Determinants of FDI for Spanish regions: Evidence using stock data.*

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Abstract

After decades of academic debate on the factors that determine FDI, the discussion still remains open. This article empirically investigates the determinants of FDI activity using Spanish regional data (NUTS 2) for the period 2004-2013. We apply the Poisson Pseudo-Maximum-Likelihood estimator with country-origin fixed effects in a gravity framework and implement an exploratory factor analysis to avoid collinearity problems. The empirical analysis revealed the following allocation patterns: FDI locational strategies in the Spanish regions are determined significantly by the economic potential, competitiveness and agglomeration effects of the regions, and to a lesser extent, by the productive capacity. We also confirm the adequacy of using the stock of FDI in the empirical analysis and obtain an improved specification of the model compared to previous literature based on FDI flows. The results allow us to draw some policy implications about the prospective promotion of incoming FDI at the subnational level.

Keywords: Foreign Direct Investment determinants; PPML; Gravity model; Spanish regions
JEL classification: F21, R12, C23

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1. Introduction and motivation

Foreign Direct Investment (FDI) has become the engine of the globalization process. It is broadly accepted that this type of investment has beneficial effects in terms of job creation and technological transfers. Therefore, most governments in the world, either at a national or regional level, have promoted generous policies to attract FDI on their soil. However, there is no current consensus in the literature about the drivers of FDI and, therefore, the most effective policies for its promotion. In the European case, the significant increase in FDI flows after the launching of the euro gave rise to mounting and persistent external imbalances, and examining the factors that attract direct investment has become a "hot topic" in the rebalancing debate in the Eurozone, that is far from being solved empirically.[1] Thus, there is a growing body of research that provides empirical evidence not only on the factors that determine FDI, but also about the existence of significant disparities in its distribution across countries.

Indeed, the peripheral European countries became massive capital importers until the outbreak of the crisis and Spain was by far the largest capital importer in absolute terms. Figure 1 presents the inward FDI stocks and inflows to Spain during the period 1970-2014.[2] Until the mid−eighties FDI was negligibly small. Since then, FDI inflows began to increase after the Spanish entry in the EU in 1986 (and the European Monetary System in 1989) and later with the creation of the monetary union. In particular, FDI inflows have increased from US$ 4.570,7 million in 1987 to US$ 76.992,5 million in 2008. Exchange rate stability has been crucial in the reduction of risk and, then, the increase of the general attractiveness of the country as an investment destination. However, the impressive upward trend in FDI inflows was disrupted by the global financial crisis in 2008. Since 2008, FDI inflows have declined. However, the bar graph in Figure 1 shows that although the FDI inward stock has slightly declined, it remains large and suggests that Spain is still an attractive host country for FDI. Even during the crisis, the value of the stock is maintained (at least in nominal terms) and only decreases with some delay, in 2013-2014.

Although there is an extensive empirical literature at the country-level for developed countries, the evidence about the determinants of FDI at the regional level is quite recent and relatively scarce (Kandogan (2012), Villaverde and Maza (2012) and Chan et al. (2014)).[3] This scarcity mainly derives from the lack of data. Some efforts have been made, however, to collect and streamline data for regions by regional statistical offices. Studies reveal regional disparities in the distribution of FDI and, in this regard, the case of Spain clearly arises as a prominent example.

Looking at Figure 2, we can observe that the regional distribution of FDI is highly concentrated.

[1] According to Bertola et al. (2013), there were two primary and interrelated causes explaining these imbalances: First, the monetary union created optimistic expectations regarding the rapid convergence of the peripheral countries with the core ones in the Eurozone. Second, the introduction of the euro eliminated the exchange-rate risk and induced investors to disregard country-specific bankruptcy risks. Both causes generated an investment and credit boom in the periphery and implied a large-scale reallocation of capital from the core to the periphery that materialized as current-account deficits.

[2] Note that data on inward FDI stock is only available since 1980.

[3] The empirical literature at the country-level has focused mainly in OECD countries, since traditionally they have represented a prominent share of world's FDI flows (Bénassy-Quéré et al. (2007) and Talamo (2007)).

The map shows total inward FDI in each of the 17 Spanish regions during the period of analysis.[4] FDI seems to be attracted mainly to four regions over the period 2004-2013. Of these, Madrid has been by far the largest recipient of inward FDI in Spain (almost 3.500 million euros), followed by Catalonia (with 1.048 millions), Asturias (304 millions) and the Basque Country (237 millions). Extremadura has attracted the lowest amount of FDI (an average of 6 millions). Another stylized fact, also related to the regional distribution of FDI, has to do with the geography of FDI: with the exception of the region of Madrid, the other regions that concentrate more FDI are in the coast. In addition, potential regional spillovers may influence Aragon's and Navarre's FDI (due to their closeness to Catalonia and Valencia in the case of the former and to the Basque Country in the case of the latter).

The sectoral distribution of FDI is also very heterogeneous. Table 1 provides the sectoral breakdown (agriculture, industry, construction and services) for the years 2004 and 2013. Three descriptive facts can be derived from the data. First, FDI inflows are also highly concentrated across sectors. Industry and services concentrate the 95% of total FDI. Second, the sectoral distribution of FDI across regions does not vary across time. The exceptions are Castilla-La Mancha, Catalonia, Extremadura, Navarre and Basque Country. And, third, the amount of inward FDI flows allocated to services increases over time. By 2013, this sector concentrated most inward FDI, 64% of the total. Despite these facts, the sectoral breakdown of FDI stock data has not been included in this study due to data availability.[5]

Finally, Figure 3 shows the main source-countries of FDI in Spain. The largest stock of FDI has come from the US (2.601 million euros, on average, what represents the 19% of inward FDI stock in Spain), followed by France, the UK and Germany, that jointly represent over 60% of the total. Together with Mexico, the Netherlands, Luxembourg, Switzerland and Portugal they constitute the largest foreign investors in Spain.

In this context, examining the factors that attract FDI in Spain seems very pertinent. Indeed, the analysis of FDI determinants at the regional level within a country may be of special interest for countries with a federal structure where regional authorities have a key role in designing policies to encourage FDI. Moreover, the motivation for studying FDI from a regional standpoint comes from the fact that a lot of interesting characteristics are hidden at more aggregate levels. More importantly, FDI determinants and effects may be localized and, thus, a regional analysis may be more appropriate to obtain better-grounded results.

This paper seeks to contribute to the existing literature by providing further insights on the

[4]We do not account for Ceuta and Melilla due to data availability. DataInvex provides data for these autonomous cities only for 3 out of 40 of the source countries included in our sample and not for the whole time span. Furthermore, FDI data for these cities is not provided separately what could be problematic for the analysis when including specific host region characteristics.

[5]The Spanish Ministry of Economy, Industry and Competitiveness through its investment registry (DataInvex database) provides data on FDI flows disaggregated by regions and sectors whereas FDI stock data are available at national level since 2007. Indeed, we are indebted to Isaac Barbero and Emilio Carmona from the Spanish Ministry of Economy, for providing us with the extended and disaggregated version of FDI stock data from the DataInvex database that allows us to conduct the study at the regional level.

determinants of inward FDI activity from a macroeconomic point of view using Spanish regional data for the period 2004-2013. We claim that our approach is a macroeconomic one because we use aggregate FDI instead of Foreign Affiliate Sales (FAS) as the dependent variable. We think this definition of FDI is preferable to FAS, because the latter may be a measure of multinational enterprise (MNE) production and hence, the drivers and the theoretical model might be different (Bergstrand and Egger (2007)). Furthermore, Baldwin et al. (2008) highlight the drawbacks of using FAS instead of the book value. They describe the two main sources to measuring FDI: central bankers and economics ministries. Central bankers consider FDI as part of the capital account of balance of payments and they gather statistics accordingly. Economics ministries, in contrast, gather data on the number of employees, sales and assets of foreign controlled firms. Unfortunately, the production/sales data is based on surveys and thus generally subject to confidentiality requirements that make the data difficult to access for scholars. And when it is accessible, it is usually for just one nation since the various datasets are not compatible enough to pool the data. The FDI data used in this paper has been extracted from *DataInvex*, a rich and under-exploited database that provides FDI data on FDI stocks and flows broken down by autonomous communities or regions (NUTS 2) for the Spanish economy.[6] Our aim is to shed some light on the increasing and heterogeneous patterns of inward FDI that the Spanish regions have attracted since the launching of the euro. We estimate an extended gravity model using the Poisson Pseudo-Maximum Likelihood (PPML) estimator in a gravity framework. We rely on PPML estimator because it produces unbiased and consistent estimates when the dependent variable comprises of a large proportion of zero observations as is the case in the present study.

Furthermore, we use inward FDI stock data, as an alternative to flows, because stocks are much less volatile than flows. This is a salient feature of our study as our hypothesis is that this variable is the most suitable for empirical studies, as Wacker (2013) has recently corroborated. Flows are more volatile not only due to the existence of economic shocks but because they are also very dependent on individual large-scale investment decisions. Our aim is to find the determinants of the long-run allocation patterns of FDI across regions. We differ in this respect from other empirical approaches of the literature that mainly focus on short term macroeconomic variables (such as the exchange rate or the business cycle performance), to explain the FDI behavior.[7] Therefore, we are not interested in determining the effect of surges (i. ex. a sudden stop) in the evolution of FDI. All in all, for the sake of comparison, we replicate the analysis using inward FDI flows.

[6] According to international recommendations, DataInvex defines FDI as those transactions through which a direct investor acquires or increases its participation in a company resident in another country so that it can exert an effective influence in its management. In practice, it is considered that the investor has the ability to influence the management of a company when he has at least 10% of the capital or voting rights. Specifically, we use in our study the investment position which represents the value of the assets that direct investors hold in companies, resident in countries other than their own, with direct investment. The position data is established from the perspective of the country that presents them (reporting country). For the purposes of this study, the position of foreign investment in Spain would be the value of the shares of non-resident investors in companies domiciled in Spain. The participations are valued on the basis of the book value of the equity of the direct investment company.

[7] See, for instance, Russ (2009), Russ (2012) or Cavallari and D'Addona (2013).

A complete understanding of the factors that determine FDI seems pertinent given the interest of many countries currently facing financial constraints to attract FDI in their quest to foster economic activity. In this context, FDI stocks, as an alternative to flows, provide a better approximation to the long-run behavior of investment decisions, the ones really relevant for growth.

The reminder of the paper is organized as follows. Section 2 reviews the theoretical approaches and reports the main determinants of FDI, whereas section 3 presents the empirical literature. Section 4 provides a description of the variables and the data sources. Section 5 describes the models to be estimated together with the results and, finally, Section 6 concludes.

2. Theoretical background

From a theoretical point of view, the so-called eclectic or *OLI paradigm* put forward by Dunning (1977, 1979) has been considered the standard workhorse theoretical framework within this strand of literature. Dunning suggests that three types of advantages influence the foreign investment decision of a MNE: Ownership, Location, and Internalization (OLI). Here, it is worth to note that while *Ownership and Internationalization advantages* are essentially of a microeconomic nature, *Locational advantages* generally correspond to macroeconomic variables. Focusing on locational advantages, Dunning (2000) identifies four main motives that encourage MNEs to engage in foreign production: market seeking, resource seeking, efficiency seeking and strategic assets seeking. Market seeking motives correspond to FDI that aims at supplying the local market or markets in adjacent territories. The host market size, its per capita income and consumer demand (all of them to take advantage of the economies of scale) are the main reasons behind market seeking FDI. Resource seeking companies are those investing abroad in order to obtain cheap natural resources and/or unskilled labour. Hence, locational decisions depend on factor endowments differences. Efficiency seeking investment is designed to promote a more efficient division of labor or specialization of assets by MNEs. Finally, strategic asset seeking FDI searches for resources such as technology, skilled workers and assets that can support worldwide development of a firm and weaken the competitive position of its competitors.

With the incorporation of multinational firms into the general equilibrium trade models from mid 1980s onwards, it became possible to base empirical work on theoretical predictions regarding the relationship between MNE activity and home and host countries characteristics (Barba Navaretti and Venables (2004)). These theories allowed to explain the existence of two basic types of FDI, namely horizontal (market-oriented) and vertical (export-oriented) FDI. The first type of FDI is explained using the proximity-concentration hypothesis which explains the trade-off between maximizing proximity to customers and concentrating production to achieve scale economies (Horstmann and Markusen (1987)). In this regard, horizontal FDI (HFDI) may imply duplication of the entire production process in several countries. In contrast, the second type (VFDI) is explained by using the factor-proportions hypothesis which accounts for the existence of vertically integrated

firms with geographically fragmented production (Faeth (2009)). In terms of HFDI, the most important factor to attract FDI is the size and growth of the host country whereas VFDI mainly looks for cost competitiveness. VFDI is conducted in order to minimize production costs in the host country and then to export the output produced to the home country or to third countries. Hence, the most important location factor for VFDI is resource endowment. Helpman (1984, 1985) showed that countries' differences in relative factor endowments (the so-called factor-proportions hypothesis) explained VFDI.

Combining vertical and horizontal motivations for FDI, Markusen et al. (1996) and Markusen and Maskus (2002) formulated the *knowledge-capital model*. Markusen and Venables (1998) explain the knowledge-capital model through two tradeoffs. The first and key tradeoff is between the scale economy gains that come from dividing up production and spatially dispersing it to be near customer concentrations. The second trade-off concerns productive factors. The so-called VFDI strives to place each stage of production in the nation where it is cheapest. However, it is important to make some remarks at this point. It can be misleading to think of the former literature as a proper FDI theory. In fact, it is a FAS literature as qualified by Markusen and Maskus in their 2002 book.[8] More recent contributions to this theoretical approach allow for heterogeneous firms. Helpman et al. (2004) consider firms that have different productivities and fixed costs of establishing "beachhead" in various markets. The most competitive firms tend to sell much more and thus tend to find the transport-cost-saving aspect of FDI especially attractive. This would explain the widely spread phenomenon that FDI is dominated by large firms. Carr et al. (2001) provided the first empirical test of the knowledge-capital model's hypotheses. Using a panel of data (US outbound and inbound affiliate sales in many nations from 1986 to 1994), they find evidence for both the horizontal and vertical motivations for FDI. Blonigen et al. (2003) question their econometrics, which, when corrected, no longer support the vertical motivations for MNE activity. Overall, under the knowledge-capital model, similarities in market size, factor endowments and transport costs were determinants of HFDI, while differences in relative factor endowments determined VFDI. The knowledge-capital model has recently been extended to explain other forms of FDI such as export-platform FDI (see Ekholm et al. (2007); Bergstrand and Egger (2004)) which is used to serve the neighboring markets of the host country. To sum up, while recent Eaton-Kortum (Ricardian) type models have been extended to motivate gravity equations for multinational production of firms either in isolation from trade flows (Ramondo (2014)) or with trade flows (Ramondo and Rodríguez-Clare (2013)), theoretical foundations for FDI per se are limited primarily to Bergstrand and Egger (2007).[9]

Indeed, a third strand of the theoretical literature on FDI determinants is the one based on the *gravity approach* to FDI. Theoretical foundations for FDI are limited basically to Bergstrand and Eg-

[8] Markusen and Maskus (2002).

[9] While Markusen and Maskus (2002) knowledge-capital model is about FAS, Bergstrand and Egger (2007) is about both, FAS and proper FDI.

ger (2007) and Head and Ries (2008). In principle, these papers provide general equilibrium theories for FDI and not FAS.[10] In this case as in gravity models applied to trade flows, the main explanatory variables are geographical location (due to its effects on transport costs) and the size of the country, crucial when economies of scale are recognized to exist in the activities of MNEs. The gravity model states that the closer two countries are (geographically, economically and culturally) the higher will be the FDI activity between them. Recent papers have provided some micro foundations for the gravity FDI specification. Head and Ries (2008) develop a model of cross-border mergers and acquisitions (M&A) activity where a mother company has a randomly assigned advantage in controlling the company in the host country, but faces a disadvantage in monitoring technology that gets more severe with geographical distance. Bergstrand and Egger (2007) add internationally mobile capital to the knowledge-capital model and find that a "modified" gravity model fits the data better. Similarly to Head-Ries, the Bergstrand-Egger model stresses the importance of relative distance. In this case, the amount of expected FDI between two nations depends upon the bilateral distance relative to some measure of the host and home nation's distance to alternative FDI sources and destinations. Kleinert and Toubal (2010) provide the theoretical underpinnings of the gravity equation applied to the analysis of FAS showing that gravity equations can be used to discriminate between different theoretical approaches, namely, two proximity-concentration models of HFDI with homogenous (Brainard (1997)) or heterogenous firms (Helpman et al. (2004)) and a two-country factor proportions model of fragmentation that explains VFDI. [11]

In this very similar theoretical framework, the relationship between FDI and trade has been put forward, among others, in Helpman et al. (2004) and from an empirical point of view in Camarero and Tamarit (2004) and Camarero et al. (2018). Therefore, many of the FDI drivers can be connected to the ones for trade. In this very same vein, changes in interest rates and exchange rates have been identified as additional FDI determinants. The role of these variables is explained by the risk diversification hypothesis of MNE, as firms are risk averse and, therefore, are trying to diversify business risk.

Lastly, it is important to consider also the influence of political variables on FDI. The strategies adopted by companies and their performance on international markets are largely determined by institutions (i.e. the "rules of the game" as in Busse and Hefeker (2007)). In this context, foreign investment can be regarded as a "game" in which the players are the multinational firm and the government of the host country, or as a contest between governments to attract FDI (Faeth (2009)). Policy variables such as corporate tax rates, tax concessions, tariffs and other fiscal and financial investment incentives have thus been posited to have an effect on FDI.

Briefly stated, the literature suggests a variety of theoretical models explaining FDI that do not necessarily replace each other (see Blonigen (2005), Faeth (2009) and Assunçao et al. (2011) for a

[10] Recently, theory has been directed, as well as empirical work, to FAS, starting with Brainard (1997) and continuing to Ramondo et al. (2015).

[11] The factor-proportions model is based on Venables (1999).

thorough literature review on FDI determinants). Therefore, in the next Section we review the wide range of factors that can be considered in empirical studies in order to find the determinants of FDI. These factors involve both micro (e.g., organizational aspects) and macro (e.g., resource allocation) dimensions and call for a very accurate empirical validation.

3. A brief survey of the empirical literature on regional FDI determinants

The location determinants of FDI have been largely explored in the empirical literature using different approaches. Blonigen and Piger (2014) make an extensive overview of the empirical determinants of FDI literature. As we have already stressed before, although sometimes difficult, it is important to distinguish between proper FDI and FAS, being the latter derived from the Multinational Production (MP) theory. Even if in this review we may not always make this distinction explicitly, we are aware of its relevance and will use it in the selection of the econometric specification as well as in the choice of the variables used in Section 5. Since this study aims to identify the factors that best explain inward FDI to a particular region, it concentrates on the locational variables.

This section will emphasize the revision of the regional analyses. However, in order to set up a taxonomy of the empirical research on FDI determinants, we will single out a few recent studies on specific areas (OECD, EU...) to focus immediately on country-specific analyses. The latter are developed both at national and regional levels. It is important to stress that the variables involved at national and regional level studies may be different due to data availability but also to theoretical considerations. More specifically, *market seeking* variables, related to the size of the host market are less relevant at a regional level, as the FDI project will be serving the whole nation, so the specific location of the FDI within the country must be due to other variables more closely related to *endowment differences* or distinct *geographical or political characteristics*. At the same time, many variables, such as the exchange rate, country-risk or business cycle (output gap) considerations have full sense at the national level but not at the regional one. In order to uncover the specific variables at play at the regional level, we will review the empirical literature at our disposal. It is worth mentioning that studies carried out at the national level have been the most prolific. Therefore, first, we will review the main studies that analyze FDI determinants for groups of countries; second, we will report the most significant studies at the country level; then we will summarize the main results of previous regional studies and finally, we will review the literature for the Spanish case.

The lion's share of the literature dealing with the FDI determinants focuses on the OECD since traditionally they have been representing an outstanding share of the world FDI inflows. Recent research by Economou et al. (2017), using both static and dynamic panel techniques over the period 1980-2012, has identified lagged FDI, market size, gross capital formation and corporate taxation as robust FDI determinants for OECD countries. Moreover, Bruno et al. (2016) estimate Ordinary Least Squares (OLS), Poisson and Heckman models on a gravity framework for 34 OECD countries

over 1985-2013. They conclude that GDP, GDP per capita and EU membership affect positively FDI inflows. Although they focus on modelling flows, they also replicate the estimations for FDI stocks and find qualitatively similar results.

Other recent country-group studies have focused on European Union countries and, in particular Central and Eastern European Countries (CEEC) after the 2004 enlargement. They try to unravel the specific importance of this economic integration process on FDI. Bevan and Estrin (2004) use panel data techniques in a gravity framework to examine the determinants of FDI in CEEC for the period 1994-2000. They identify unit labor costs, gravity factors, market size and proximity as the most important drivers of FDI. Besides, announcements about EU accession proposals have been found to have an impact on FDI for the future member countries.

Similarly, Demekas et al. (2007) use both FDI flows and stocks to explain inward FDI in 16 European transition economies, applying cross-section as well as dynamic panel data techniques. In addition to gravity factors, they control for host country policy variables as FDI determinants. They find that gravity factors, trade and foreign exchanges liberalization as well as infrastructure reforms encourage FDI, while high unit labor costs, corporate taxes and import tariffs discourage it.

For the case of EU countries, Canton and Solera (2016) estimates a Heckman two-step selection procedure in the context of a gravity model for the period 2003-2014. His findings suggest that business climate and product market regulations play a key role on attracting greenfield investment in the EU.

Far less research has been carried out concerning the factors that attract FDI within a particular country, that is, at a *regional level*. Moreover, most of these studies at the subnational level have been conducted in large countries (most of them in China, but also in other countries such as the US), and only rarely in smaller countries. Using provincial panel data from China, Chan et al. (2014) examine all possible flows of causality involving FDI and a set of potential determinants, both in the short and in the long run. In a context of error correction models with Granger causality tests they show that in both the short and the long run, GDP growth directly influences FDI, while growth in local infrastructure and local investment have indirect but not direct influence.

In the case of the US, Kandogan (2012) investigates within-country regional locational decisions of multinationals. He uses states within the US as regions and applies multiple regression analysis for both FDI stock and flows as dependent variable. They identify unemployment rate, market size, per capita income, income growth and state regulations as the main determinants of FDI.

Although to a lesser extent, regional studies within small countries can also be found in the empirical literature. This is the case of Chidlow et al. (2009) that, using a multinomial logit model, investigate the location determinants of FDI inflows in the Polish regions. The authors claim that knowledge seeking factors alongside market and agglomeration factors act as the main drivers for FDI inflows into the Mazowieckie region, while efficiency and geographical factors encourage FDI to other areas of Poland. Similarly, Dimitropoulou et al. (2013) analyze FDI projects in UK regions to

identify the main determinants of the location choices of these investments. Using multinomial and conditional logit models, they find that existing regional specialization is the single most important determinant of inward FDI. Focusing on Croatian regions, Kersan-Skabic and Tijanic (2014) apply static (random effects estimator) and dynamic panel data methodologies to analyze their attractiveness as FDI locations. They conclude that FDI inward stocks are attracted to Croatia by education, infrastructure, the manufacturing industry and the capital city region, while unemployment and EU-border regions have a negative effect on FDI.

In the case of Spain, although most of the empirical evidence has been obtained at the national level, since the early 1990's the regional perspective has also been brought to the forefront of this field of research.[12] Egea and López (1991) conduct a cluster analysis for the period 1985-1989 and conclude that per capita and per employee income, human capital and the productive structure are the main drivers of FDI. In contrast, the unemployment rate, infrastructure endowment and subsidies are not found significant. Pelegrín (2002), using three different methodologies (OLS, LS with fixed effects and GLS), estimates a FDI equation for the period 1993-1998. Three key determinants of FDI location are identified, namely, market size, human capital and public incentives; however, infrastructures are not significant while labour costs have a positive coefficient. In another paper, Pelegrín and Bolancé (2008) find that agglomeration economies and the concentration of research and development (R&D) activities are important drivers for manufacturing FDI in a model estimated using GLS. Using the same methodology together with instrumental variables, Rodríguez and Pallas (2008) show that real GDP, human capital, sectoral export potential and the differential between labor productivity and the cost of labor are key factors in explaining the regional distribution of FDI during the period 1993-2002.

More recently, Villaverde and Maza (2012) analyze the regional distribution of FDI in Spain and its main determinants between 1995 and 2005/2008 by means of panel data techniques, namely by GLS and two stage GLS. The econometric analysis reveals that factors such as economic potential, labour conditions and competitiveness are important for attracting FDI both at aggregate and sectoral levels.

Finally, Gutiérrez-Portilla et al. (2016) estimate a FDI equation by GMM and GLS over the period 1997-2013, and show that FDI inflows in Spain are mainly determined by market size, the level of human capital in interaction with wages, and the characteristics of Madrid as capital of the nation. The research is conducted not only for the whole period and total FDI but also for two sub-periods (pre-crisis and crisis) and areas of origin (Europe and America).

Our paper contributes to the existing literature in different respects. First, we use a testing framework based on the gravity model embedding competing theoretical approaches. Second, despite the amount of empirical work that has analyzed the factors that determine FDI, the majority has focused on the evolution of flows. To the best of our knowledge, there are no empirical papers

[12]Some examples of these studies are Bajo-Rubio and Sosvilla-Rivero (1994), Pelegrín (2003) and Martínez-Martín (2011), among others.

dealing with regional FDI determinants based on stock data. Overall, from the above literature review it can be inferred that the main FDI determinants in Spain are those related to market seeking (i.e.market size) and resource seeking (i.e.human capital, labor market conditions and physical infrastructure endowment). Third, unlike baseline estimates in earlier studies using OLS or Heckman two-stage selection procedure, we use the PPML estimator proposed by Silva and Tenreyro (2006) which provides robust results.

In the next two sections, adopting a regional perspective, we provide further evidence on the performance of the PPML estimator using FDI stock data. The existence of an updated and largely unexploited database developed by the Spanish Ministry of Economy (DataInvex) calls for further research in this field.

4. Data and stylized facts

In this section, and prior to present the empirical results, we describe the variables we have chosen for the analysis based on the previous literature discussion, both from a theoretical and empirical point of view. In addition, we describe their sources and point to some stylized facts. More detailed variable definitions and data sources can be found in Table 2, while Tables 3 and 4 report some basic descriptive statistics and the correlations, respectively.

The dependent variable is bilateral inward FDI stock from the origin countries towards the Spanish regions for the period 2004-2013.[13] They have been obtained from *DataInvex* from the Spanish Ministry of Economy, Industry and Competitiveness that provides data on FDI disaggregated by regions. Unlike the vast majority of the literature on this field, we use bilateral FDI stock as our dependent variable.[14] We argue that stocks are much less volatile than flows, especially in relatively small countries.[15] This volatility has its origin not only in the existence of economic shocks, but also on individual large-scale investment decisions. However, we have also applied the analysis to inward flows for the sake of comparison. Furthermore, FDI stocks (as a valuation of the cumulative FDI) provide a better approximation to the long-run behavior of investment decisions, the ones really relevant to capture growth and the dynamic effects of economic integration. In the same vein, Baldwin et al. (2008) argue that factors such as stock market fluctuations or exchange rate volatility cause short-run variability on FDI flows that may not always be linked to the explanatory variables and therefore lead to worse model fit for flows than for stocks.

Our dataset is annual and covers the period 2004-2013. Hence, we have a balanced panel with dimension n=680 (17 regions x 40 countries, that is, all possible bilateral relationships) and T=10. The number of observations is nxT=6800. Table 5 reports the countries included in the study. We

[13] We do not include FDI information of ETVE (Empresas de Tenencia de Valores Extranjeros-brokers) firms because they are considered instrumental companies whose existence obeys to fiscal optimization strategies within a business group and in many cases their investments lack direct economic effects.

[14] Exceptions are Wacker (2013) and Blonigen and Piger (2014).

[15] Bénassy-Quéré et al. (2007), p.769.

assume zero FDI in case of non-reported data as in Canton and Solera (2016) and treat negative values of FDI stock as zero following Gouel et al. (2012).[16]

In search of the main determinants of inward FDI in the Spanish regions, we have chosen a set of explanatory variables that capture the main factors likely to attract FDI, considering not only the theoretical models but also the empirical studies previously discussed. These variables include factors describing labour market characteristics, the degree of openness, as well as capital endowment, both physical and human.[17] The variables considered are the following:

Market Size (MS_{it}): proxied by GDP per capita. Most of the literature considers this variable a robust determinant of FDI. From Dunning's OLI framework, to the HFDI theory (i.e. the proximity-concentration hypothesis) as well as the knowledge-capital model. As market's size increases, so do the prospects of higher demand (greater purchasing power), better market opportunities for the firms and potentially higher returns on their capital. In this regard, market seeking is among the main motives for investors to undertake FDI. Larger markets in the host region do not only denote good economic performance, but also allow for a reduction in the cost of entry through the exploitation of economies of scale. Hence, we would expect to find a positive relationship between market size and FDI.

Labour Productivity (LP_{it}): defined as GDP per total employment. The role of this variable would be also in line with the OLI framework, HFDI and the knowledge-capital model. The expected sign on FDI is ambiguous. We would expect a negative association when labour productivity in the host country is low due to capital scarcity, thereby the marginal return to capital is relatively high and FDI is attractive. On the other hand, a positive relationship might be expected if labour productivity indicates favourable factors for FDI, such as market size and good business climate conditions (see Canton and Solera (2016) and Razin et al. (2008)).

Wage (W_{it}): defined as employee's compensation per hour worked. The effect of wages in the host country is somewhat ambiguous in the literature: If VFDI activities are the dominant driving force it should be expected a negative relationship. However, if the driving force is HFDI it would be expected a positive relationship between the wage level and FDI (indicating the need for a qualified workforce in the foreign affiliate production and higher sales). Given that the sectoral breakdown of FDI stock data could not be included in this study due to data availability, wages are not disaggregated by sectors either. Table 6 reports the gross value added (GVA) across sectors and regions together with the level of wages. It can be observed that the Spanish sectoral structure

[16]This last point can be tricky. Following the advice of one referee we elaborate on this point to justify our position. According to UNCTAD (2018): "FDI flows are presented on a net basis, i.e. as credits less debits. Thus, in cases of reverse investment or disinvestment, FDI may be negative." Thereby, negative FDI flows have real economic meaning. On the contrary, although analytically a negative sign on FDI stocks indicates that at least one of the three components of FDI flows (i.e. equity capital, reinvested earnings or intra-company loans) is negative and is not been offset by positive amounts of other components, from an economic perspective this negative sign lacks real economic meaning and are usually considered the consequences of accounting methods (see Gouel et al. (2012), Bae and Jang (2014), Baronchelli and Uberti (2018) and Petkova et al. (2018)). Thereby, replacing the negative FDI stocks with a zero have become a common practice among some recent empirical studies (see, for instance Bae and Jang (2014) and Petkova et al. (2018)).

[17]It should be noted that the choice of variables was somewhat restricted by the availability of disaggregated Spanish data.

is the typical one for developed countries, with the services sector generating the highest value added, followed by industry. As regards the level of wages, the industry is the highest-wage sector, followed by services. This structure is maintained across regions.

Unemployment Rate (UR_{it}): defined by the annual unemployment rate. The effect of the unemployment rate on FDI could be either positive or negative. High levels of unemployment may draw in efficiency seeking FDI by increasing the availability of labour and the willingness of employees to work harder and for lower wages. However, unemployment can also reduce FDI by restricting incomes and spending power in host country markets. Furthermore, higher unemployment could also signal less competitive conditions and a lower quality of life that tend to discourage foreign investors.

Human Capital (HC_{it}): proxied by the share of population with tertiary education. Again, the effect of human capital on FDI can be argued to be positive or negative. The positive relationship accords with the OLI framework and the proximity-concentration HFDI theory. All other things being equal, regions with highly-skilled workers would be expected to compete more favorably than others in attracting FDI. Indeed, qualified workers attract FDI oriented to industrial sectors with higher demand and technology. Hence, higher human capital is expected to have a positive effect on FDI. However, if FDI was oriented to activities with a very low value added (following VFDI theories), it would seek cheap and less qualified workers. Hence, a negative association between skilled labour and FDI could also be expected.

Trade Openness (OP_{ijt}): defined by the sum of bilateral exports plus imports over GDP. According to the OLI framework, the HFDI and the knowledge-capital model, a reduction of barriers to external trade and, in general, a business-friendly economic climate would increase investment in general, thus attracting FDI as well. In addition, it is expected that MNEs would invest in trade-partner markets with whom they are already familiar. Numerous empirical studies suggest that trade (imports and exports) complements rather than substitutes FDI. Much of FDI is export-oriented and may also require the import of complementary, intermediate and capital goods. In either case, the volume of trade is enhanced and thus trade openness is generally expected to be a positive and significant determinant of FDI.

Differences in Relative Factor Endowments (RFE_{ijt}): proxied by differences in per capita GDP between the host and the source country. Following Mitze et al. (2008), the variable takes a minimum of zero for equal factor endowments in the two regions. According to the knowledge-capital model, differences in relative factor endowments determine VFDI. Vertical or export-oriented FDI is conducted in order to minimize production costs in the host country and then to export the output produced to the home country or to third countries. In this regard, the most important location factors are resource endowments.

Infrastructure (RI_{it},GCF_{it}): proxied by road infrastructure (RI_{it}) and gross capital formation (GCF_{it}). According to market seeking and/or efficiency seeking FDI, multinationals would look for regions with good infrastructure as it is needed for market access and it leads to higher pro-

ductivity. The empirical evidence usually supports a positive relationship between infrastructure variables and FDI.

Agglomeration Effects ($L.FDI_{ijt}$): proxied by one-year lagged FDI stock. A positive and significant coefficient of lagged FDI stock means the presence of foreign-specific agglomeration. According to the theory of agglomeration economies, once a country attracts the first mass of foreign investors, the process will become self-reinforcing, without needing a change in policies. The self-reinforcing effect of foreign investment allows new investors to benefit from positive spillovers by locating next to existing MNEs (Campos and Kinoshita (2003)).

It is worth to note that the above variables can be subject to sparse cross-dependencies and cross-correlations that may lead to collinearity problems in the estimation of the model giving to misleading results. In our case, the correlations matrix as well as some preliminary analysis indicated the presence of some collinearity. Hence, following Villaverde and Maza (2012), we implement an exploratory factor analysis (EFA) to reduce the initial number of explanatory variables to a set of non-collinear factors. Following Hair et al. (2010), firstly, we examine the data adequacy for conducting factor analysis by computing the Kaiser Meyer Olkin statistic (KMO). The KMO ranges from 0 to 1, with 0,50 considered the minimum threshold for a suitable for factor analysis. In our case, the KMO statistic is found to be 0.6 which indicates that the dataset is adequate for conducting factor analysis. Furthermore, in order to conduct EFA, the literature establishes that the sample size should be 100 or larger and that the ratio of observations per variable would be preferably 10:1 (Hair et al. (2010)). Our sample fulfills both criteria.

After diagonalizing the correlation matrix we obtain new variables, the factors, non-correlated among them. Deriving from the analysis of the eigenvalues and using as a criterium the cut-off value of greater than 1, we can get the number of factor to be retained (see Table 7). Our results show that the ten FDI determinants initially considered can be reduced to three significant factors explaining 62.07% of the cumulative variance of the nine original variables. As a next step, we examine the Pattern Matrix to identify the three factors with their constituent parts in Table 8. When examining the factor loadings greater than 0.5 in absolute value we can easily identify their location and provide names for each factor. It can be observed that gdp per capita, labour productivity, human capital, wage and gross capital formation belong to the first factor. It appears that all the first factor elements look like they are directly related to the region's economic potential. That is why we call this factor *Economic or Market potential*. The second factor includes unemployment rate and road infrastructure . We call this factor *Productive capacity*. Finally, the third factor consists of trade openness, differences in relative factor endowments and the lagged FDI stock and we call it *Competitiveness and agglomeration effects (Comp.& agglom.)*. We can now extract each factor scores and run the regression model specification with the factors as additional determinants of FDI.[18]

In the next Section we turn to the specification of the empirical model used in this paper, the

[18]Notice that the results are interpreted considering these three new dimensions: region's economic potential, productive capacity and competitiveness and agglomeration effects.

empirical methodology and the results found.

5. Econometric specification, methodology and estimation results

Although the gravity model (Anderson and van Wincoop (2003)) has been extensively employed by the trade literature to explain bilateral trade flows, its use to study bilateral FDI flows and FAS has been quite restricted until recently with the exceptions of the seminal papers by Eaton and Tamura (1994) and Wei (2000). One reason is that the transposition of the gravity model to study overseas investments was not supported by the theory. As our variable of interest is FDI and not FAS, we focus on the developments made by Head and Ries (2008), Bergstrand and Egger (2007) and Kleinert and Toubal (2010). In fact, Kleinert and Toubal (2010) refer to three different theoretical models of FAS to derive gravity equations that can yield an aggregate FDI equation. In particular, they rely on an horizontal model where firms can serve the foreign market j either by producing abroad or by exporting. They represent aggregate sales of foreign affiliates from firm i in j as follows:

$$n_i p_{ij} x_{ij} = n_i p_{ii}^{1-\sigma} \tau_{ij}^{(1-\sigma)(1-\in)} (1-\mu) Y_j P_j^{(\sigma-1)} \tag{1}$$

where n_i is the number of firms, p_{ij} the good price of firm i; x_{ij} is country j's consumption of variety from country i, τ_{ij} are the distance costs, Y_j the market size of country j and P_j the price index of country j.

According to Kleinert and Toubal (2010), the home country's market capacity can be denoted $s_i = n_i p_{ii}^{1-\sigma}$, while country's j's equivalent is $m_j = (1-\mu) Y_j P_j^{\sigma-1}$, and $AS_{ij} = n_i p_{ij} x_{ij}$ is bilateral foreign affiliates production. They express distance costs (τ_{ij}) as an increasing function of geographical distance between i and j, that is, $\tau_{ij} = \tau D_{ij}^{\eta_1}$. Then, equation 1 can be rewritten as:

$$AS_{ij} = s_i (\tau D_{ij}^{\eta 1})^{(1-\sigma)(1-\in)} m_j \tag{2}$$

where τ represents the unit distance costs and $\eta_1 > 0$.

The gravity equation can be then obtained by log-linearizing equation 2:

$$ln(AS_{ij}) = \alpha_1 + \zeta_1 ln(s_i) - \beta_1 ln(D_{ij}) + \xi_1 ln(m_j) \tag{3}$$

where $\alpha_1 = (1-\sigma)(1-\in) ln(\tau)$ and $\beta_1 = (\sigma-1)(1-\in)\eta_1$.

This setting is enlarged using some additional variables following Blonigen and Piger (2014). Moreover, as the variable we are interested in is inward FDI, most of the relevant determinants should be related to the destination countries or regions (Blonigen et al. (2007)).

Silva and Tenreyro (2006) argue that estimating a log-linearized equation like the one shown in Equation 3 by OLS results in bias. The conditional distribution of the dependent variable is altered and estimation by OLS would produce misleading estimates, as the t-values of the estimated

coefficients cannot be trusted.

They have proposed instead a PPML estimator which deals with this problem and provides consistent estimates of the original nonlinear model. The PPML estimator has a number of additional desirable properties. First, it is consistent under the presence of fixed effects; this is an important issue for the gravity approach since most theory-consistent models require the inclusion of fixed effects. Second, the PPML estimator naturally includes observations for which the FDI value is zero.

Actually, data in many country-pairs involve zero investment flows. In particular, in this study the proportion of zero inward FDI stock constitutes the 22,09% of the total. Ignoring this number of zeros would lead to misleading results.

Model specifications like the one in Equation 3 do not incorporate absolute zero flows since the natural logarithm of zero is undefined and is consequently dropped. Therefore, we rely on PPML estimator proposed by Silva and Tenreyro (2006) which takes the following general form:

$$y_i = exp[X_i\beta]\epsilon_i \tag{4}$$

In this equation, y_i is a dependent variable such that $y_i \geq 0$ and $E[\epsilon_i|x_i]$. Since we are using a count variable as dependent, i.e. a variable that is discrete and non-negative, the PPML method is an appropriate estimator with an increasing recognition in the empirical literature. Therefore, we rely on this estimator in the present paper.

Following the above discussions, the PPML estimator in the context of the current study would take the following form:

$$\begin{aligned} &FDI_{ijt} = \beta_0 + \beta_{1k}X_{ikt} + \beta_2 Z_{ijt} + \beta_{3l}D_l + \psi_j + \psi_t + \epsilon_{ijt} \\ &t = 1, ..., T, k = 1, ..., K, l = 1, ..., L \end{aligned} \tag{5}$$

where FDI_{ijt} represents inward FDI stock received by region i from country j in any period t. Matrix X_{ikt} denotes all k FDI long-run macroeconomic determinants specific to the region and correspond to the factors *Economic potential* and *Productive capacity* more closely associated with HFDI, while Z_{ijt} contains bilateral determinants such as trade openness, differences in factor endowments and the lagged of FDI stock which are included in factor *Competitiveness and agglomeration effects* mostly related to VFDI. D_l stands for additional variables. We have augmented the analysis with a group of variables to capture not only the traditional gravity issues, but also the institutional differences, either internal or external, related to the European Union that are relevant from the point of view of the regions. We denote *Distance* the geographical distance between the reporting country and the specific region; *Landlocked* takes the value 1 when the region has not access to the sea, and 0 for coastal regions; *FIS* takes the value 1 for those regions with special fiscal regime (i.e. the Basque Country, Navarre and the Canary Islands) and 0 for the remaining ones; *OBJ1* is one for the regions Objective 1 according to the criteria of the European Structural Funds and 0 otherwise; *Capital*

stands for a dummy variable that represent Madrid. We consider also the regional location quotient for the industry sector (*LQind*), measured as the relative share of industry GVA in the incumbent region compared to the national industry GVA share. Finally, *Crisis* is a dummy that captures the international financial crisis period. It takes the value 1 for the years 2008 and 2009 and 0 otherwise.

We also include country-origin fixed effects ψ_j to capture all those fixed effects of the investors, as well as time fixed effects ψ_t to control for business cycle effects over the sample period. ϵ_{ijt} is an error term such that $\epsilon_{ijt} \sim N(0, \sigma^2)$. Note that β_{1k} and β_{3l} are two vectors of k and l coefficients, respectively, associated to the explanatory region-specific variables and the dummies.

More formally, our empirical specification and the expected signs of the FDI determinants are as follows:

$$FDI_{ijt} = f \begin{pmatrix} MS_{it} & LP_{it} & W_{it} & UR_{it} & HC_{it} & OP_{ijt} & RFE_{ijt} & RI_{it}/GCF_{it} & L.FDI_{ijt} \\ (+) & (+) & (+/-) & (+/-) & (+/-) & (+) & (+/-) & (+) & (+) \end{pmatrix} \quad (6)$$

Previously in Section 4 we have conducted an exploratory factor analysis in order to reduce the above-mentioned explanatory variables to a set of non-collinear factors. We identified the following factors: *Economic potential*, *Productive capacity* and *Competitiveness and agglomeration effects*.

Therefore, taking into account the theoretical and empirical surveys of the literature as well as the main stylized facts, the present study proposes the following testing hypotheses:

- For the explanatory variables:

  H1: *Economic potential* positively influences the decision of a MNE to invest, that is, $\beta_{11} > 0$)

  H2: The relationship between *Productive capacity* and inward FDI will be positive, so that $\beta_{12} > 0$.

  H3: *Competitiveness and agglomeration effects* has a positive influence on inward FDI, $\beta_2 > 0$.

- For the dependent variable:

  H4: FDI stock data are more appropriate than flows in econometric FDI analysis.

Table 9 reports the results for the PPML estimator for different model specifications including the factors in logarithms. Column (1) presents the estimated coefficients for the baseline model; columns (2)-(6) are alternative augmented versions of the basic model in order to test for additional FDI determinants, represented by the variables described above. According to the overall indicator for the model's "fit", R^2, shows that all the specified models have a similar explanatory power of FDI (around $93 - 95\%$).

Taking a closer look at the estimated coefficients in column (1), FDI is positively and significantly related to the three factors: *Economic potential*, *Productive capacity* and *Competitiveness and agglomeration* of the regions. At this point it is worth to compare our results with earlier studies on regional FDI drivers. For the Spanish case, similar results were also found by Villaverde and Maza (2012).

Although not explicitly using the same variables, they perform a factor analysis and found, like us, that economic potential, labour conditions and competitiveness are important factors for attracting FDI. More specifically, the factor they labelled "labour conditions" is comprised in our *Productive capacity* factor and the factor they coined as "competitivenes" contains a trade openness indicator which is linked to our *Competitiveness and agglomeration* factor. However, our study uses a different dataset and applies a distinct econometric methodology. Compared to other previous studies, we find that unlike Pelegrín (2002), infrastructure, which is embedded in our productive capacity factor, is found to be a significant determinant for FDI. Besides, the positive effect of human capital, a variable comprised in our *Economic potential* factor, is in line with previous literature (Pelegrín (2002) and Rodríguez and Pallas (2008)). Similarly, results for labour productivity are in line with those obtained by Rodríguez and Pallas (2008). Finally, our results support also the agglomeration or self-reinforcing effects of FDI as in Head and Ries (1996) or Cheng and Kwan (2000) for Chinese regions. Table 10 provides a summary of the Spanish regional FDI determinants.

Column (2) additionally includes two traditional gravity factors, *Distance* and *Landlocked*. Unexpectedly, *Distance* is found to have no significant impact on inward FDI unlike the traditional empirical literature on gravity models but the coefficient has the expected negative sign in models (4) to (6). On a second thought, these results seem quite sensible as the distance may be important at a national level, but at the regional one is not relevant to explain the heterogeneous location of FDI across regions. As for the estimated coefficient of the dummy variable *Landlocked*, this one is found to be negative, as expected, and statistically significant in models (4) to (6) once the headquarter effect is controlled for through a dummy variable for Madrid (*Capital*).

In column (3) we extend the model to include a dummy variable *FIS* to control for those regions with different fiscal system (i.e. the Basque Country, Navarre and the Canary Islands). We find that the dummy is significant but the sign is negative, so that differences in fiscal regime may cause a negative effect on FDI. This result, that may initially seem striking as counterintuitive, can be somewhat justified when we include the dummy variable accounting for the headquarter effect as FDI attractor. We will comment on that in the next paragraph. Previous empirical evidence has introduced also fiscal variables in the analysis and obtained a significant and negative effect on FDI (see Rodríguez and Pallas (2008)). Additionally, in column (3) trying to capture other institutional effects, we also consider the role that the European structural policies may have on the regions and whether the affluence of European funds may stimulate FDI toward these regions. We have denoted this variable *OBJ1*. Yet, it is dropped from the analysis due to the existence of multicollinearity.

Column (4) includes a dummy for the capital city where the large majority of the MNE headquarters are located: Madrid (*Capital*). In columns (4) to (6) the dummy for Madrid has a positive and very significant influence on inward FDI. We should also emphasize that once this dummy is included, the effect of the fiscal variable (*FIS*) disappear. Moreover, both the first factor (*Economic potential*) and the second (*Productive capacity*) become insignificant. Yet, the latter becomes significant in models (5) and (6). The third factor, *Competitiveness and agglomeration* remains positive and

significant.

In an attempt to capture industry-specific specialization, column (5) includes the regional location quotient for the industry sector (*LQind*), calculated by comparing the relative share of industry's GVA in the region with the national share. We find a positive and significant effect in models (5) and (6) in line with the evidence found in Copenhagen Economics (2006) and Dimitropoulou et al. (2013). Thereby, the higher the degree of regional specialization in the industry sector is, the higher the attraction for FDI. This variable is consistent with the idea that positive externalites, such as knowledge creation (learning and innovation) and knowledge transfer (diffusion and synergies), that arise with the agglomeration of firms specialized in a particular sector are seen as an attractive factor for MNEs location. Indeed, the largest recipient regions of inward FDI (i.e. Madrid, Catalonia, Galicia, Asturias and the Basque country, as shown in Figure 2) are those that accounted for around 94% of FDI directed towards the industry sector in 2013 (see Table 1). Furthermore, this variable is also providing indirect evidence of a complementary relationship between FDI and trade as those sectors with high location quotient are usually export-oriented.

Finally, the global financial crisis is found to be non-significant (see column (6)), suggesting some degree of persistence in the behaviour of the FDI stock: although FDI flows decreased during the crisis, the stock has maintained its total size, as reflected in the aggregated data shown in Figure 1.

Overall, the models in columns (4) to (6) present the highest R^2 and the lowest AIC becoming candidates to be our chosen specifications.

We replicate the estimations for FDI inflows for the sake of comparison. Results are presented in Table 11. Even though we do not consider all the alternative models to be strictly comparable, the interpretation of the estimation results is in a similar vein. We find that *Economic potential* is a positive and significant determinant of FDI. However, the second factor (*Productive capacity*) and the third one (*Competitivenes and agglomeration*) appear to be non-significant. Gravity factors included in column (2) have the expected negative sign but are statistically non-significant in this specification. Yet, *Landlocked* becomes significant in models (3) to (6). FIS also has a negative and significant impact on FDI in columns (3) to (6) and, as before, *OBJ1* is dropped from the models because of multicollinearity. Columns (4) to (6) confirm that Madrid attracts more FDI in line with the FDI regional distribution presented previously. Furthermore, *LQind* remains positive and significant in models (5) and (6). Lastly, the dummy variable included in model (6) representing the financial crisis has, this time, a significant effect but the sign is positive. This is not surprising, as the financial crisis affects the flows of FDI but the stock is only affected in a lesser extent.

The Ramsey (1969) Regression Equation Specification Error Test (RESET) can be considered a general misspecification and omitted variables test for the estimated models, both for the FDI stock and flow specifications. This is essentially a test for the correct specification of the conditional expectation, by testing the significance of an additional regressor constructed as $(x'b)^2$, where b denotes the vector of estimated parameters (Silva and Tenreyro (2006)). The corresponding p-values are reported at the bottom of Tables 9 and 11, respectively. In the specifications using FDI inflows,

the test rejects the null hypothesis of a good specification. This means that these models are either inappropriate due to its functional form or that some relevant information is missing. In contrast, models estimated using FDI stocks clearly pass the RESET test. Thereby, the RESET test suggests that, for our empirical specification, FDI stock data are more appropriate than flows for the correct specification of the model of FDI long-run determinants.[19]

6. Concluding remarks

In the last decades, understanding the factors that determine FDI has attracted an intense academic and policy-oriented interest. This paper feeds the discussion conducting an empirical investigation to identify the main driving forces for FDI activity directed towards the Spanish regions. In addition to the regional dimension itself, this paper makes three contributions to the literature: first, our research represents one of the first attempts to find the main determinants of inward FDI into Spanish regions using FDI stock instead of flows. We have compared, for the sake of robustness, the estimation results using the two definitions of FDI and concluded that the stock model was a superior model specification. Second, we use the PPML estimator which produces unbiased and consistent estimates when the dependent variable includes a large proportion of zero observations, as it turns out to be our case. Third, we have implemented an exploratory factor analysis to reduce the number of explanatory variables and avoid collinearity problems in the estimation.

We have identified three factors as FDI determinants that, according to the variables they include, were labeled as *Economic potential*, *Productive capacity* and *Competitiveness and agglomeration*. The first two factors are more closely related to HFDI while the third one is to VFDI. The empirical analysis revealed the following allocation patterns: as expected, FDI locational strategies in the Spanish regions are determined significantly by the relative competitiveness of the regions, the agglomeration effects and, to a lesser extent, by the productive capacity or the market size. This is a sensible outcome since FDI at the regional level cannot be expected to be market seeking but an efficiency seeking one, intending to fit in the global value chains developed by the multinational production strategies of transnational companies. Therefore, at a regional level the FDI drivers are linked to vertical strategies, where endowment differentials and trade openness have shown themselves to be vital. This finding supports the view of a complementary relationship between trade and FDI, a result common to the majority of empirical studies on trade-FDI linkages.

The agglomeration or self-reinforcing effect of FDI is found to be an important driver for FDI location. In the presence of agglomeration, investors decide to locate near existing MNEs in order to benefit from positive externalities such as knowledge spillovers, specialized labor, and intermediate inputs. Our results also show that the degree of industrial specialization of the regions is a major driving force for MNEs locational choice. The agglomeration of firms specialized in a particular

[19] We have also repeated the exercise of all the before-mentioned estimations applying OLS instead of PPML as a robustness check and the results obtained point to a superior performance of the PPML method compared to OLS. All these results are not reported in the paper but are available from the authors upon request.

sector generates positive externalities that influence the attractiveness of that region as a potential FDI location as opposed to competing regions without industry clustering. Furthermore, our analysis points out that FDI location depends upon the geographical position of each region, stressing the importance of coastal areas; this means that transport infrastructures and interconnectedness matter as FDI attractors.

Finally, although a sectoral breakdown of FDI stock data is not available and hence, we are not able to conduct a more disaggregated analysis, the findings in this paper give some clues about the factors that regions should emphasize in order to attract FDI. Results point out to regional competitiveness and agglomeration factors as the most efficient ways for a region to attract FDI. More specifically, given the loading of each variable inside this factor, we think that future policies should promote internationalization as well as factor endowment improvements. From a regional policy perspective, industry cluster formation is also important to attract foreign investors. Furthermore, a region wishing to attract FDI should promote policies encouraging an adequate transport infrastructure and the quality of labor by increasing human capital and labour productivity.

7. Compliance with Ethical Standards

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Table 1: Sectoral distribution of gross inward FDI flows in Spanish regions, Millions of euros, No-ETVE

	2004					2013				
	Total	Agriculture	Industry	Construction	Services	**Total**	Agriculture	Industry	Construction	Services
Andalusia	242.83	6.10	21.94	37.14	177.65	149.87	4.71	13.79	23.45	107.92
Aragon	46.28	0	33.09	4.20	8.99	104.87	0	76.19	0.08	28.60
Cantabria	1.05	0	0	0.01	1.04	15.54	2	0.01	1.23	12.31
Castile and León	5.28	0.14	1.82	0.02	3.30	171.08	0.5	81.99	1.66	86.93
Castilla-La Mancha	36.33	0	29.61	2.43	4.28	24.52	3	2.53	0.004	18.99
Catalonia	1400.78	5.09	687.65	61.19	646.84	3464.95	4.44	1395.55	86.94	1978.02
Madrid	3414.73	3.53	526.99	213.12	2671.07	7172.54	4	1517.77	279.33	5371.45
Valencian Community	659.15	5.64	176.30	9.80	467.41	160.46	4.46	20.30	14.32	121.38
Extremadura	1.76	0.06	0.86	0	0.84	12.25	12.15	0.04	0.001	0.05
Galicia	31.74	0.4	22.68	4.14	4.52	221.50	0.25	165.85	37.04	18.34
Balearic Islands	89.03	0	0.04	43.25	45.73	759.29	7.54	0.34	45.33	706.08
Canary Islands	247.09	0.55	0.02	2.09	244.44	35.99	0.25	0.18	0.89	34.66
Navarre	1.12	0.24	0.87	0	0.01	62.22	0	1.39	0	60.83
La Rioja	1530.76	0.59	1524.20	0.005	5.95	43.77	0.003	29.87	0.19	13.70
Basque Country	255.17	0.003	84.41	1.29	169.46	290.34	0	165.22	10.43	114.70
Asturias	610.12	0.001	593.99	0.13	15.99	872.50	0	851.01	0	21.49
Murcia	326.46	1.70	309.90	0.06	14.80	43.85	1.80	36.34	0.003	5.71
Spain	**8910.44**	**24.06**	**4022.37**	**379.01**	**4484.99**	**13605.93**	**45.12**	**4358.39**	**500.89**	**8701.53**

Notes: Inward foreign investment from the 40 source countries included in our study. *Source: DataInvex.*

Table 2: Data description and source

Variable name	Description	Source
$FDIin_{ijt}$	Inward FDI stock, in millions of euros (current values)	DataInvex[a]
$FDIinflow_{ijt}$	Inward FDI flows, in millions of euros (current values)	DataInvex
MS_{it}	Gross Domestic Product per capita (current EUR)	INE[b]
LP_{it}	GDP (current EUR) per total employment	INE
W_{it}	Employee's compensation per hour worked, calculated as the ratio of total compensation (current EUR) per hours worked	Eurostat
UR_{it}	Unemployment rate	INE
HC_{it}	Share of population with Tertiary Education[c]	Ivie[d]
OP_{ijt}	Sum of bilateral exports and imports as a share of GDP(%), in millions of euros (current values)	DataComex [e]
RFE_{ijt}	GDP per capita difference between host region and parent country (current EUR)	INE, World Bank
RI_{it}	Motorways kilometers	Eurostat
GCF_{it}	Gross capital formation (% of GDP) (current values)	Ivie, INE
$L.FDIin_{ijt}$	1-year lag of inward FDI stock, in millions of euros (current values)	DataInvex
Distance	Log of distance between region capital for Spain and national capital for the parent country, in km	Own elaboration
Landlocked	1 if host region is landlocked and 0 otherwise	Own elaboration
FIS	1 for those regions with special fiscal regime (the Basque Country, Navarre and the Canary Islands) and 0 otherwise	Own elaboration
OBJ1	1 if host region is considered Objective 1 according to the criteria of the European Structural Funds and 0 otherwise	European Commission[f]
Capital	1 for Madrid and 0 otherwise	Own elaboration
Crisis	1 for the years 2008 and 2009 and 0 otherwise	Own elaboration
LQind	Log of the regional location quotient for the industry sector, measured as the relative share of industry gross value added (GVA) in the incumbent region compared to the national industry GVA share.	INE

[a]Spanish Ministry of Economy and Competitiveness
[b]Spanish Statistical Institute
[c]Tertiary Education includes "FP II", "Anteriores al Superior" and "Superiores".
[d]Fundación Bancaja e Ivie (Instituto Valenciano de Investigaciones Económicas). Capital Humano en España y su distribución provincial. Enero de 2014. Database available on: http://www.ivie.es/es/banco/caphum/series.php
[e]Spanish Ministry of Industry, Tourism and Trade
[f]Directorate-General for Regional and Urban Policy

Table 3: Descriptive statistics

Variable		Mean	Std.dev.	Min.	Max.	Obs.
$FDIin_{ijt}$	Overall	331.3704	2084.274	0	38082	N=6800
	Between		2023.563	0	29193.1	n =680
	Within		504.7879	-8595.33	11864.77	T=10
$FDIinflow_{ijt}$	Overall	21.18571	312.3285	0	18021.7	N=6800
	Between		146.0353	0	2591.995	n =680
	Within		276.1358	-2287.903	16147.48	T=10
MS_{it}	Overall	22263.52	4389.056	13117.98	32151.92	N=6800
	Between		4204.211	15421.66	30298.7	n=680
	Within		1269.576	18085.13	24596.31	T=10
LP_{it}	Overall	58628.89	26651.64	36836.03	188178.9	N=6800
	Between		25215.97	44311.21	156920.2	n=680
	Within		8677.923	-26979.1	89887.63	T=10
HC_{it}	Overall	0.1950035	0.0429806	0.1134766	0.3000077	N=6800
	Between		0.0408146	0.1388397	0.2862831	n=680
	Within		0.0135538	0.157349	0.2263087	T=10
OP_{ijt}	Overall	0.0078201	0.0163329	2.43e-08	0.1848764	N=6800
	Between		0.0160351	1.63e-06	0.1581036	n=680
	Within		0.003159	-0.0210068	0.054379	T=10
RFE_{ijt}	Overall	13959.61	10817.48	3.105469	70319.9	N=6800
	Between		10167.72	638.0404	59443.57	n=680
	Within		3711.085	-2557.866	31233.15	T=10
UR_{it}	Overall	14.87141	7.513715	4.72	36.22	N=6800
	Between		3.804143	9.797	22.764	n=680
	Within		6.481016	4.006412	28.32741	T=10
W_{it}	Overall	14.34223	2.142297	9.782425	19.53279	N=6800
	Between		1.683675	12.09357	17.93362	n=680
	Within		1.326058	11.47515	15.96533	T=10
RI_{it}	Overall	784.1412	636.51	57	2462	N=6800
	Between		626.2473	88.8	2282.4	n=680
	Within		116.0968	247.9412	1063.441	T=10
GCF_{it}	Overall	36.0575	11.6485	18.9108	59.72894	N=6800
	Between		11.39165	19.94766	54.45922	n=680
	Within		2.467734	30.85473	43.03918	T=10
$L.FDIin_{ijt}$	Overall	329.4655	2100.268	0	38082	N=6120
	Between		2042.544	0	29769.78	n=680
	Within		494.5683	-8157.646	11997.58	T=9

Notes: All the variables are in levels.

Table 4: Cross-correlation table

Variables	MS_{it}	LP_{it}	HC_{it}	OP_{ijt}	RFE_{ijt}	UR_{it}	W_{it}	RI_{it}	GCF_{it}	$L.FDIin_{ijt}$
MS_{it}	1.000									
	6800									
LP_{it}	0.6181*	1.0000								
	(0.0000)									
	6800	6800								
HC_{it}	0.7695*	0.5577*	1.000							
	(0.000)	(0.000)								
	6800	6800								
OP_{ijt}	0.1184*	0.0427*	0.1341*	1.000						
	(0.000)	(0.0004)	(0.000)							
	6800	6800	6800	6800						
RFE_{ijt}	-0.0184	0.0064	0.0096	-0.1706*	1.000					
	(0.1292)	(0.5993)	(0.4292)	(0.000)						
	6800	6800	6800	6800	6800					
UR_{it}	-0.3836*	-0.0560*	-0.1670*	-0.0731*	0.0819*	1.000				
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
	6800	6800	6800	6800	6800	6800				
W_{it}	0.8017*	0.6061*	0.7989*	0.0867*	0.0254*	0.1393*	1.000			
	(0.0000)	(0.0000)	(0.000)	(0.0000)	(0.0364)	(0.0000)				
	6800	6800	6800	6800	6800	6800	6800			
RI_{it}	-0.2655*	-0.0370*	-0.2047*	0.0120	0.0208	0.2700*	-0.0831*	1.000		
	(0.000)	(0.0023)	(0.0000)	(0.3228)	(0.0869)	(0.000)	(0.0000)			
	6800	6800	6800	6800	6800	6800	6800	6800		
GCF_{it}	-0.5766*	-0.3777*	-0.2195*	-0.0333*	0.0300*	0.2150*	-0.3339*	0.2423*	1.0000	
	(0.000)	(0.000)	(0.000)	(0.0060)	(0.0134)	(0.000)	(0.0000)	(0.000)		
	6800	6800	6800	6800	6800	6800	6800	6800	6800	
$L.FDIin_{ijt}$	0.2075*	0.3473*	0.1697*	0.2198*	-0.0594*	-0.0301*	0.2086*	0.0109	-0.1536*	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.0185)	(0.0000)	(0.3930)	(0.0000)	
	6120	6120	6120	6120	6120	6120	6120	6120	6120	6120

Table 5: Countries included in the study

Source countries				
OECD				
Australia	Estonia	Ireland	Netherlands	Slovenia
Austria	Finland	Israel	New Zealand	Sweden
Belgium	France	Italy	Norway	Switzerland
Canada	Germany	Japan	Poland	Turkey
Chile	Greece	Korea, Republic of	Portugal	United Kingdom[g]
Czech Republic	Hungary	Luxembourg	Slovak Republic	United States
Denmark	Iceland	Mexico		
Non-OECD				
Argentina	China	Hong Kong	Singapore	
Brazil	India	Russian Federation		

[g]Since the 2016 referendum vote to leave the EU, the UK is on course to leave the EU.

Table 6: Gross value added (GVA) and wages by sector and region, 2010.

	GVA			Wages		
	Industry	Construction	Services	Industry	Construction	Services
Andalusia	16.614.034	13.548.900	96.529.409	17,02	14,55	15,08
Aragon	7.381.593	2.964.839	19.581.313	19,79	15,24	16,25
Cantabria	2.570.365	1.255.569	7.722.694	20,32	15,28	15,11
Castile and León	10.961.019	4.582.546	32.752.292	18,81	13,53	15,30
Castilla-La Mancha	7.226.701	4.032.910	22.367.302	16,78	13,52	15,79
Catalonia	38.933.793	14.301.827	130.732.544	21,27	16,10	16,95
Madrid	19.017.886	12.333.904	149.783.526	21,88	16,33	19,18
Valencian Community	16.261.288	9.682.957	65.685.541	16,68	14,56	15,19
Extremadura	2.110.368	1.968.227	11.346.594	14,27	11,63	15,21
Galicia	10.421.849	5.403.221	33.897.441	16,04	13,32	14,72
Balearic Islands	2.053.226	2.101.212	19.738.430	16,71	13,19	15,47
Canary Islands	3.472.665	2.939.545	30.750.777	15,92	13,38	15,30
Navarre	5.077.599	1.406.313	9.685.817	22,22	19,70	16,95
La Rioja	2.060.606	697.774	4.181.096	17,67	14,46	15,47
Basque Country	16.390.237	5.317.238	38.015.463	23,64	18,62	17,87
Asturias	4.855.996	2.073.347	13.695.672	22,18	17,23	15,31
Murcia	4.436.025	2.692.043	17.478.263	15,52	13,57	14,93

Note: Gross value added (GVA) is expressed in thousand of euros (current values) whereas wages is measured as employee's compensation per hour worked (current EUR). *Source:* INE and Eurostat.

Table 7: Factor analysis. Total variance explained.

Factors	Eigenvalue	% Variance	Cumulative % variance
1	**3.59615**	**0.3596**	**0.3596**
2	**1.35632**	**0.1356**	**0.4952**
3	**1.25446**	**0.1254**	**0.6207**
4	0.90239	0.0902	0.7109
5	0.84590	0.0846	0.7955
6	0.76595	0.0766	0.8721
7	0.69710	0.0697	0.9418
8	0.39292	0.0393	0.9811
9	0.15156	0.0152	0.9963
10	0.03725	0.0037	1.0000

Notes: The three extracted factors are shown in bold.

Table 8: Factor analysis. Rotated component matrix.

Variable	Factor 1 (Economic potential)	Factor 2 (Productive capacity)	Factor 3 (Comp. & agglom.)	Communalities
MS_{it}	**0.8650**	-0.4063	0.0596	0.9168
LP_{it}	**0.8044**	0.0717	0.0944	0.6611
HC_{it}	**0.8338**	-0.1360	0.0343	0.7149
OP_{ijt}	0.0706	-0.0240	**0.7553**	0.576
RFE_{ijt}	0.1053	0.1937	**-0.6216**	0.435
UR_{it}	-0.0627	**0.8012**	-0.1345	0.6639
W_{it}	**0.9231**	0.0907	-0.0043	0.8603
RI_{it}	-0.1524	**0.6808**	0.1400	0.5062
GCF_{it}	**-0.5113**	0.4095	-0.0053	0.4292
$L.FDIin_{ijt}$	0.3444	0.1739	**0.5429**	0.4436

Notes: The variables loading on each factor are shown in bold.

Table 9: PPLM Estimates of the Spanish inward FDI stock determinants, 2004-2013.

	Dependent variable: Inward FDI stock					
	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
Economic Potential	0.313***	0.371**	0.391**	0.015	0.151	0.151
	(2.780)	(2.553)	(2.521)	(0.121)	(1.162)	(1.162)
Productive capacity	0.139**	0.139**	0.121*	0.048	0.110**	0.110**
	(1.975)	(1.972)	(1.808)	(1.098)	(2.323)	(2.323)
Comp. & agglom.	0.727***	0.736***	0.732***	0.773***	0.621***	0.621***
	(4.607)	(4.632)	(4.534)	(5.596)	(4.984)	(4.984)
Distance		0.068	0.071	−0.319	−0.214	−0.214
		(0.092)	(0.095)	(−0.433)	(−0.350)	(−0.350)
Landlocked		−0.191	−0.216	−2.162***	−2.621***	−2.621***
		(−1.129)	(−1.230)	(−4.002)	(−5.336)	(−5.336)
FIS			−0.421**	−0.140	−2.082**	−2.082**
			(−1.969)	(−0.672)	(−2.282)	(−2.282)
Capital				2.652***	7.393***	7.393***
				(4.197)	(3.296)	(3.296)
LQind					6.692**	6.692**
					(2.103)	(2.103)
Crisis						0.096
						(0.510)
R^2	0.939	0.938	0.940	0.954	0.957	0.957
Investing country FE (j)	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	218	218	218	218	218	218
RESET test $p-values$	0.5116	0.8925	0.9956	0.2678	0.2421	0.2421
AIC	200769.8	197324.5	196002.3	145981.1	132267.3	132267.3

Notes: Country pair clustered standard errors are in parentheses. *, ** and *** denote significance at 10%, 5%, and 1% significance levels, respectively. Factors are included in logarithms. OBJ1 was included in models (3) to (6), but it is dropped because of multicollinearity.

Table 10: Summary of Spanish regional FDI determinants

Author(s)(year)	Level	Dependent variable	Time period	Estimation technique	Determinants	Effect
Pelegrín, A. (2002)	Regional	FDI inflows/GDP	1998-2000	OLS	Market size	(+)
				LSDV	Human capital	(+)
				GLS	Public incentives	(+)
					Labour cost	(+)
					Infraestructure	(0)
Pelegrín, A. and Bolancé, C. (2008)	Regional and sectoral	FDI inflows	1995-2000	Random Effects	Same industry activity	(+)
					Comparative Advantage	(+)
					R&D agglomeration	(+)
					Wage	(-)
Rodríguez, X.A. and Pallas, J.(2008)	Regional and sectoral	FDI inflows	1993-2002	GLS	Demand factors	(+)
				W2SLS	Labour productivity and its cost differential	(+)
					Human capital	(+)
					Export potential	(+)
					Fiscal pressure	(-)
					Inflation differential	(-)
Villaverde, J. and Maza, A. (2012)	Regional and sectoral	FDI inflows/GDP(POP)	1995-2005/2008	Factor Analysis	Economic potential	(+)
				GLS	Labour conditions	(+)
				Two-stage GLS	Competitiveness	(+)
					Market size	(0)
Gutiérrez-Portilla, P. et al. (2016)	Regional and sectoral	FDI inflows/GDP	1997-2013	GMM	Market size	(+)
				GLS	Human capital*Wages	(+)
					Capital dummy	(+)
					Lag FDI	(+)

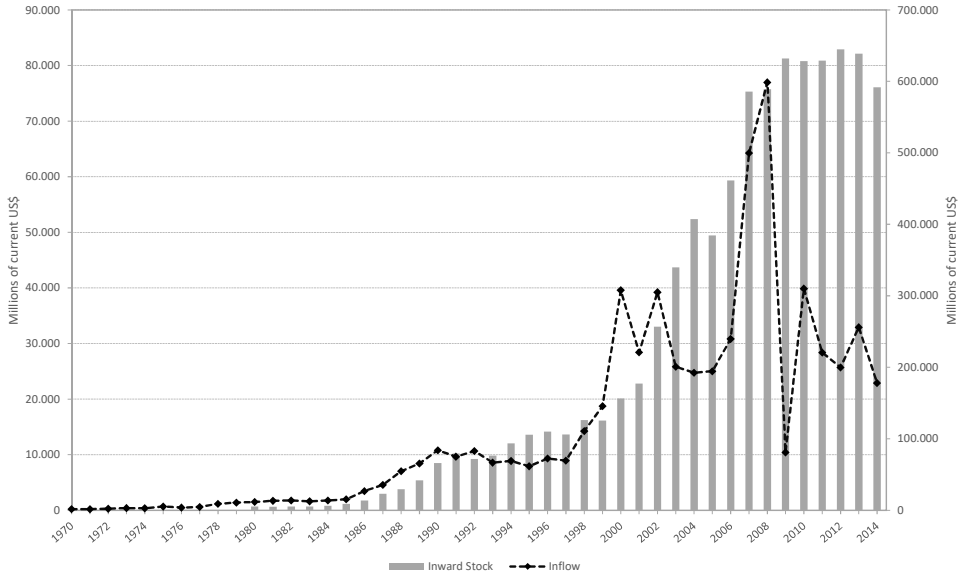
Notes: (+) and (-) denote a positive and negative statistically significant effect, respectively. (0) denotes no statistically significant effect. *Source:* Own elaboration.

Table 11: PPLM Estimates of the Spanish FDI inflow determinants, 2004-2013.

	Dependent variable: FDI inflow					
	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
Economic Potential	1.064***	1.347***	1.577***	1.001***	1.488***	1.488***
	(5.620)	(4.951)	(4.522)	(3.478)	(4.106)	(4.106)
Productive capacity	−0.126	−0.144	−0.183	−0.169	−0.084	−0.084
	(−0.636)	(−0.668)	(−0.833)	(−0.771)	(−0.348)	(−0.348)
Comp. & agglom.	0.141	0.091	−0.017	−0.006	−0.200	−0.200
	(0.680)	(0.352)	(−0.061)	(−0.022)	(−0.790)	(−0.790)
Distance		−1.098	−1.188	−1.502	−2.158	−2.158
		(−0.855)	(−0.812)	(−0.997)	(−1.234)	(−1.234)
Landlocked		−0.366	−0.615**	−2.504***	−4.138***	−4.138***
		(−1.148)	(−2.314)	(−4.870)	(−5.136)	(−5.136)
FIS			−3.607***	−3.136***	−8.549***	−8.549***
			(−6.421)	(−6.368)	(−4.062)	(−4.062)
Capital				2.703***	15.866***	15.866***
				(3.974)	(3.291)	(3.291)
LQind					18.397***	18.397***
					(2.649)	(2.649)
Crisis						2.412***
						(3.244)
R^2	0.737	0.740	0.734	0.734	0.738	0.738
Investing country FE (j)	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	244	244	244	244	244	244
$RESET$ test $p-values$	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
AIC	62199.69	61302.97	59363	58274.53	55601.82	55601.82

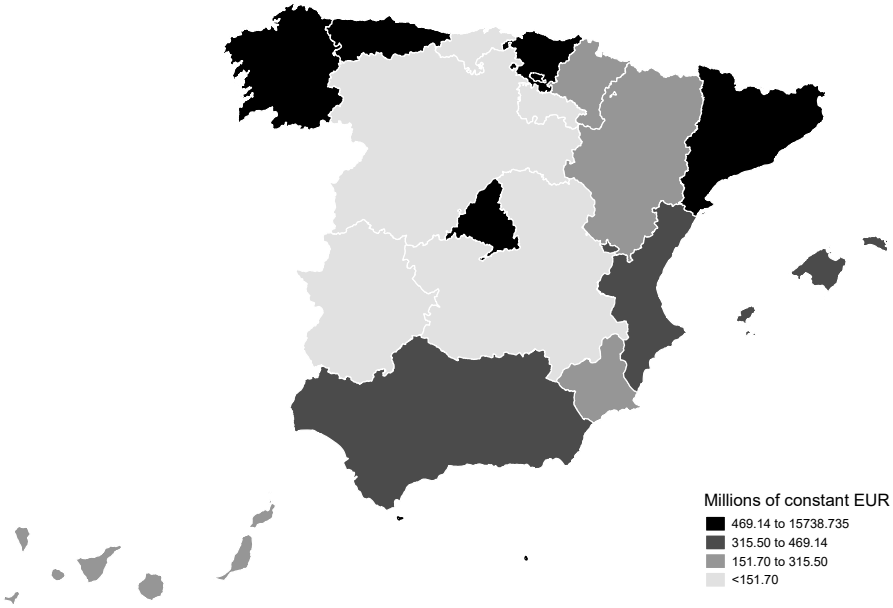
Notes: Country pair clustered standard errors are in parentheses. *, ** and *** denote significance at 10%, 5%, and 1% significance levels, respectively. Factors are included in logarithms. OBJ1 was included in models (3) to (6), but it is dropped because of multicollinearity.

Figure 1: Foreign Direct Investment in Spain.



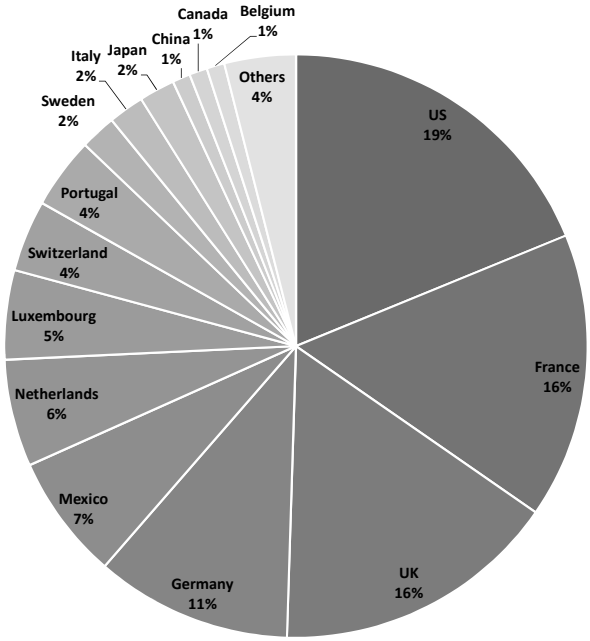
Source: UNCTAD database.

Figure 2: Spatial distribution of average inward FDI stock (2004-2014).



Source: DataInvex.

Figure 3: Main investors in Spain: Average FDI stock for the 2004-2014 period, in percent.



Source: DataInvex.