	Ln(Population)	World Development Indicators (World Bank)
Trade costs (TC_{it})	Ln(bilateral trade costs)	ESCAP-World Bank Trade Cost Database
Human capital (HC_{it})	Ln(Gross enrollment rate in tertiary education)	World Development Indicators (World Bank)
Regulatory quality (RQ_{it})	Index ranging from -2.5 (weak) to 2.5 (strong governance performance)	Worldwide Governance Indicators (World Bank)
Distance ($DIST$)	Ln(Great circle distance between capital cities), in kilometers	Centre d'Etudes Prospective et d'Informations Internationales (CEPii)
Cultural proximity ($LANG$)	Dummy on common language	CEPii

Table 3.5 FDI strategies and expected signs of the FDI spatial lag and surrounding-market potential coefficients.

FDI strategies	Sign of FDI spatial lag (ρ)	Sign of surrounding-market potential (θ)
Pure horizontal	0	0
Export platform	−	+
Pure vertical	−	0
Complex vertical	+	0/+

Note: 0 denotes non-statistical significance.

3.5 Model estimation and results

Prior to showing the results, there are two econometric issues in need of clarification; the potential presence of spatial dependence and, if so, which model better captures it. Then, we firstly tested for the presence of spatial dependence in the non-spatial versions of Equations (3.2) and (3.3); the Lagrange Multiplier (LM) tests revealed, for both periods, that there is spatial dependence, so a spatial approach is needed. Secondly, we estimated the two versions of the SDM (Equations 3.2 and 3.3) and, to ascertain whether these models could be simplified into SAR models or into Spatial Error Models (SEM), computed the corresponding Likelihood Ratio (LR) tests; the results, reported in Table 3.6, show that the null hypotheses can be rejected both in the pre-crisis and crisis periods. Consequently, we found support for our initial ideas: the existence of spatial dependence makes traditional models no longer appropriate, and it is necessary to combine spatial interdependencies in FDI with those in its determining factors.

Equations (3.2) and (3.3) are estimated (by maximum likelihood because the inclusion of spatial lags causes OLS results to be inconsistent). First, we focus our attention on the results obtained for the pre-crisis period, which are shown in Table 3.7. Looking at the point estimates of the non-spatially lagged variables in Equation (3.2), only the regulatory quality seems to be statistically significant. Nevertheless, in Equation (3.3), the results hint at the relevance of the market potential, trade costs, human capital and regulatory quality together with the geographical distance and cultural ties in the decision of Spanish firms to engage in investing abroad. Therefore, country fixed effects seem to be somehow capturing the effect of these variables (except regulatory quality) on FDI. If we focus on the coefficients associated to the spatially lagged variables in Equation (3.2), the direct investment to a particular host country appears to be influenced by characteristics of its neighbors; namely, population, human capital and FDI. When country fixed effects are replaced by $DIST$ and $LANG$, surrounding market potential and trade costs turn out to be statistically significant, while population in nearby countries lose their significance.

Table 3.6 Likelihood Ratio (LR) tests for spatial dependence.

	Equation (3.2)		Equation (3.3)	
Tests	Statistic	p-value	Statistic	p-value
LR test for SAR				
Pre-crisis period	36.67	0.00	31.44	0.00
Crisis period	22.79	0.00	27.58	0.00
LR test for SEM				
Pre-crisis period	35.92	0.00	26.66	0.00
Crisis period	21.69	0.00	25.72	0.00

However interesting, the point estimates directly obtained from the estimation of Equations (3.2) and (3.3) are not accurate measures to capture the effect of each explanatory variable on FDI; thanks to the work of LeSage and Pace (2009), we know that they may lead to erroneous conclusions. Accordingly, point estimates are only a preliminary step to obtain direct and indirect effects of the different variables on FDI. Partial derivatives should be used as they provide a better interpretation of parameters in spatial regressions. This is so because, using the Leontief expansion $(I_n - \rho W)^{-1} = I_n + \rho W + \rho^2 W^2 + \cdots$, feedback effects arise as a result of impacts passing through neighboring countries and back to the country where the changes originated from; therefore, there are global spillovers. So, we compute the average direct and indirect effect estimates (LeSage and Pace, 2009). The direct effect, defined by averaging the own-partial derivatives (the main-diagonal elements of the matrix of effect estimates),[7] measures the average impact on the FDI received in a specific country caused by one percent change in an explanatory variable of that country. The indirect or spatial spillover effect, computed by averaging the cumulative sum of the cross-partial derivatives (the off-diagonal elements), measures the cumulative average effect of the change in an explanatory variable of neighboring countries on the FDI received in a particular country.

Table 3.7 Point estimates. Spatial Durbin Model. Pre-crisis period (1996-2007).

Dependent variable: FDI_{it}	Equation (3.2)	Equation (3.3)
GDP_{it}	2.07 (1.42)	0.53*** (0.18)
POP_{it}	-5.33 (3.69)	0.26 (0.17)
TC_{it}	1.22 (1.01)	-3.03*** (0.54)
HC_{it}	0.37 (0.37)	-0.50** (0.19)
RQ_{it}	0.98* (0.55)	1.34*** (0.22)
$\sum_j W_{ij}\, GDP_{jt}$	6.74 (7.79)	4.16*** (1.40)
$\sum_j W_{ij}\, POP_{jt}$	-91.24*** (20.92)	0.82 (1.44)
$\sum_j W_{ij}\, TC_{jt}$	-3.07 (7.24)	-15.05*** (3.53)
$\sum_j W_{ij}\, HC_{jt}$	7.20*** (1.82)	1.73* (0.90)
$\sum_j W_{ij}\, RQ_{jt}$	-0.15 (2.38)	-3.06 (2.04)
$\sum_j W_{ij}\, FDI_{jt}$	0.16*** (0.05)	0.35*** (0.11)
$DIST$		-0.50*** (0.19)
$LANG$		2.60*** (0.54)
Time fixed effects	yes	yes
Country fixed effects	yes	no
Observations	600	600

Notes: standard errors in parentheses. *** (**) (*) Significant at 1% (5%) (10%) respectively.

Table 3.8 reports direct and indirect effects for the pre-crisis period. There exists a small difference in magnitude between the point estimates associated to the non-

[7] The matrix of partial derivatives (effect estimates) of the expected value of FDI with respect to the *k*th explanatory variable takes the following form: $(I_n - \rho W)^{-1}[I\beta_k + W\theta_k]$.

spatially lagged variables and the direct effects. It should be highlighted, however, that in the specification with two-way fixed effects (Equation 3.2), the point estimate of GDP was not statistically significant whereas the direct effect associated to this variable turns out to be significant, which unveils that, as previously mentioned, considering point estimates would be misleading. In contrast, there are large discrepancies between the point estimates associated to the spatially lagged variables and the corresponding indirect effects, which is in accordance with the literature.

Table 3.8 Effect estimates. Spatial Durbin Model. Pre-crisis period (1996-2007).

Dependent variable: FDI_{it}	Equation (3.2)		Equation (3.3)	
	Direct Effect	Indirect Effect	Direct Effect	Indirect Effect
GDP_{it}	1.99*	6.63	0.44***	6.31***
	(1.15)	(7.06)	(0.16)	(2.36)
POP_{it}	-4.37	-81.22***	0.29	1.58
	(4.10)	(21.79)	(0.18)	(2.27)
TC_{it}	1.30	-2.66	-3.37***	-25.81***
	(1.07)	(5.82)	(0.62)	(7.03)
HC_{it}	0.32	6.19***	-0.42**	2.45
	(0.35)	(1.51)	(0.18)	(1.65)
RQ_{it}	1.10**	-0.66	1.28***	-4.06
	(0.54)	(2.11)	(0.23)	(2.66)

Notes: Equation (3.2) includes two-way fixed-effects and Equation (3.3) includes time fixed effects. Standard errors in parentheses. *** (**) (*) Significant at 1% (5%) (10%) respectively.

As indicated in the previous section, particular attention should be given to the coefficient of the spatial lag of FDI and the indirect effect associated to GDP (the surrounding market potential). Namely, their signs allow us to determine the predominant FDI strategy of Spanish multinational firms. The positive and significant coefficient of the spatial lag of FDI supports geographical clustering of FDI for supply reasons before the crisis; FDI going to a country can be seen as a complement to that going to neighboring countries, which points to the presence of agglomeration economies in FDI.[8] Furthermore, the indirect effect associated to GDP results to be positive and statistically significant only in Equation (3.3); it loses its statistical significance when country fixed effects are included in the model. In any case, regardless of the significance of the indirect effect of GDP, Spanish MNEs seem to follow a complex vertical FDI strategy. Namely, they set up their vertical chain of production by seeking out low-cost suppliers in neighboring countries. These results are in line with those drawn by Martínez-Martín (2011) for Spanish outward direct investment, but also by Garretsen and Peeters (2009) for Dutch outward FDI, and Nwaogu and Ryan (2014) for US outward FDI.

Apart from the identification of the strategy, some additional results are worth being mentioned. As expected, the direct effect of GDP always discloses a positive and significant relationship between the market potential of the host country and the investment flows received, which is in agreement with Blonigen et al. (2007), Garretsen and Peeters (2009) and Martínez-Martín (2011). We also find a negative and significant indirect effect for the host population in Equation (3.2), which is in line with previous literature. As regards trade costs, when country fixed effects are excluded from the model (Equation 3.3), there are negative and significant direct effects as well as spillover effects on the attraction of FDI flows. This result seems to reveal that any host country would be more prone to receive Spanish direct investment if its trade costs with Spain are low and if surrounded by countries with low trade costs. Additionally, in Equation (3.2) the direct effect of human capital is not relevant, but the level of human capital in neighboring countries positively influences the attractiveness of the recipient country. However, in Equation (3.3), when country fixed effects are not included, the direct effect of human capital results to be negative and statistically significant,[9] which indicates that Spanish

[8] A discussion on the spillover effects and agglomeration economies arising in FDI can be found in Blomström and Kokko (1998).

[9] A possible explanation is that the level of human capital is quite invariant in time and so, fixed effects were picking up its effect.

direct investment abroad might have sought out cheap labor with low qualifications in the destination country during this period, which is in line with a complex-vertical strategy. As regards the regulatory quality, it does seem to be a driving force for FDI; consistently with former literature, countries with a favorable environment for investment seem to receive more investment (Amendolagine et al., 2013). There are no spillover effects though, which is in line with Claeys and Manca (2011). Furthermore, as expected, distance discourages FDI, while cultural ties (sharing a common language) promotes it (Barrios and Benito-Ostolaza, 2010).

Turning our attention to the crisis period, Tables 3.9 and 3.10 display the results. We focus our attention on direct and indirect effects since, as already noted, point estimates are not accurate. Relevant differences emerge in relation to the previous period. On the one hand, the spatial lag of FDI loses its explanatory power. It seems that Spanish investors do no longer agglomerate in host countries; in other words, the decision of Spanish firms to engage in FDI in a specific country is not influenced by the FDI going to other countries. On the other, the surrounding market potential does not seem to be a factor driving FDI anymore; as can be seen, the indirect effect of GDP is statistically non-significant. These results point to pure horizontal (or market-seeking) FDI.[10] Thus, the strategy of Spanish MNEs changed with the outbreak of the financial crisis: Spanish investors seem to perform horizontal, rather than complex vertical direct investment.

[10] As the purpose of horizontal FDI is selling products in the host country, this type of FDI is not associated with either any spatial relationship between FDI into neighboring markets or the market potential of other countries.

Table 3.9 Point estimates. Spatial Durbin Model. Crisis period (2008-2014).

Dependent variable: FDI_{it}	Equation (3.2)	Equation (3.3)
GDP_{it}	4.33** (2.09)	1.30*** (0.23)
POP_{it}	-7.91 (7.12)	-0.16 (0.23)
TC_{it}	-0.59 (0.79)	-1.00* (0.51)
HC_{it}	-0.97 (0.86)	-1.42*** (0.31)
RQ_{it}	-0.47 (0.91)	0.59** (0.23)
$\sum_j W_{ij}\, GDP_{jt}$	-16.13 (10.39)	-1.11 (1.74)
$\sum_j W_{ij}\, POP_{jt}$	119.83*** (42.64)	-0.07 (2.04)
$\sum_j W_{ij}\, TC_{jt}$	0.83 (5.42)	-1.43 (2.63)
$\sum_j W_{ij}\, HC_{jt}$	-6.39 (6.45)	6.30*** (2.01)
$\sum_j W_{ij}\, RQ_{jt}$	14.56** (6.08)	-3.61** (1.74)
$\sum_j W_{ij}\, FDI_{jt}$	-0.29 (0.20)	0.10 (0.18)
$DIST$		-0.98*** (0.36)
$LANG$		2.09*** (0.75)
Time fixed effects	yes	yes
Country fixed effects	yes	no
Observations	350	350

Notes: standard errors in parentheses. *** (**) (*) Significant at 1% (5%) (10%) respectively.

Concerning the rest of FDI drivers during the crisis, the direct effect linked to the GDP is positive and statistically significant, which provides evidence of Spanish investors looking for a large market in the host country. Notwithstanding, one has to notice that Spanish FDI seeks out a broader market in the host country than before the economic downturn (a 1% increase in the market potential of the host country enhances FDI to that country by 4.49% rather than 1.99%), probably due to the business cycle situation. As regards population, positive and significant spillovers emerge when country fixed effects are included, which tend to convey the idea that if neighboring countries to any host country j gain population, investment towards this country will increase; this reinforces the fact that FDI moves towards wealthy countries. Trade costs do not seem to affect Spanish investment during this period. Considering human capital, the results reveal a negative and significant direct effect, and a positive and significant indirect effect upon FDI, only when country fixed effects are removed. Additionally, it seems that Spanish outward FDI is linked, during the recession period, to high regulatory quality in the host country. Finally, the negative (positive) effect of distance (sharing a language) is in line with the evidence found in the previous period.

Table 3.10 Effect estimates. Spatial Durbin Model. Crisis period (2008-2014).

Dependent variable: FDI_{it}	Equation (3.2)		Equation (3.3)	
	Direct Effect	Indirect Effect	Direct Effect	Indirect Effect
GDP_{it}	4.49**	-12.35	1.29***	-1.30
	(1.82)	(9.06)	(0.20)	(2.25)
POP_{it}	-8.88	91.41**	-0.14	0.17
	(7.94)	(39.49)	(0.22)	(2.39)
TC_{it}	-0.57	0.52	-0.97	-2.21
	(0.82)	(4.28)	(0.63)	(3.51)
HC_{it}	-0.91	-4.96	-1.32***	7.09**
	(0.83)	(5.09)	(0.29)	(3.21)
RQ_{it}	-0.47	11.26**	0.58**	-3.94*
	(0.91)	(4.94)	(0.23)	(2.06)

Notes: Equation (3.2) includes two-way fixed-effects and Equation (3.3) includes time fixed effects. Standard errors in parentheses. *** (**) (*) Significant at 1% (5%) (10%) respectively.

Overall, our findings seem to indicate that during the pre-crisis period Spanish firms adopted complex integration strategies to set up their production process abroad. Nevertheless, this strategy seems to have changed over the crisis period. Spanish direct investment to any host country in this period is no longer a complement for that to another third country. Spanish markets were severely hit by the 2008 financial crisis and subsequent global recession, which significantly reduced Spanish firms' opportunities (Claeys and Vašíček, 2014). This, together with the fall in the Spanish internal demand, forced Spanish MNEs to search for foreign markets and engage in market-seeking (horizontal) FDI.

3.6 Robustness check

In this section, we provide a robustness analysis. Firstly, we run regressions for direct investment abroad just for the industry and service sectors, as they concentrate the bulk of FDI flows during the sample periods, to check whether the results using aggregate FDI are maintained. Secondly, we change the specification of the spatial weight matrix. As it happens that according to the log-likelihood statistic, the model presented in Equation (3.2) displays a higher goodness-of-fit, here and for the sake of simplicity, only this equation is estimated.

The results at sectoral level are displayed in Tables 3.11 and 3.12 in which we only show the point estimate for the spatial lag of FDI and the direct and indirect effects for the rest of explanatory variables. FDI in the pre-crisis period seems to exhibit a complex vertical FDI strategy in both sectors; notwithstanding, the complementarity in FDI among neighboring countries is much stronger in services. Additionally, the effect of the population is higher in services. Furthermore, the findings reveal that trade costs matter only for Spanish FDI in the service sector. Besides, a high level of human capital in neighboring host countries is a significant driver for FDI in both sectors. Finally, a strong regulatory quality in the host country seems to attract more Spanish investment in the two sectors.

Concerning the crisis period, FDI appears to be market-seeking in industry and services, which is also in agreement with the aggregate results; in other words, the spatial lag of *FDI* and the indirect effect of *GDP* turn out to be non-significant. Moreover, the positive and significant direct effect of GDP supports the market-seeking motives of FDI. There exist, however, some differences between sectors. Population emerges as a more significant driver for FDI in the industry sector. Moreover, a strong regulatory quality only attracts FDI for the service sector.

Table 3.11 Sector-level FDI regressions. Spatial Durbin Model. Pre-crisis period (1996-2007).

	Industry			Services		
	Point estimate	Direct Effect	Indirect Effect	Point estimate	Direct Effect	Indirect Effect
GDP_{it}		1.13	6.46		0.99	12.50
		(2.03)	(10.65)		(1.40)	(9.59)
POP_{it}		3.05	-87.02***		-8.17*	-113.88***
		(6.86)	(31.11)		(4.63)	(29.96)
TC_{it}		-1.54	-9.50		2.04*	22.46***
		(1.77)	(8.70)		(1.23)	(8.45)
HC_{it}		-0.31	5.14**		0.55	5.27***
		(0.59)	(2.12)		(0.41)	(1.97)
RQ_{it}		1.63*	-3.01		1.68***	1.52
		(0.89)	(3.21)		(0.62)	(2.75)
$\sum_j W_{ij}\, FDI_{jt}$	0.28*			0.41***		
	(0.15)			(0.15)		

Notes: two-way fixed-effects are included. Standard errors in parentheses. *** (**) (*) Significant at 1% (5%) (10%) respectively.

Coming back to the aggregate analysis, and as in some cases the results may critically depend on the spatial weight matrix employed, the second robustness check consists of changing the weighting scheme. Specifically, we use the inverse square distance matrix (which imposes a higher penalty to distance than the inverse distance matrix) and the exponential distance matrix (in which the penalty to distance is even greater). Then, both matrices give more weight than before to the closest markets to the host country, so that the weight of countries belonging to a different continent is now almost negligible. The results of the estimation, reported in Tables 3.13 and 3.14, mainly reinforce previous findings, especially those regarding investment strategies. In the pre-crisis period, Spanish direct investment abroad seems to follow a complex vertical pattern, although the strength of agglomeration economies in FDI when using the exponential distance matrix is a bit lower. Once again, the outbreak of the economic crisis has triggered a change in Spanish outward FDI strategy towards horizontal or market-seeking motives.

Table 3.12 Sector-level FDI regressions. Spatial Durbin Model. Crisis period (2008-2014).

	Industry			Services		
	Point estimate	Direct Effect	Indirect Effect	Point estimate	Direct Effect	Indirect Effect
GDP_{it}		4.73**	-1.31		4.39**	-8.17
		(2.25)	(15.45)		(2.24)	(10.32)
POP_{it}		-24.56*	184.46***		2.40	83.61*
		(12.75)	(70.31)		(9.68)	(44.44)
TC_{it}		-0.83	-6.27		1.42	6.76
		(1.33)	(7.72)		(1.00)	(4.96)
HC_{it}		1.91	-6.84		-0.83	7.27
		(1.34)	(8.94)		(1.00)	(5.71)
RQ_{it}		-2.79*	1.01		1.98*	14.50**
		(1.43)	(8.53)		(1.13)	(5.80)
$\sum_j W_{ij}\, FDI_{jt}$	-0.17			-0.38		
	(0.18)			(0.25)		

Notes: two-way fixed-effects are included. Standard errors in parentheses. *** (**) (*) Significant at 1% (5%) (10%) respectively.

As for the FDI determinants, the results obtained in the pre-crisis period (Table 3.13) support the positive influence of the host market potential and regulatory quality. Besides, the spillovers on population, trade costs and human capital are robust to specification of the spatial weight matrix. Considering the crisis period (Table 3.14), the results reinforce the positive direct effect of market potential, and the positive spillover effect of population on FDI. However, positive spillovers derived from human capital are not robust to alternative specifications of the spatial weight matrix, which casts some doubt on the role of this variable during the crisis period. Finally, strong regulatory quality in neighboring host countries seems to discourage FDI to a particular country.

Table 3.13 Alternative spatial weight matrices. Spatial Durbin Model. Pre-crisis period (1996-2007).

	Inverse square distance matrix			Exponential distance matrix		
	Point estimate	Direct Effect	Indirect Effect	Point estimate	Direct Effect	Indirect Effect
GDP_{it}		2.23*	3.56		2.77**	1.00
		(1.22)	(3.61)		(1.26)	(2.34)
POP_{it}		-5.95	-36.20***		-6.80	-23.54***
		(4.06)	(9.25)		(4.36)	(7.51)
TC_{it}		1.08	-4.81*		1.01	-6.14**
		(1.09)	(2.65)		(1.09)	(2.56)
HC_{it}		0.01	2.26***		-0.04	1.92**
		(0.35)	(0.61)		(0.35)	(0.82)
RQ_{it}		0.96*	0.03		0.90*	0.49
		(0.54)	(0.99)		(0.54)	(0.90)
$\sum_j W_{ij} FDI_{jt}$	0.18***			0.11**		
	(0.06)			(0.05)		

Notes: two-way fixed-effects are included. Standard errors in parentheses. *** (**) (*) Significant at 1% (5%) (10%) respectively

Table 3.14 Alternative spatial weight matrices. Spatial Durbin Model. Crisis period (2008-2014).

	Inverse square distance matrix			Exponential distance matrix		
	Point estimate	Direct Effect	Indirect Effect	Point estimate	Direct Effect	Indirect Effect
GDP_{it}		4.82***	-0.60		5.07***	0.95
		(1.72)	(4.20)		(1.74)	(3.42)
POP_{it}		-8.22	43.91**		-11.31	34.30**
		(7.71)	(17.73)		(8.05)	(16.10)
TC_{it}		-0.73	1.53		-0.31	1.57
		(0.83)	(1.84)		(0.82)	(3.16)
HC_{it}		-1.30	-4.85**		-1.14	-2.91
		(0.82)	(2.36)		(0.83)	(1.99)
RQ_{it}		0.06	-0.32**		0.08	-0.25**
		(0.05)	(0.13)		(0.05)	(0.11)
$\sum_j W_{ij} FDI_{jt}$	-0.03			-0.02		
	(0.08)			(0.08)		

Notes: two-way fixed-effects are included. Standard errors in parentheses. *** (**) (*) Significant at 1% (5%) (10%) respectively.

3.7 Conclusions

Understanding the factors that determine FDI activity has attracted the interest of academics and policy makers over the last decades. This paper adds to the discussion investigating the drivers behind Spanish direct investment abroad and disentangling its dominant strategy. The paper contributes to the literature in several respects: firstly, it separately analyzes pre-crisis and crisis periods to find out whether the FDI strategy varies with the business cycle. Secondly, it estimates a panel spatial Durbin model, which offers key advantages over the conventional approach. Furthermore, partial derivatives are computed to obtain accurate results. Additionally, the paper develops the analysis at both aggregate and sectoral levels, this way avoiding the potential mask of heterogeneous patterns among sectors.

The empirical analysis points to relevant findings. There exist agglomeration economies concerning outward Spanish investments from 1996 until the crisis outbreak. Complex-vertical FDI motives prevail. Specifically, the results point out to a geographical clustering of Spanish direct investment abroad for supply reasons, which is in line with Martínez-Martín (2011). However, this strategy seems to have changed in the aftermath of the crisis, as demand factors have gained importance; Spanish firms seem to have opted instead for primarily undertaking horizontal or market-seeking FDI. Thereby, direct investment in one host country does no longer seem to be influenced by the one going to neighboring countries.

This change of strategy, which is robust to the use of disaggregated data (analysis at sectoral level) and alternative specifications of the spatial weight matrix, can be understood by analyzing what happened with the fixed costs of outsourcing at a particular stage. If firms can sell on a large scale, those fixed costs are worthwhile because firms are saving on their variable costs. However, after the global economic crisis, the demand went down and firms sold on a smaller scale. Therefore, those fixed costs were no longer worthwhile and MNEs shifted towards more market-seeking FDI.

Additional results support the importance of some traditional FDI determinants. Results on the direct effects show that the choice of location of Spanish direct investment abroad is always driven by the host market potential. Furthermore, a strong regulatory quality in the host country seems to foster FDI to this country in the pre-crisis period.

Considering indirect effects, in the pre-crisis period findings indicate that FDI goes to a particular country if neighboring countries have a large market potential, low population, low trade costs and skilled labor. With respect to the crisis period, spillovers appear in population, human capital and regulatory quality variables. Finally, in both periods distance hinders FDI, whereas cultural proximity fosters it.

And what about the policy implications that can be drawn from this paper? Our results show that the strategy followed by Spanish direct investment abroad changed with the outbreak of the crisis from complex-vertical to horizontal FDI. But it is well-known that the positive effects of outward FDI on the Spanish economy are higher if FDI follows a complex vertical rather than a horizontal strategy. Under complex vertical FDI, MNEs set up their vertical chain of production process across multiple countries to benefit from their comparative advantages. Thus, their competitiveness could increase. Besides, productive activities in the new locations might require an increase of the activities developed in the home country. Therefore, complex vertical FDI could promote employment and exports in Spain. On the contrary, in the case of horizontal FDI, foreign affiliates serve the local market in the host country and substitute previous exports from the home country, which could reduce production and employment in Spain (Myro, 2014). Consequently, policy initiatives in times of recession in Spain should be focused on assisting MNEs through direct financial support to make the fixed costs of outsourcing, even with the decrease in demand, affordable. This type of policies could avoid the change in FDI strategy and therefore, benefit the whole Spanish economy.

Chapter 4

The link between outward FDI and exports in Spain: a heterogeneous panel approach dealing with cross-section dependence

4.1 Introduction

Over the last decades, FDI, both inwards and outwards, and trade have grown considerably mainly due to the removal of financial and trade barriers and the reduction in transport costs and communications. The effects of this internalization process on economic growth and employment depend, among other factors, on the relationship between FDI and exports.

In this setting, determining whether outward FDI and exports are substitutes or complements has been a subject of hot debate. Outward FDI, viewed as reallocation of capital to foreign countries, may substitute domestic investment and exports, this raising concerns not only about the performance of the balance of payments but also, and somehow more important, about its effects on domestic employment (Pfaffermayer, 1994). If, effectively, outward FDI had a negative impact on domestic employment, policies about its promotion would need to be carefully evaluated and implemented.

Therefore, it is no wonder that the relationship between outward FDI and exports has given rise to a large number of theoretical and empirical studies. From a theoretical point of view, the literature on horizontal FDI (Markusen, 1984; Brainard, 1997) points toward a relationship of substitution, while that on vertical FDI (Helpman, 1984; Helpman and Krugman, 1985) argues for one of complementarity. From an empirical perspective, a large body of literature establishes a relationship of complementarity between FDI and exports (Lipsey and Weiss, 1984; Eaton and Tamura, 1994; Pfaffermayr, 1994, 1996; Lin, 1995; Fontagné and Pajot, 1997; Clausing, 2000; Hejazi and Safarian, 2001; Pantulu and Poon, 2003), although there is also evidence of substitution (Pain and Wakelin, 1998; Türkcan, 2007). Therefore, neither theoretical nor empirical literature is conclusive in this respect.

Focusing our attention on empirical studies, and more precisely on methodological issues, it is important to point out that, despite numerous papers on the subject, the existence of cross-country parameter heterogeneity has been frequently overlooked. This is an important flaw since, as Pesaran and Smith (1995) showed, imposing common parameters (homogeneous panel) when slope coefficients are expected to differ across countries may yield inconsistent results. This being the case, a heterogeneous panel approach, allowing for a different coefficient for each country, is needed.

To the best of our knowledge, there are only a few papers on the FDI-exports nexus that emphasized the importance of taking into account heterogeneous effects across countries (Pain and Wakelin, 1998; Camarero and Tamarit, 2004; Chiappini, 2011; Dritsaki and Dritsaki, 2012). These works, however, do not address another potential problem: the presence of cross-section dependence. This is, indeed, the main contribution of this paper since, if the assumption of independence is not fulfilled, standard estimators are biased (Driscoll and Kraay, 1998; Bond and Eberhardt, 2009). For this reason, we estimate the long-run relationship between outward FDI and exports by means of a heterogeneous panel approach but using, unlike previous papers, estimators that are robust to the presence of cross-section dependence: the Pesaran's (2006) Common Correlated Effects Mean Group (CCEMG) estimator and the Augmented Mean Group (AMG) estimator (Bond and Eberhardt, 2009; Eberhardt and Teal, 2010). Next, for the sake of robustness, we also apply, using cross-sectionally demeaned data, the group mean Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) estimators of Pedroni (2000, 2001). Apart from parameter heterogeneity and cross-section dependence, all these estimators produce robust estimates to other problems that often plague empirical work, including omitted variable bias and endogeneity (Banerjee, 1999; Baltagi and Kao, 2000; Pedroni, 2007; Herzer, 2011). Finally, we also examine the long- and short-run causality between outward FDI and exports through the estimation of an error-correction model.

In addition, the paper focuses attention on the fact that cross-section dependence could be due, apart from the presence of unobserved common factors across all countries, to the existence of spatial dependence (Baltagi and Pesaran, 2007). This is important since the aforementioned estimators are especially suitable when there are common factors across countries. Therefore, before carrying out the estimates, the paper tests for spatial dependence and, once confirmed, it is removed. By doing it, not only we eliminate one potential factor causing inconsistent estimates (Anselin, 1988; LeSage and Pace, 2009) but also we confirm that there are other factors, apart from those of geographical nature, causing cross-section dependence. Although there are many papers employing a heterogeneous panel approach dealing with cross-section dependence on many other different topics, as far as we know this is the first one disentangling the two components of cross-section dependence.

This paper also departs from the previous ones as for its case study. It uses bilateral flows of FDI and exports from Spain towards the top-50 recipient countries over the period 1995-2016. The Spanish case is especially relevant since it has turned out to be a leading player in the area of FDI. Measured as a share of GDP, Spain has become the third European economy regarding outward FDI (Myro, 2015). In spite of this, few empirical studies have analyzed the relationship between Spanish outward FDI and exports (Caballero et al., 1989; Alguacil et al., 1999; Bajo-Rubio and Montero-Muñoz, 2001; Alguacil and Orts, 2002; Martínez-Martín, 2010). Additionally, the results obtained are mixed and hence do not provide conclusive evidence.

The remainder of the paper is organized as follows. Section 4.2 briefly reviews the theoretical and empirical literature on the relationship between outward FDI and exports. Section 4.3 provides an overview of the evolution of these two variables in Spain over the sample period. Section 4.4, after specifying the benchmark model, deals with several econometric issues. First, it checks for the presence of spatial dependence in all variables and, due to its existence, applies a spatial filtering technique to remove it. Second, it also tests for the presence of cross-section dependence, unit roots and cointegration. Section 4.5 is devoted to the results of the heterogeneous panel approach. On the one hand, it shows the results obtained for the long-run relationship between outward FDI and exports. On the other, it presents the short- and long-run dynamics by addressing causality issues. Finally, Section 4.6 provides the main conclusions.

4.2 Literature review

The aim of this section is twofold. First, to provide a theoretical basis regarding the link between FDI and exports and, second, to briefly review the empirical research on the issue.

To begin with, the theoretical literature on horizontal FDI predicts that a relationship of substitution between FDI and exports prevails. According to Markusen (1984), an MNE chooses to serve foreign markets through FDI instead than exporting if the additional fixed costs of establishing a new plant in a foreign country are lower than the fixed costs of exporting. Another reason to engage in horizontal FDI is to avoid trade costs such as tariffs and transport costs. As pointed out by Brainard (1997), firms face the proximity-concentration trade-off: they have to decide between maximizing proximity to local markets and avoiding transport costs or concentrating production to achieve economies of scale. When proximity outweighs concentration advantages, there is a substitution effect between FDI and trade.

The theoretical literature on vertical FDI predicts, however, a relationship of complementarity between FDI and trade. In the models developed by Helpman (1984) and Helpman and Krugman (1985), the location choice of MNEs depends on the differences in relative factor costs and resource endowments. Vertical FDI, which implies the splitting-up of the production process across different locations to take advantage of lower factor prices, will create more bilateral trade in intermediate goods between the home company and its foreign affiliates, thus boosting trade flows of final goods too.

Recent studies developed by Carr et al. (2001) and Markusen (2002) have attempted to combine both horizontal and vertical motives for FDI in what is known as the knowledge-capital (KK) model. Horizontal FDI prevails in countries with similar factor endowments and high trade costs, whereas vertical FDI does when there are differences in factor endowments and trade costs are low. Thus, when referring to FDI and exports between developed countries, the KK model suggests that FDI and exports are likely to substitute each other; on the other side, when these flows take place between countries with quite different levels of development, they tend to complement each other.

Therefore, due to the existence of reasons for both a relation of substitution and complementarity between FDI and exports, no definitive conclusion can be drawn by relying only on theoretical arguments. The situation does not change significantly from an empirical point of view, as the literature is not very conclusive either. While it is true that most studies predict a relation of complementarity, others find evidence of substitution.

As for the papers suggesting a positive relationship (meaning complementarity) between FDI and exports, it is necessary to stand out those by Lipsey and Weiss (1984), Clausing (2000) and Hejazi and Safarian (2001) for the US, Pfaffermayr (1994, 1996) for Austria, Eaton and Tamura (1994) and Pantulu and Poon (2003) for both Japan and the US, Lin (1995) for Taiwan (in this case to a small sample made up of four ASEAN countries)[1] and Fontagné and Pajot (1997) for France. Regarding causality, Pfaffermayr (1994) finds a causal relationship of outward FDI and exports in both directions.

Alternatively, Pain and Wakelin (1998) conclude that outward FDI has an overall negative (meaning substitution) effect on exports across OECD countries. Similarly, Türkcan (2007) finds evidence of substitution effects between FDI and final goods exports for the US. As for causality, Türkcan (2007) provides evidence on a causal relationship running from outward FDI to exports.

As mentioned in the Introduction, Pain and Wakelin (1998) and more recently, Camarero and Tamarit (2004), Chiappini (2011) and Dritsaki and Dritsaki (2012) make a step forward by employing a heterogeneous panel approach. Camarero and Tamarit (2004) find a complementary relationship between FDI and exports for a panel of 13 OECD countries. Chiappini (2011) examines heterogeneous Granger causality between exports and FDI for a sample of 11 European countries, pointing to the existence of a causal relationship from outward FDI to exports and a strong heterogeneity in the causal relationship from exports to FDI. Dritsaki and Dritsaki (2012), for a sample of 12 new members of the EU, find that FDI has a positive effect on exports (complementarity) in the long run and a bilateral causal relationship in the long and short-run.

Focusing the attention on our case study, the empirical evidence, based on homogeneous rather than heterogeneous panel data estimators, is mixed as well. A relation of complementarity between Spanish outward FDI and exports is found in

[1] Indonesia, Malaysia, the Philippines and Thailand.

Bajo-Rubio and Montero-Muñoz (2001), Alguacil et al. (1999), Alguacil and Orts (2002) and Martínez-Martín (2010). Bajo-Rubio and Montero-Muñoz (2001) provide evidence of Granger causality from outward FDI to exports in the short-run and bilateral Granger causality in the long-run. Alguacil and Orts (2002) find negative short-run and positive long-run Granger causality from FDI to exports, although this does not occur in the opposite direction. Martínez-Martín (2010) gets a positive causality relationship from FDI to exports of goods and services in the long-run, while only goods exports are positively affected by FDI in the short-run. On the other hand, findings by Caballero et al. (1989) support a substitution relationship.

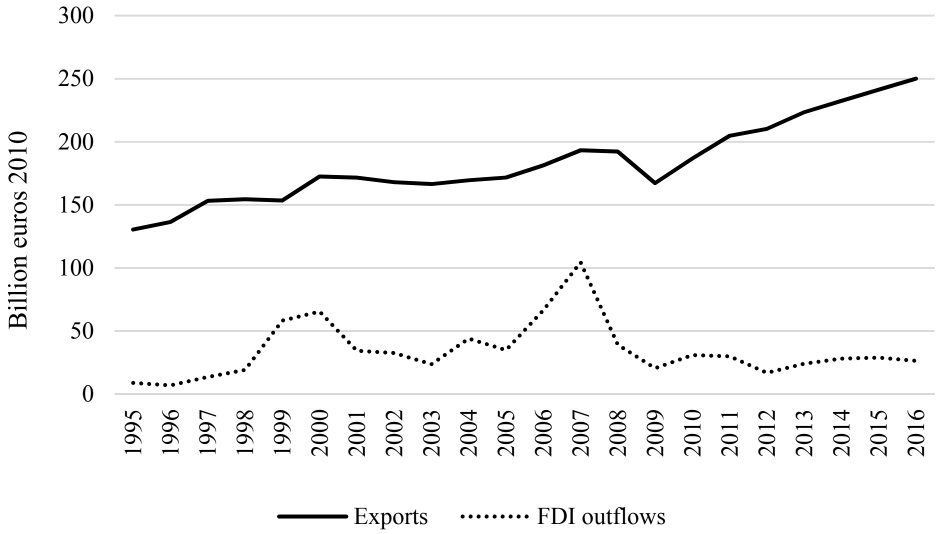
4.3 Spanish outward FDI and exports: an overview

Before moving on to the empirical analysis, here we provide an overview of Spanish outward FDI and exports. Annual data on exports are obtained from the Spanish Ministry of Economy, Industry and Competitiveness (DataComex), while FDI data come from the Spanish Foreign Investment Registry (DataInvex). Both variables are measured in thousand euros of 2010.[2]

Figure 4.1 displays the evolution of both variables over the period of study (1995-2016). It can be seen that FDI outflows, although volatile, increased between 1995 and 2007 when they reached their peak. Afterwards, they drop dramatically at the outbreak of the global economic and financial crisis and, from then on, they remained rather stable. On the contrary, the series of exports exhibited a continuous upward trend, except for the decrease in 2009 with the eruption of the crisis. From then onwards, exports rose steadily again reaching its highest level (250.12 billion euros) in 2016.

[2] The Consumer Price Index and the Export Price Index for Industrial Products have been used to deflate FDI and exports, respectively.

Figure 4.1 FDI outflows and exports from Spain, 1995-2016.



As regards the geographical distribution of FDI outflows and exports from Spain, Table 4.1 shows the corresponding amounts in absolute and relative figures. Note that FDI outflows went mainly to the United Kingdom, the Netherlands, Brazil and the United States; Argentina and Mexico also received a large share of Spanish FDI. The primary destinations for the Spanish exports were France and Germany, followed by Portugal, Italy, the United Kingdom and the United States. Additionally, it can be appreciated that Ireland and the United Kingdom registered the highest annual growth rates in receiving Spanish FDI, whereas Poland and Hungary did the same with the Spanish exports. Figures on the coefficient of variation indicate that FDI outflows are highly volatile in all countries, particularly in the Czech Republic, Canada, Hungary, Poland and Turkey. Exports, however, report lower levels of volatility.

Table 4.1 Geographical distribution of Spanish FDI outflows and exports (million euros), 1995-2016.

Country	FDI outflows				Exports			
	Total	Annual growth rate (%)	%	CV	Total	Annual growth rate (%)	%	CV
United Kingdom	5962.30	24.59	17.32	1.59	14151.72	2.81	7.73	0.15
Netherlands	3603.17	8.02	10.47	1.44	5999.44	2.46	3.28	0.15
Brazil	3283.24	10.76	9.54	1.28	1851.43	2.75	1.01	0.36
United States	3089.83	7.60	8.97	1.00	7613.61	3.38	4.16	0.20
Argentina	2068.50	8.10	6.01	2.17	1016.13	-2.07	0.55	0.44
Mexico	1844.73	3.48	5.36	0.86	2597.53	7.68	1.42	0.35
France	1456.51	-1.75	4.23	1.23	33062.26	1.60	18.05	0.09
Germany	1389.57	4.44	4.04	1.35	21120.71	1.62	11.53	0.11
Portugal	1302.04	-8.74	3.78	0.78	15829.17	2.31	8.64	0.11
Chile	1094.88	6.10	3.18	1.40	787.53	3.53	0.43	0.33
Italy	1051.22	12.39	3.05	1.16	15441.13	2.41	8.43	0.12
Hungary	669.26	-2.19	1.94	2.53	888.16	9.00	0.48	0.38
Ireland	631.59	36.36	1.83	1.85	944.81	6.34	0.52	0.32
Switzerland	615.32	-15.08	1.79	1.34	2595.68	4.64	1.42	0.38
Canada	549.86	12.53	1.60	3.19	882.74	3.91	0.48	0.28
Turkey	398.78	-4.09	1.16	2.41	2989.24	8.25	1.63	0.43
Colombia	387.15	9.66	1.12	1.02	472.07	3.58	0.26	0.39
Poland	339.80	0.88	0.99	2.51	2307.56	9.65	1.26	0.51
Belgium	239.45	-6.22	0.70	1.74	5177.55	3.15	2.83	0.17
Czech Republic	229.92	4.71	0.67	3.82	1185.35	8.31	0.65	0.41
China	208.54	14.84	0.61	1.49	2076.61	6.39	1.13	0.63
Remaining countries	4014.04	2.27	11.66	0.44	44193.13	4.17	24.13	0.31
Total	34429.71	5.10	100	0.65	183183.55	3.01	100	0.18

Note: CV = coefficient of variation.

4.4 Empirical model and econometric issues

Although the relationship between outward FDI and exports has been thoroughly analyzed at both theoretical and empirical level, as previously seen results are not conclusive. Therefore, more research is needed and we contribute to it by examining the Spanish case. Our sample encompasses the top-50 recipient countries, which receive, on average between 1995 and 2016, 92.48% of total Spanish outward FDI and 91.54% of total Spanish exports (see the list of countries in the Appendix 3).

The model takes the following specification:

$$log\, EXPORTS_{jt} = \alpha_j + \beta_j\, log\, FDI_{jt} + \epsilon_{jt} \tag{4.1}$$

where $EXPORTS_{jt}$ denotes real exports from Spain to country j in year t, FDI_{jt} refers to Spanish FDI flows to country j in year t, α_j are country fixed effects and ϵ_{jt} denotes the error term. As indicated in Equation (4.1), variables are defined in logs, so that β_j represents an elasticity. It is worth pointing out that the specification of this model is the traditional one apart from the fact that, unlike homogeneous panel models, it implies that the effect of outward FDI on exports varies across recipient countries; that is to say, it allows for heterogeneity in the slope coefficients β_j.

Before estimating Equation (4.1), several econometric issues (the potential presence of cross-section dependence, unit roots and cointegration) should be considered. Regarding cross-section dependence, here we pay special attention to what Baltagi and Pesaran (2007, p. 229) state about the fact that *"cross-section dependence can arise due to spatial or spillover effects, or could be due to unobserved (or unobservable) common factors"*. For this reason, to make sure of which factor, if any, is at the root of cross-section dependence, we initially test for the presence of spatial dependence so that, if it exists, we can remove it by using spatial filtering techniques. Only by doing this we could assert that problems of cross-section dependence, if any, are due to unobserved common factors. Furthermore, there are many papers proving that the presence of spatial dependence can, by itself, lead to misleading estimates (Anselin, 1988; LeSage and Pace, 2009), so getting rid of spatial dependence before testing for cross-section dependence is no doubt pertinent.

To check for the presence of spatial dependence, we compute Moran's I statistic, for which we use a binary spatial weight matrix with a distance-based cut-off (6,300 kilometers), above which spatial interactions across countries are assumed negligible.[3] The results, displayed in Table 4.2, indicate that positive spatial dependence exists in both variables.

Table 4.2 Spatial dependence.

	$EXPORTS$		FDI	
Year	Moran's I	p-value	Moran's I	p-value
1995	-0.01	0.30	0.02	0.01
1996	-0.01	0.29	0.04	0.00
1997	-0.01	0.27	0.07	0.00
1998	0.01	0.09	0.04	0.00
1999	0.01	0.03	0.06	0.00
2000	0.02	0.02	0.05	0.00
2001	0.02	0.01	0.04	0.00
2002	0.03	0.00	0.01	0.05
2003	0.05	0.00	-0.01	0.26
2004	0.04	0.00	0.00	0.12
2005	0.03	0.00	-0.01	0.20
2006	0.03	0.00	-0.00	0.18
2007	0.03	0.00	-0.01	0.22
2008	0.03	0.00	-0.03	0.29
2009	0.02	0.01	-0.02	0.40
2010	0.01	0.09	-0.00	0.17
2011	0.01	0.04	0.01	0.07
2012	-0.00	0.16	0.02	0.02
2013	-0.00	0.19	0.00	0.13
2014	0.01	0.08	-0.01	0.24
2015	0.01	0.07	-0.00	0.16
2016	0.02	0.01	0.03	0.01

[3] This matrix is employed since it is the appropriate one to apply the spatial filtering procedure by Getis (1995), as explained below.

Therefore, spatial filtering techniques have to be applied.[4] As the two most common spatial filtering methods in the literature, namely the Getis's (Getis, 1995) and Griffith's (Griffith, 2000) approaches, are equally effective (Getis and Griffith, 2002), here we opt for using the first one. It transforms a spatially dependent variable x (FDI or exports depending on the case) into a spatially independent one x^F by removing the spatial dependence embedded in it.[5] The spatially independent variable is defined as follows:

$$x_j^F = x_j \frac{\sum_i w_{ji}(d)}{(N-1)G_j(d)}, \tag{4.2}$$

where N is the number of countries (50 in our case), $G_j(d)$ is the spatial statistic developed by Getis and Ord (1992) computed as follows:

$$G_j(d) = \frac{\sum_i w_{ji}(d)x_i}{\sum_i x_i}, j \neq i \tag{4.3}$$

and w_{ji} are the elements of a one/zero spatial weight matrix (of order 50*50 in this case) with ones for all links defined as being within distance d of a given country j, and zero for the rest. The selection of the distance (in this case d = 6,300 kilometers) was carried out according to the criterion set up by Getis (1995).[6]

[4] Another possibility would be to use spatial modelling techniques dealing with the presence of spatial dependence in the residuals of Equation (1). We opt for filtering the data since, as mentioned, by doing it we can disentangle the two components of cross-section dependence (spatial effects and unobserved common factors) so that, subsequently, we can employ estimation techniques that are especially advisable when addressing problems related with the presence of multiple unobserved common factors.

[5] By comparing the results obtained with raw and filtered data, the literature has demonstrated that spatial dependence can drastically affect the results obtained (see e.g. Maza and Villaverde, 2009).

[6] We ran different permutations by increasing the distance 100 kilometers each, and then chose the value of d corresponding to the weight distance matrix with the maximum absolute sum of the G_j significance scores.

After filtering the variables, we test for the presence of cross-section dependence in the error term ϵ_{jt} in Equation (4.1).[7] Namely, we test if there are other factors, apart from those of geographical nature, causing cross-section dependence. Standard techniques that fail to account for cross-section dependence result in inconsistently estimated standard errors (Driscoll and Kraay, 1998), thus the importance of addressing this issue. Specifically, we compute the *CD* statistic by Pesaran (2004), the *FRE* statistic by Frees (1995, 2004) and the R_{AVE} statistic by Friedman (1937), which are appropriate, as in our case, for $T<N$ heterogeneous panels. As can be appreciated in Table 4.3, the three tests strongly reject the null hypothesis of no cross-section dependence. Therefore, even after getting rid of spatial dependence, empirical evidence confirms the presence of cross-section dependence.[8]

Table 4.3 Tests for cross-section dependence.

Test statistics	
CD	60.28***
FRE	11.01***
R_{AVE}	379.56***

Notes: *** indicates rejection of the null hypothesis of no cross-section dependence at the 1% level. For $T \leq 30$, Frees' test provides the critical values from the Q distribution.

Another important step before proceeding with the estimation of the model is to determine whether the variables included in it exhibit unit root properties. Due to the presence of cross-section dependence, we use the cross-sectionally augmented IPS (CIPS) test, proposed by Pesaran (2007). CIPS test is based on cross-sectionally augmented Dickey-Fuller (CADF) regressions.[9] Table 4.4 reports the results using

[7] While the estimated residuals of Equation (4.1) with raw data showed problems of spatial dependence, Moran's I statistic computed on the residuals of this equation with filtered data indicate that these problems vanish.

[8] We also examine whether $log\ EXPORTS$ and $log\ FDI$ are plagued by cross-section dependence. The Pesaran's *CD* statistic for each variable shows evidence of cross-section dependence. The results are available upon request.

[9] CADF regression augments ADF regression with the cross-section averages of lagged levels and the first differences of the individual series to proxy common factors between the cross-section units.

1-3 lags. As can be appreciated, it suggests that both $log\,EXPORTS$ and $log\,FDI$ are I(1). On one side, the tests cannot reject the null hypothesis that the series in levels are non-stationary; on the other side, non-stationarity is rejected for the variables in first-differences.

Table 4.4 CIPS panel unit root test.

Variables	*CADF*(1)	*CADF*(2)	*CADF*(3)
		Constant	
$log\,EXPORTS$	-1.97	-2.01	-2.03
$log\,FDI$	-2.05	-2.07	-2.06
$\Delta\,log\,EXPORTS$	-4.40***	-4.34***	-4.27***
$\Delta\,log\,FDI$	-5.92***	-5.88***	-5.95***
		Constant and trend	
$log\,EXPORTS$	-2.19	-2.19	-2.24
$log\,FDI$	-2.69	-2.74	-2.72

Notes: The critical values at the 1% (5%) (10%) level for Pesaran's CIPS test statistics are -2.3 (-2.16) (-2.08) with a constant, and -2.78 (-2.65) (-2.58) with constant and trend. *** indicates rejection of the null hypothesis of non-stationary variable at the 1% level.

Given that both variables are I(1), it is compulsory to test whether the series are cointegrated to avoid spurious regression problems. To do so, Pedroni (1999, 2004) proposes several panel cointegration tests based on a panel version of the augmented Dickey-Fuller equation for residuals estimated in Equation (4.1) such as:

$$\hat{\varepsilon}_{jt} = \gamma_j \hat{\varepsilon}_{jt-1} + \sum_{k=1}^{K_j} \gamma_{jk} \Delta \hat{\varepsilon}_{jt-k} + \omega_{jt} \tag{4.4}$$

These test statistics correct the bias introduced by potentially endogenous independent variables and are robust to the presence of panel data heterogeneity. They are, after proper standardization, asymptotically normally distributed. We apply those test statistics based on between-dimension of the panel, known as the group mean panel test statistics: the group ρ-statistic (analogous to the Phillips and Perron rho-statistic), the group PP-statistic (similar to the Phillips and Perron *t*-statistic) and the group ADF-statistic (analogous to the augmented Dickey-Fuller *t*-

statistic). Their null hypothesis of no cointegration is implemented as a test of $H_0: \gamma_j = 1$ for all j, versus the more general alternative hypothesis $H_1: \gamma_j < 1$ for all j. Alternatively, the CIPS panel unit root test previously used can also be applied to the residuals of Equation (4.1), so that if the null hypothesis of non-stationarity is rejected, the residuals are I(0) and, thus, the series are cointegrated.

Table 4.5 reports the results. As can be seen, the null hypothesis of no cointegration can be rejected in all cases. Therefore, we can assert there is a long-run relationship between outward FDI and exports. The existence of cointegration between $log\,EXPORTS$ and $log\,FDI$ implies that the model is not plagued by the omitted variable problem (Herzer and Strulik, 2017).

Table 4.5 Panel cointegration tests.

Group mean panel test statistics	
Group ρ-statistic	1.58**
Group PP-statistic	-3.78***
Group ADF-statistic	-3.92***
CIPS statistic	-2.749***

Notes: Pedroni's test statistics include constant and trend. *** (**) indicates rejection of the null hypothesis of no cointegration at the 1% (5%) level. The relevant 1% critical value for the CIPS statistic is -1.74.

4.5 Empirical analysis

Briefly, results from the previous section indicate that there is cross-section dependence even after removing spatial dependence and that outward FDI and exports become stationary after taking first differences and are cointegrated. Here we provide reliable estimates of the long-run relationship between outward FDI and exports in this setting, and test the robustness of the results. We also develop a causality analysis to determine the short- and long-run causal relationship between the two variables.

4.5.1 Long-run relationship and robustness checks

Due to the presence of cross-section dependence, Equation (4.1) is misspecified.[10] To deal with this issue, the CCEMG estimator proposed by Pesaran (2006) augments the OLS regression in Equation (4.1) with the cross-section averages of the dependent and independent variables ($\overline{log\,EXPORTS}$ and $\overline{log\,FDI}$). As explained by Pedroni, *"the basic idea behind this approach is to use estimates of the cross-sectional averages from each of the variables to proxy for multiple common factors, and to include these in the regression with member-specific coefficients in order to allow for heterogeneous responses"* (Pedroni, 2007, p. 443-444). So, in order to estimate the long-run relationship between outward FDI and exports, we use the following equation:

$$log\,EXPORTS_{jt} = \alpha_j + \beta_j\,log\,FDI_{jt} + b_{j0}\,\overline{logEXPORTS_{jt}} + b_{j1}\,\overline{logFDI_{jt}} + \epsilon_{jt} \quad (4.5)$$

The coefficient of interest is computed as the simple average of the *N* countries ($\hat{\beta}_{CCEMG} = N^{-1}\sum_{j=1}^{N}\widehat{\beta_j}$), being in our case *N=50.*

The AMG estimator by Bond and Eberhardt (2009) and Eberhardt and Teal (2010) is an alternative to the Pesaran (2006) CCEMG estimator. It accounts for cross-section dependence by the inclusion of a 'common dynamic process' in Equation (4.1). This variable is extracted from the year dummy coefficients of a pooled regression in first differences and represents *"the levels-equivalent mean evolvement of unobserved common factors across all countries"* (Bond and Eberhardt, 2009, p. 2-3). Provided that the unobserved common factors form part of the country-specific cointegration relation, the augmented model encompasses the cointegrating relationship, which is allowed to differ across countries.

[10] It is important to note that Equation (4.1) could be estimated by the mean group (MG) estimator of Pesaran and Smith (1995). However, as it has been proven that there are problems of cross-section dependence, its results would be misleading.

Accordingly, the first stage consists of estimating a standard first difference OLS (FD-OLS) equation with *T-1* year dummies (D_t):

$$\Delta\ log\ EXPORTS_{jt} = b\ \Delta\ log\ FDI_{jt} + \sum_{t=2}^{T} c_t\ \Delta D_t\ + \epsilon_{jt} \qquad (4.6a)$$

Then, we collect the estimated year dummy coefficients from Equation (4.6a), which are relabeled as $\hat{c_t} \equiv \hat{\mu}_t^*$.[11] In the second stage, this variable is added to each of the *N* equations that also include linear trend terms to capture omitted idiosyncratic processes that evolve in a linear fashion over time:

$$log\ EXPORTS_{jt} = \alpha_j + \beta_j\ log\ FDI_{jt} + c_i\ t + d_j\ \hat{\mu}_t^* + \epsilon_{jt} \qquad (4.6b)$$

Finally, following the Pesaran and Smith (1995) mean group (MG) approach, the coefficient of interest is, as in the case of CCEMG estimator, computed as the simple average of the individual country estimates ($\hat{\beta}_{AMG} = N^{-1} \sum_{j=1}^{N} \hat{\beta}_j$).

The results of CCEMG and AMG approaches, reported in Table 4.6, point to a positive and significant effect of outward FDI on exports in the long-run. Namely, one percent increase in outward FDI enhances exports by 0.014%-0.015%.[12]

Table 4.6 Estimated long-run CCEMG and AMG results.

	CCEMG	AMG
$log\ FDI$	0.015*** (0.005)	0.014*** (0.007)

Notes: Standard errors are reported in parentheses. *** Significant at 1%.

For the sake of robustness, we also use the group mean FMOLS and DOLS estimators developed by Pedroni (2000, 2001), which capture the impact of cross-

[11] "*This process is extracted from the pooled regression in first differences since nonstationary variables and unobservables are believed to bias the estimates in the pooled levels regressions*" (Bond and Eberhardt, 2009, p. 3).

[12] To confirm the existence of cointegration in the new specifications we only compute, for the sake of simplicity, the CIPS statistic on CCEMG and AMG residuals. As expected, the results point to cointegration.

section dependence through common time effects.[13] These two estimators, based on the between dimension of the panel, perform well in heterogeneous cointegrated panels with cross-section dependence as long as cross-sectionally demeaned data are used.

FMOLS estimator corrects for the potential endogeneity and serial correlation to the OLS estimator. The following cointegrated system is estimated:

$$log\, EXPORTS_{jt} = \alpha_j + \beta_j \, log\, FDI_{jt} + \epsilon_{jt} \tag{4.7a}$$

$$log\, FDI_{jt} = \, log\, FDI_{j,t-1} + u_{jt} \tag{4.7b}$$

where $\xi_{jt} = (\epsilon_{jt}, u_{jt})'$ is stationary with asymptotic covariance matrix Ω_j, and log $EXPORTS$ and $log\ FDI$ are I(1) and cointegrated. The coefficient of interest, β, is computed as follows:

$$\hat{\beta} = N^{-1} \sum_{j=1}^{N} \left(\sum_{t=1}^{T} \left(log\, FDI_{jt} - \overline{logFDI_j} \right)^2 \right)^{-1} \left(\sum_{t=1}^{T} \left(log\, FDI_{jt} - \overline{logFDI_j} \right) logEXPORTS_{jt}^{*} - T\hat{\gamma}_j \right) \tag{4.7c}$$

where $logEXPORTS_{jt}^{*} = \left(logEXPORTS_{jt} - \overline{logEXPORTS_j} \right) - \frac{\hat{L}_{21j}}{\hat{L}_{22j}} \, \Delta log\, FDI_{jt}$;

$\hat{\gamma}_j = \hat{\Gamma}_{21j} + \hat{\Omega}_{21j}^{o} - \frac{\hat{L}_{21j}}{\hat{L}_{22j}} \left(\hat{\Gamma}_{22j} + \hat{\Omega}_{22j}^{o} \right)$ and $\hat{L}_j$ is a lower triangular decomposition of $\hat{\Omega}_j$ (Pedroni, 2000).

Concerning DOLS estimator, it is based on the following equation:

$$log\, EXPORTS_{jt} = \alpha_j + \beta_j \, log\, FDI_{jt} \; + \sum_{i=-q}^{q} \lambda_{ji} \, \Delta \, log\, FDI_{j,t-i} + \epsilon_{jt} \tag{4.8}$$

[13] These estimators assume that cross-section dependence is driven by a single common source and that the response to the common factor is the same for all countries (Pedroni, 2007). The CCEMG estimator, however, allows for cross-section dependence that arises from multiple unobserved common factors and permits the individual responses to these factors to differ across countries, thus accommodating more general forms of dependency.

where λ_{ji} denotes the coefficients of the lags and leads of the differenced independent variable, which control for possible serial correlation and endogeneity of the independent variable, thus yielding unbiased estimates. The coefficient of interest, β, is computed as the simple average of the long-run DOLS estimates for each country.

Table 4.7 reports the results using Pedroni's estimators. Consistent with CCEMG and AMG results, the coefficients of outward FDI in the long-run are positive and statistically significant. According to FMOLS estimates, the long-run elasticity of outward FDI on exports indicates that one percent increase in outward FDI enhances exports by 0.076%. Similarly, according to DOLS estimates, one percent increase in outward FDI fosters exports for the panel of host countries by 0.089%.

Table 4.7 Estimated long-run FMOLS and DOLS results.

	FMOLS	DOLS
$log\ FDI$	0.076*** (0.027)	0.089*** (0.002)

Notes: Standard errors are reported in parentheses. *** Significant at 1%.

In summary, our findings reveal that Spanish outward FDI has a statistically significant positive impact on exports, although it is quantitatively rather small; the long-run elasticity of outward FDI on exports ranges from 0.014 to 0.089. According to the literature review provided in Section 4.2, this relation of complementarity between outward FDI and exports is consistent with vertical FDI strategies.

4.5.2 Causality

Once a positive albeit small effect of outward FDI on exports is found in the long-run, here we want to determine the short- and long-run causal relationship between the two variables. Since the series $log\ EXPORTS$ and $log\ FDI$ are non-stationary but cointegrated, we know from the Granger representation theorem (Engle and Granger, 1987) that they can be specified in the form of a dynamic error-correction term. We employ a two-step procedure to estimate the error-correction model. In the first step, we estimate the long-run model specified in Equation (4.5) and generate the residuals. In the second step, the lagged values of the estimated residuals ($ect_{j,t-1}$) serve as the error-correction term in the estimation of the dynamic error-correction model. Accordingly, we estimate the following error-correction model:

$$\Delta \log EXPORTS_{jt} = c_{1j} + \sum_{i=1}^{m} \chi_{11i}\, \Delta \log EXPORTS_{j,t-i} + \sum_{i=1}^{m} \chi_{21i}\, \Delta \log FDI_{j,t-i} + \kappa_1 ect_{j,t-1} \tag{4.9a}$$

$$\Delta \log FDI_{jt} = c_{2j} + \sum_{i=1}^{m} \chi_{21i}\, \Delta \log EXPORTS_{j,t-i} + \sum_{i=1}^{m} \chi_{22i}\, \Delta \log FDI_{j,t-i} + \kappa_2 ect_{j,t-1} \tag{4.9b}$$

where Δ is the first difference operator, m is the lag length (given the relatively short time period, we assume that $m = 1$), and $ect_{j,t-1}$ is the lagged error-correction term, which corresponds to the residuals ϵ_{jt} from the long-run relationship in Equation (4.5). Short-run causality is determined by implementing a χ^2 test on the coefficients associated to the first differences of the lagged independent variables. Long-run causality is determined by implementing a χ^2 test on the coefficients of the lagged error-correction terms. Although the existence of cointegration implies long-run Granger-causality in at least one direction, long-run causality may also run from exports to outward FDI.

Table 4.8 displays the results from the panel error-correction model. It can be seen that the null hypotheses of short-run Granger non-causality are rejected, which indicates that there exists a Granger causality relationship from FDI to exports and from exports to FDI in the short-run. Therefore, the results in the short-run point to the existence of bidirectional causality between our two variables. As regards the long-run dynamics, the negative and statistically significant coefficients linked to the error-correction terms suggest that exports and FDI respond to deviations from long-run equilibrium. The null hypothesis of long-run Granger non-causality is rejected, which supports bidirectional causality between exports and FDI in the long-run. In sum, long- and short-run Granger causality are bidirectional, suggesting that outward FDI is both a cause and a consequence of exports.

Table 4.8 Causality analysis. Error-correction model.

Dependent variable	Sources of causation		
	Short-run		Long-run
	$\Delta\, log\, EXPORTS$	$\Delta\, log\, FDI$	ect
$\Delta\, log\, EXPORTS$		0.91** (0.002)** [0.023] [0.001]	7.37*** -0.004** [0.006] [0.002]
$\Delta\, log\, FDI$	4.18** (1.189)** [0.040] [0.041]		212.16*** -0.542*** [0.000] [0.031]

Notes: statistics reported concerning short-run changes in the independent variable and ect. P-values in brackets reported underneath the statistics. Coefficients for the short-run changes denoted in parentheses. ect represents the coefficient of the error-correction term. Standard errors in brackets reported underneath the coefficients. *** (**) Significant at 1% (5%).

4.6 Conclusions

The impact of outward FDI on exports has been widely studied in the literature. Nevertheless, neither theoretical discussions nor the empirical evidence provide any clear-cut answer to one of the most relevant questions: Are outward FDI and exports substitutes or complements? In this context, this paper tries to add to the literature by investigating the relationship between Spanish outward FDI and exports towards the top-50 recipient countries over the period 1995-2016.

In line with recent methodological improvements on this issue, we use a heterogeneous panel approach. However, this paper differs from previous papers in that it also deals with the presence of cross-section dependence, as standard estimators used so far are severely biased and, as such, useless. Another important novelty of the paper is that it also checks for the presence of spatial dependence, as this is one component of the cross-section dependence that, by using filtering techniques, can be removed. By doing this, the paper reveals there is cross-section dependence arising from its other component: unobserved common factors or shocks.

Next, unit root properties of both variables are assessed by employing second-generation unit root tests, the results indicating that outward FDI and exports are integrated of order one; that is, they are non-stationary in levels but become stationary in first differences. After that, panel cointegration tests confirm that these variables are cointegrated, which means there is a non-spurious long-run relationship between them.

After dealing with such crucial econometric issues, we devote the empirical analysis to, first, estimate the long-run relationship between outward FDI and exports and, second, examine the short- and long-run causal relationship between them. To tackle the first point, several heterogeneous panel cointegration techniques -that are suitable when facing cross-section dependence due to unobservable common factors- are employed. Specifically, we use Pesaran's (2006) CCEMG estimator and AMG estimator (Bond and Eberhardt, 2009; Eberhardt and Teal, 2010). Then, to check the robustness of the results, FMOLS and DOLS estimators of Pedroni (2000, 2001) are employed. Results reveal that FDI has a positive and statistically significant, albeit small effect on exports in the long-run, which is consistent with vertical FDI motivation. This indicates that Spanish investment strategy abroad is mainly driven by factor cost considerations; namely, it seems that Spanish MNEs tend to locate their production in the foreign countries with the lowest factor costs.

As regards the causality analysis, relevant results arise from the estimation of the corresponding error-correction model. The long-run Granger non-causality test discloses bidirectional causality between outward FDI and exports, suggesting that outward FDI is both a cause and a consequence of exports. As regards the short-run Granger non-causality, results indicate a short-run relationship between outward FDI and exports that, once again, is bidirectional.

Finally, it is important to note that the findings of this paper have a clear policy flavor. This is so because, as Pfaffermayr (1996, p. 501) indicates, "*the relationship between foreign outward direct investment and exports is crucial for assessing the impact of increased internationalization by foreign outward direct investment on a country's welfare*". So, given that our results unveil a positive impact of Spanish outward FDI on exports in the long-run, the conclusion is crystal-clear: the concern that outward FDI replaces exports is, at least for Spain, very much misplaced. Just the opposite, policymakers should consider that policies aimed at promoting outward FDI would be welcome, among other reasons, for the expansion of exports they would trigger. These policies, hence, would likely enhance domestic employment and economic welfare in the long-run.

Conclusiones

Conclusiones

En esta última sección se presentan, por un lado, los principales resultados obtenidos en cada capítulo, así como las recomendaciones de política económica que se derivan de los mismos y, por otro lado, las posibles líneas futuras de investigación, las cuales estarán sujetas a la disponibilidad de datos.

El Capítulo 1 analiza los factores determinantes de los flujos de entrada de IED a nivel regional y sectorial. Los resultados del análisis empírico indican que los flujos de entrada de IED en España están determinados principalmente por el tamaño de mercado, el nivel de capital humano en interacción con los salarios, y las características propias de Madrid. Estos resultados, en general, se mantienen para la IED procedente de Europa y América. Asimismo, los efectos aglomeración son mayores durante el periodo pre-crisis que crisis, justo lo contrario que sucede con el tamaño de mercado. Además, la intensidad de la variable interacción de los salarios y el capital humano es mucho más fuerte durante la crisis; algo similar ocurre con la variable dummy de Madrid. Los resultados son robustos independientemente del enfoque econométrico.

En el Capítulo 2 se lleva a cabo un enfoque espacial sobre la relación entre la IED y el crecimiento en España. Los principales resultados son, primero, que la IED promueve el crecimiento económico, y segundo, que sólo cuando se elimina el efecto sede de los datos primarios es cuando existen spillovers espaciales en la IED. Por consiguiente, parece que este efecto está enmascarando la existencia de efectos spillover espaciales regionales sobre el crecimiento. Estos resultados son robustos a la inclusión de Cataluña, además de Madrid, en el cómputo del efecto sede, y al uso de diferentes especificaciones de la matriz de pesos espaciales. Por otro lado, el análisis sectorial de los datos de IED confirma los resultados agregados, pero indica también que el sector servicios (en especial la rama de transporte, almacenamiento y comunicaciones) es, en cuanto a los flujos de capital extranjero recibidos, el principal impulsor del crecimiento regional.

Desde el punto de vista ahora de la inversión de salida, el Capítulo 3 aborda el efecto de la crisis en la estrategia de inversión directa española en el exterior. Los resultados indican que la estrategia de IED española se ha visto notablemente afectada por la crisis económica global: mientras que inversión de tipo complex vertical prevalece en el periodo pre-crisis, IED de tipo horizontal predomina durante el periodo de crisis. En concreto, hubo una concentración espacial de la inversión española en el exterior por razones de suministro antes de la crisis. Sin embargo, las empresas españolas optaron por llevar a cabo IED de tipo horizontal o market-seeking tras la crisis. Resultados adicionales revelan la importancia del mercado potencial del país receptor y, especialmente en el periodo pre-crisis, un marco regulador sólido en el país receptor. En lo que respecta a los efectos spillover espaciales, la IED en el periodo pre-crisis se dirige a un país particular si éste está rodeado de países con gran potencial de mercado, baja población, bajos costes comerciales y mano de obra cualificada. En cuanto al periodo de crisis, existen spillovers en las variables de población, capital humano y calidad regulatoria. Finalmente, en ambos periodos la proximidad cultural fomenta la IED mientras que la distancia la desalienta.

Para finalizar, el Capitulo 4 profundiza en el análisis de la relación entre IED española en el exterior y exportaciones. En primer lugar, el estadístico *I* de Moran indica que existe dependencia espacial positiva en los flujos de salida de IED y en las exportaciones. Por lo tanto, aplicamos el procedimiento de filtrado espacial desarrollado por Getis (1995) para eliminar esta dependencia. Los resultados muestran que estas dos variables son no estacionarias en niveles, pero se vuelven estacionarias al tomar primeras diferencias. Además, existe una relación de cointegración en el largo plazo entre ambas variables. Así, a través de un análisis en panel heterogéneo y abordando la presencia de dependencia de sección cruzada, la evidencia empírica sugiere que la inversión española en el exterior tiene un efecto positivo y significativo sobre las exportaciones en el largo plazo. Finalmente, la estimación de un modelo de corrección de error de panel apunta hacia la existencia de causalidad bidireccional entre IED y exportaciones en el corto y largo plazo.

Desde el punto de vista de política económica, los resultados obtenidos a lo largo de esta Tesis Doctoral sugieren una serie de recomendaciones. En primer lugar, gracias al análisis desarrollado en el Capítulo 1 sabemos que las regiones españolas deben implementar políticas que mejoren la calidad de la mano de obra sin considerar el potencial incremento de los salarios como un efecto colateral negativo con el objetivo de atraer más IED. En segundo lugar, dados los resultados obtenidos en el siguiente capítulo, no se puede confiar en los datos primarios de IED debido a que están sesgados por la existencia del efecto sede. Puesto que los efectos spillovers derivados de la IED resultan cruciales para estimular el crecimiento, se deben diseñar estrategias conjuntas a nivel regional para atraer IED y, por consiguiente, impulsar el crecimiento económico. En tercer lugar, en vista de que los resultados proporcionan evidencia a favor de un cambio en la estrategia de inversión directa española en el exterior (de inversión de tipo complex vertical a horizontal) con el estallido de la crisis y de que los efectos positivos de la IED de salida son mayores en el caso de IED complex vertical (Myro, 2014), las políticas económicas en tiempos de recesión deben centrarse en proporcionar ayuda financiera directa a las empresas multinacionales para lograr que los costes fijos de la subcontratación sean asequibles. Por último, si bien no menos importante, debido al impacto positivo y significativo de la inversión española en el exterior sobre las exportaciones, los legisladores deberían implementar políticas destinadas a impulsar la inversión española en el exterior lo cual fomentaría las exportaciones y, por consiguiente, el empleo doméstico y el bienestar económico en el largo plazo.

Los cuatro capítulos de la Tesis, aunque abordando cuestiones científicas fundamentales en el campo de la IED, sugieren temas específicos que pueden ser tratados en futuras investigaciones. Por un lado, la utilización de datos de IED más desagregados como, por ejemplo, datos a nivel de empresa de la base de datos Amadeus permitirían extraer conclusiones adicionales que están fuera del alcance en los análisis macroeconómicos. En este sentido, sería interesante analizar diferentes ramas de un sector particular, por ejemplo, la industria manufacturera. Por otro lado, la inversión greenfield de la base de datos FDI Markets proporcionaría también información relevante. Otra posible línea de investigación futura sería extender los análisis a otros países europeos, lo que permitiría detectar diferencias entre ellos y formular recomendaciones de política económica a medida.

Conclusions

Conclusions

This final section concludes the Thesis by including, on the one hand, the main findings obtained in each chapter and the policy implications derived from them and, on the other, the possible future research lines, which will be subject to the availability of data.

Chapter 1 examines the influencing factors of inward FDI flows in Spain at regional and sectoral levels. Results from the empirical analysis indicate that FDI inflows in Spain are mainly determined by market size, the level of human capital in interaction with wages, and the own characteristics of Madrid. These results are, in general, maintained for the FDI coming from Europe and America. Additionally, agglomeration effects are greater during the pre-crisis than crisis period; just the opposite occurs with the market size. Besides, the intensity of the interaction variable of wages and human capital is much stronger during the crisis, and something similar happens with the dummy for Madrid. Results are robust regardless of the econometric approach.

A spatial approach to the FDI-growth nexus in Spain is developed in Chapter 2. The main findings are, first, that FDI does foster economic growth and second, that only when the headquarters effect is removed from raw data, do FDI spatial spillovers arise. Hence, it seems that this effect is masking the existence of regional FDI spillovers on growth. These results are proved robust to the inclusion of Cataluña, apart from Madrid, in the computation of the headquarters effect, and to the use of different specifications of the spatial weight matrix. Furthermore, the sectoral breakdown of FDI data reinforces the aggregate results, but also points to the service sector (especially the transport, storage and communications branch), regarding foreign capital inflows, as the key enhancer of regional growth.

Turning the focus to outward FDI, the effect of the crisis on the Spanish direct investment strategy abroad and the FDI determinants is analyzed in Chapter 3. Results show that Spanish FDI strategy has been markedly affected by the global economic crisis: while complex vertical FDI motives prevailed over the pre-crisis period, horizontal FDI was the dominant strategy during the crisis. Specifically, there was a geographical clustering of Spanish direct investment abroad for supply reasons before the crisis. However, Spanish firms opted for primarily undertaking horizontal or market-seeking FDI in the aftermath of the crisis. Additional findings reveal the importance of the host market potential and, especially in the pre-crisis period, a strong regulatory quality in the host country. As regards spatial spillovers, FDI in the pre-crisis period goes to a particular country if neighboring countries have large market potential, low population, low trade costs and skilled labor. Considering the crisis period, spillovers emerge in population, human capital and regulatory quality variables. Finally, in both periods cultural proximity fosters FDI while distance discourages it.

To conclude, Chapter 4 examines the link between Spanish outward FDI and exports. First of all, Moran's *I* statistic points to the existence of positive spatial dependence in outward FDI flows and exports. To remove it, we apply the Getis' (1995) spatial filtering procedure. Results disclose that these two variables are non-stationary in levels, but become stationary after taking first differences. Additionally, outward FDI and exports exhibit a long-run cointegration relationship. Then, by adopting a heterogeneous panel approach dealing with cross-section dependence, empirical evidence supports that outward FDI from Spain has a positive and statistically significant effect on exports in the long run. Finally, the estimation of a panel error correction model reveals the existence of bidirectional causality between FDI and exports in the short and long run.

From a policy perspective, some implications can be drawn based on the results obtained throughout this Doctoral Thesis. First, from the analysis developed in the first chapter we have learned that Spanish regions trying to attract more FDI should implement policies mainly aimed at improving the quality of their workforce without considering a potential increase in wages as a negative side effect. Second, in view of the results obtained in the next chapter, one cannot rely on raw FDI data since they are biased due to the existence of the headquarters effect. As FDI spillovers are found to be essential to foster growth, regional-level joint strategies should be implemented to attract FDI and thus, promote economic growth. Third, given that our results provide evidence for a change in the Spanish FDI strategy (from complex vertical to horizontal FDI) with the outbreak of the crisis and that the positive effects of outward FDI on the Spanish economy are higher when complex vertical FDI prevails (Myro, 2014), policy initiatives in times of recession in Spain should be focused on assisting MNEs through direct financial support to make the fixed costs of outsourcing affordable. Last but not least, due to the positive and significant effect that Spanish outward FDI has on exports, policymakers should implement policies aimed at promoting outward FDI which would enhance exports and hence, domestic employment and economic welfare in the long run.

The four chapters of the Thesis, while having answered some critical scientific questions in the field of FDI, suggest specific issues that can be addressed in future research. First, the use of more disaggregated FDI data such as firm-level data from Amadeus database would provide additional insights that are beyond the scope of macro-level analyses. In this respect, it would be interesting to focus on different branches of a particular sector, for instance, manufacturing industries. Additionally, the consideration of greenfield investment from FDI Markets database would offer relevant information as well. Another possible line of future research would consist of extending the analyses for other European countries, which would allow to detect differences among them and be able to design tailor-made policy recommendations.

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Appendix

Appendix 1.

Results of the SAR model of FDI determinants.

Table A1.1 FDI determinants. Spatial Autoregressive model.

Variables	Point estimates
$\sum_j w_{ij} fdi_{it}$	0.153** (0.076)
GDP_{it}	0.490*** (0.075)
$(WAGE * Hc)_{it}$	2.961*** (0.547)
RI_{it}	-0.145 (0.151)
d_{Madrid}	1.309*** (0.315)
R-squared	0.730
LIK	-478.460
AIC	968.920
SC	991.586

Notes: standard errors in parentheses. *** (**) Significant at 1% (5%) respectively. Results obtained by using the row-standardized inverse distance matrix.

Table A1.2 FDI determinants. Spatial Autoregressive model. Average direct, indirect and total effects.

	Direct effects	Indirect effects	Total effects
GDP_{it}	0.494*** (0.080)	-0.040 (0.081)	0.454*** (0.104)
$(WAGE * Hc)_{it}$	2.961*** (0.463)	-0.233 (0.474)	2.728*** (0.643)
RI_{it}	-0.134 (0.163)	0.017 (0.033)	-0.117 (0.150)

Notes: standard errors in parentheses. *** Significant at 1%. Results obtained by using the row-standardized inverse distance matrix.

Appendix 2.

List of countries considered in Chapter 3.

Algeria, Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Costa Rica, Cuba, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Finland, France, Germany, Greece, Guatemala, Hungary, India, Ireland, Italy, Japan, Luxembourg, Malaysia, Mexico, Morocco, Namibia, Netherlands, Norway, Panama, Peru, Poland, Portugal, Romania, Russia, South Africa, Sweden, Switzerland, Tunisia, Turkey, United Kingdom, United States, Uruguay, Venezuela.

Appendix 3.

List of countries considered in Chapter 4.

Algeria, Andorra, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Cuba, Czech Republic, Denmark, Egypt, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Iran, Ireland, Israel, Italy, Japan, Mexico, Morocco, Netherlands, Norway, Poland, Portugal, Romania, Russia, Saudi Arabia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Sweden, Switzerland, Tunisia, Turkey, United Arab Emirates, United Kingdom, United States, Venezuela.