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Pattern of Interdependence of Aggregate FDI from the Same Source Country

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Abstract

This paper explores the possibility that monitoring resources explain the clustering in space of aggregate FDI from the same source country. Theoretically, the paper shows that independently of any institutional incentive setting, costly monitoring incites headquarters to locate new plants where monitoring resources are relatively cheap. Clustering of firms from the same source country is therefore interpreted as information sourcing. Empirical application finds that the importance of geographic neighbors to the location choice of US non-manufacturing FDI in Europe conform to the advanced hypothesis.

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1 Introduction

The study of cross-host countries effects in the pattern of flows of foreign direct investments is quite recent. While the extant FDI literature contends that direct investment location decisions are based on characteristics proper to the host country, several recent studies in economic geography reveal that the effects of various agglomeration externalities and spillovers are crucial in explaining FDI location. These studies emphasize proximity among firms as an important factor in the process of transmission of externalities between foreign and local firms. Empirically, these contributions indicate that in different countries FDI tends to cluster in certain regions and new flows of investments are likely to be closer to old ones. In effect, the clustering of firms with horizontal or vertical relationship, generates productivity and wage spillovers that operate through various channels[1]. Drawing upon this literature, this paper explores the possibility that spillovers justify the clustering in space of FDI from the same source country.

Current FDI literature addresses issues related to proximity around two majors concerns. First, many authors question whether and when spillovers to local economy occur. The conventional analysis, outlined by Blomstrm and Kokko (1996), for instance, suggests that technology and managerial skill spillovers can be realized when local firms invest in new tools and procedures. It follows that FDI incentives motivated by expectations of spillovers to local firms should be accompanied by financial and technical preparation of those firms (Blomstrm and Kokko, 2003, 1996). Second, the literature questions the motives of multinational firms when they locate closer to existing firms. Building on the work of Marshall (1960), various contributions emphasize positive agglomeration effects resulting from the clustering of firms. They suggest that agglomeration effects attract new investments (Wheeler and Mody, 1992; Love, 2003). Love (2003) suggested for example that new firms might be sourcing technology, therefore locating close to leading research centers in areas where the source country is relatively less skilled, with the hope of absorbing learning spillovers. However, empirical investigation of this claim produced mixed results. Driffield and Munday (2000) did not find evidence of such behavior in a panel of

[1] See Lipsey (2002)for an extensive review of literature on FDI spillovers within the host country

FDI in the United Kingdom (UK) manufacturing industry. They concluded that profit seeking motivates location of new firms, even when close to older firms. Nevertheless, Branstetter (2001) suggested that technology sourcing motivated the increase in Japanese investments in the US in the second half of 1980. However, even in this case, sourcing of spillovers benefited only firms located in the same country. Attempts to study interdependence of foreign direct investments flows or stock across neighboring countries, have been limited to the role that economic integration plays in the increase in FDI received by member countries (Neary, 2002; Balasubramanyam, Sapsford, and Griffiths, 2002; Girma, 2002).

Economics and statistics motives suggest that in analyzing FDI the actual treatment of interdependence between outflows or between stocks is incomplete. From an economic standpoint, even in the absence of economic integration[2] among countries, three motives may create cross-country interdependence of stock and flows of FDI. First, the ability of countries to attract FDI can be related to their geographic location, because natural resources endowments, geophysical shocks, and epidemics cause correlation of outflows to geographic neighbors (Weinhold, 2002). Second, the presence of multinational corporations (MNC) creates externalities that cannot be fully internalized (Lipsey, 2002). For example, local firms can either replicate an MNCs knowledge and technology without additional cost, or can face stiff competition that forces them to find ways to survive[3]. At any rate, limiting replication of technology or competition to a single country seems to be against accepted ideas of propagation of skills and knowledge across countries (Lucas, 1990; Krugman, 1991). Unless the MNC adopts preventive measures to reduce spillovers, neighbors of the host country could also benefit from knowledge and technology spillovers from the MNC[4] to them. Third, and finally due to the strong profit-seeking motive for FDI a high GDP is a great motivation to attract new flows of FDI. The economic growth literature argues that GDP growth rates are correlated across countries (Conley and Ligon, 2002; Weinhold,

[2]European Integration is a possible reason that Portugal, Ireland, and Spain have recently emerged as second best locations for new flows of total investment. See, for example, Barry (2003).

[3]See Blomstrm and Kokko (1996) for the channels of transmission of spillovers

[4]Branstetter (2001), shows that for Japanese and US firms, intra-national knowledge spillovers are more important in scope. He, however, does not rule out the existence of international spillovers. Also see Keller (2004) for the idea of MNC preventing the diffusion of technology

2002). Growth rate correlation is generally explained by similar macroeconomic shocks in aggregate trade and investments. Similarity of shocks supposes possible correlation of inflows of investment. The hypothesis in this paper is that correlation of FDI flows may arise because information contained in US investment stock in a country encourages new investment flows to its neighbors. From a statistical standpoint, if there is dependence between flows or between stocks of FDI across neighboring countries, spillovers may be present and may lead to bias in an analysis based only on a host country's characteristics. Figures 1 and 2 display such pattern of autocorrelation around the world in FDI from the US and Japan.

This paper departs from existing FDI literature in two ways. First, the paper introduces a model for FDI location under information asymmetry. Current analysis of spillovers is presented as technology diffusion or market size effects from the ownership internalization and location (OLI) literature. The usual presentation is an extension of the non formal pull and push approach to capital flows. This is, to our knowledge, the firs attempt to model aggregate flows in an information asymmetry perspective. Second the paper applies the model to aggregate flows from the United States. Thus, spillovers across countries are explicitly introduced as a determinant of foreign direct investment. The traditional capital flow perspective justifies flows by profits and factor costs considerations within the host country. To the best of our knowledge, there is no clear attempt to question the importance of capital flows to third countries in the aggregate flows literature. Attempts in the OLI literature have considered market size motive and profit seeking motives stemming from third countries (Baltagi, Egger, and Pfaffermayr, 2008, 2007). They do not, however, consider the influence of the presence of firms in neighboring countries. In this study the significant influence of neighbors stocks of investment will suggest that there may be a bias in previous research. Countries can also view their geographical proximity to leading investment centers as a possible reason to be an alternate investment location (complementary or substitute location). The use of panel data technique in this paper allows us to work around endogeneity problems that are frequent in cross section analysis. It will also be possible to capture the magnitude of the importance of the spatial variable (neighbor's variable) as a determinant of FDI. Finally, using manufacturing and non-manufacturing FDI as alternate dependent variables help improve our understanding of spillovers.

After a brief literature review (Section 2), a model for FDI location under information asymmetry is developed(Section 3). An empirical estimation of the derived equation tests the importance of neighbors' stock investments of foreign direct investment in Section 4. Section 5 concludes the paper and derives some implications of the study.

2 Neighbor's Effects in the FDI Literature

Within the current dominant paradigm, where FDI is explained by ownership, location, and internalization (Dunning, 1988), it is admitted that the presence of a Multinational Corporation (MNC) affects local firms through productivity and wage spillover.

Productivity spillovers arise because ownership advantages attached to tangible and intangible assets are easily transferable and can be replicated at low cost. Policymakers find the presence of MNC attractive because they expect advantages to spillover to local firms. Blomstrm and Kokko (1996); Lipsey (2002); Keller (2004, 2002) support this opinion. Wage spillovers, on the other hand, arise when the presence of a multinational affects the average wage rate in the country[5]. There are mixed views in the literature on wage spillovers.

Current FDI literature explores three main channels through which the presence of an MNC improves the productivity of local firms: linkages among firms (vertical and horizontal, backward and forward) as well as competition and technology. First, regarding linkages between foreign and local firms, spillovers can happen in horizontal relationships, such as technology transfers, training, and demonstration effect within one industry; and in vertical relationships, supply or demand contacts between the MNC and local firms incite similar transfer. For example, Love (2003) reported that defections from an MNC contributed to production efficiency of domestic industries in Mexico. He did not report, however, the characteristics of the firms hiring trained workers or their locations with re-

[5]See Lipsey (2002) for a literature review of international diffusion of technology through FDI and through exports

spect to the MNC.

Second, regrading competition, the presence of foreign firms may affect the cost structure of local firms through factor price effects, and through the quality of hired workers.Nevertheless, an important branch of this literature insists that the overall effect of the presence of an MNC for local firms is negative (Aitken and Harrison, 1999; Djankov and Hoekman, 2000; Haddad and Harrison, 1993).

Third, regarding technology spillover, the hypothesis is that through all relationships taken together (observation, demonstration effect, hiring of trained workers, backward and forward relationships), knowledge and technology spillovers to local firms are achieved. Empirically, Branstetter (2001) found such evidence in the increase in the flow of knowledge spillovers to and from Japanese firms in the US. Yeaple (2003) also found evidence of technology spillovers in developed countries. Nonetheless, other studies report the lack of evidence of productivity spillovers in developing countries and question the direction of spillovers when agglomeration exists (Haddad and Harrison, 1993). Blomstrm and Kokko (1996) argued that in most countries local firms needed the capacity to benefit from spillovers, thus the pattern of knowledge and technology transmission needed clear definition. To this effect Javorcik (2004) adds that the existence of spillovers is associated with shared ownership of the multinational affiliate.

The issue of the direction of spillovers is still contentious. If foreign to domestic spillovers depends on the preparation of local firms, and happens within uncertain geographic range, domestic to foreign spillovers is still a possibility that depends on the relative technological intensities of the source and host nations (Pearce, 1999; Serapio Jr. and Dalton, 1999; Love and Lage-Hidalgo, 2000; Love, 2003). The evidence so far is that foreign firm are attracted by agglomeration effects in general (e.g., trained workers and consumers), and the possibility of technology sourcing. In this respect, some studies report that in technology intensive industries inward FDI from countries with relatively less technology, tended to locate closer to firms of the same industry (Driffield and Munday, 2000; Love, 2003). They are however cautious in concluding that these were clear cases of technology sourcing.

Empirical evidence on wage spillovers is more mixed. While high wages paid by multinational companies may not always increase the average wage level in the manufacturing industry **??** the average level of wages paid by all local firms may increase as in Lipsey

(2002). Girma (2002) specifically tested for wage spillovers to domestic firms in their UK company data set for 1991-96 and found no overall spillover effect on wage levels nor a lower negative effect on wage growth (p. 128). However, in a cross section of Indonesian manufacturing data Lipsey and Sjholm (2004) found that the presence of foreign firm significantly raises the average wage paid by local firms (which is evidence of spillover).
In conclusion, spillovers happen through technology and wages. Evidence on both types of spillovers is relatively mixed. However productivity spillovers are more likely to happen. Whether these spillovers diffuse to neighboring countries is not clearly considered, if the usual hypothesis is that intranational spillovers are more important (Branstetter, 2001).

To be clear, most of the literature admits the existence of some form of international connection between countries. Diffusion of technology occurs through exports (Keller, 2004; Branstetter, 2001) as consequence of globalization, in general, Marshall (1960), resulting from returns to scale, economic and regional concentration, transportation costs, and knowledge spillovers (Krugman and Venables, 1995, 1993). According to the location theory of Braunerhjelm and Svensson (1996) regions with relatively more foreign establishments are more likely to attract additional investments as in Swedish high-tech firms in OECD countries in countries that specialize in similar production. Wheeler and Mody (1992) have a similar idea of regional concentration at the firm level when they show that during the period 1982-1988 in a panel of 42 countries the presence of many other foreign firms in a region mattered significantly as a determinant of new FDI inflows.

The perspective in this study is based on flows of capital (equity, reinvested earnings, intercompany debt)irrespective of institutional arrangements, and constitutes a microeconomic approach to aggregate FDI data. Moreover, this study considers two sources of agglomeration effects. The first source is the presence of past investments in the host country. The second source is the presence of foreign investments in neighboring countries. This study attempts to show that locational characteristics, defined as existence of monitoring resources, are likely to not only drive flows into areas dense in FDI stock, but also to drive new FDI to the outskirts of the area, where they may benefit from high relative profitability over time.

3 Multinational Approach to Neighbors' Effects

Unlike traditional models that associate a measure of FDI to host country characteristics only,(Barrell and Pain, 1996; Love, 2003; Bajo-Rubio and Sosvilla-Rivero, 1994), or include a third country in a non formal manner in an OLI perspective (Baltagi et al., 2008, 2007; Blonigen, Davies, Waddell, and Naughton, 2007), this paper formally uses imperfect information to justify the use of resources outside the host country. Information asymmetry has been used to show the superiority of FDI over hiring a local contractor in the host country (Markusen, Maskus, and Str, 2002).[6] The principal (the investor in the source country) may use available resources in a third country to improve monitoring the agent (The FDI recipient whose main function is to attract FDI and in return, produces output for the principal). Obviously, there is information asymmetry between the principal and his local agent because the principal cannot completely monitor the behavior of his agent[7]. Under these circumstances, the output level from which profits are derived is uncertain. The principal can either devise efficient flows of FDI to motivate agents to produce the level of output that maximizes profits or spend additional resources to monitor the agents. The idea developed in this model is that, to obtain a profit maximizing production level, the corresponding cost function should reflect the design of incentives that motivate efficient efforts from the agent. The model is first explored in a regular cost minimization under constraint including information cost, then the theoretical expectations of the model are confirmed in the principal agent framework.

For a multinational producing a homogeneous product at home and abroad, the profit derived from sales and maintenance activities, or manufacturing activities is:

$$\Pi = TR - TC \tag{1}$$

[6] However, since FDI implies relatively high level of control defined by most institutions as above 10 percent ownership, it does not mean total ownership and leaves room for strategic behavior from local partners in the host country.

[7] Markusen et al. (2002) developed FDI models with information asymmetry where the principal can either hire a local contractor or set up his own affiliate. These models compare the relative efficiency of the two strategies in one period and in many periods and assess the timing and opportunity of FDI decisions.

TR are revenues from sales at home and abroad, TC is the total cost associated with production, with the total revenue TR given by:

$$TR = P_1(X_1)X_1 + P_2(X_2)X_2 \tag{2}$$

where P_1 is the price in the home market, P_2 is the price in the foreign market, X_1 is the sales in the home market, X_2 is the sales in the foreign market. If production is carried out abroad, and there is information asymmetry, production abroad is given by:

$$Q_2 = f_f(L_2, F, e, N) \tag{3}$$

Where, L_2 is labor needed for production abroad, F is physical factors abroad funded by FDI, e is effort needed for positive production, correlated with headquarters monitoring, N represents other resources not funded by FDI.

The multinational motivates agents' efforts by continually using extra resources. Monitoring is necessary because headquarters have a partial control over the production process, but they stand to lose their investment if the agent's effort is not enough to provide sufficient returns. This idea is consistent with the definition of FDI (more than 10% ownership), and with the characterization of usual risks associated with investing in a foreign country (**?**). The unit cost of monitoring effort is r. The total expenditure on efforts is

$$re = R \tag{4}$$

Assuming that activities abroad also raise the level of demand, foreign prices can be written as $P_2(X_2, Q_2)$. Maximizing shareholders net worth, (equivalent to maximizing profits) is therefore written as:

$$\Pi = P_1(X_1)X_1 + P_2(X_2, Q_2)X_2 - TC(Q_1) - TC_2(Q_2) - \lambda(X_1 + X_2 - Q_1 - Q_2) \tag{5}$$

With prices denominated in common currency. The equivalent cost minimization problem is

$$Min : TC = TC_1 + TC_2 \tag{6}$$

With

$$TC_1 = w_1 L_1 + c_1 K_1 \tag{7}$$

and

$$TC_2 = w_2 L_2 + c_{2f} F + c_{2n} N + r_2 e \tag{8}$$

Where w_2 is the unit cost of labor in the foreign country, c_{2f} is the per unit cost of physical capital funded by FDI, c_{2n} is the per unit cost of non labor resources funded by borrowing on the local market, r_2 is the per unit cost of agents efforts.

The lagrangian can be written as:

$$L = w_1 L_1 + c_1 K + w_2 L_2 + c_{2f} F + c_{2n} N + r_2 e + \lambda(Q_1 + Q_2 - f_l(K_1, L_1) - f_f(L_2, F, N, e)) \tag{9}$$

With first order conditions:

$$\frac{\partial L}{\partial L_1} : w_1 - \lambda MPL_1 = 0 \tag{10}$$

$$\frac{\partial L}{\partial L_2} : w_2 - \lambda MPL_2 = 0 \tag{11}$$

$$\frac{\partial L}{\partial F} : c_{2f} - \lambda \frac{\partial f}{\partial F} = 0 \tag{12}$$

$$\frac{\partial L}{\partial e} : r_2 - \lambda \frac{\partial f}{\partial e} = 0 \tag{13}$$

$$\frac{\partial L}{\partial N} : c_{2N} - \lambda \frac{\partial f}{\partial N} = 0 \tag{14}$$

$$\frac{\partial L}{\partial \lambda} : Q_1 + Q_2 - f(K_1, L_1) - f(L_2, F, e, N) \tag{15}$$

All the λ' from the first order conditions should be equal. We can therefore write

$$r_2 = \frac{\frac{\partial f}{\partial e}}{\frac{\partial f}{\partial F}} c_{2F} \tag{16}$$

Under information asymmetry it should be costly to motivate effort from the agent abroad thus we should have $r_2 > 0$. It should be noted that free information would revert the problem back to the usual optimization framework with perfect information, which would unrealistically associate clustering in space of investment to absence of information friction. Positive information externalities which can be translated into negative information costs can also theoretically increase the flows of investments from other firms in locations close enough to the host country. The framework here supposes only investment from firms originating from the same source and locating affiliates in neighboring locations.
Assuming positive investments ($F > 0$) we can have $c_{2F} > 0$: two situations become consistent with $r_2 > 0$

Proposition 1

Positive agents' marginal efforts match positive FDI input contribution to profits

$$\frac{\partial f}{\partial e} > 0; \frac{\partial f}{\partial F} > 0 \tag{17}$$

as long as the second order conditions for cost minimization are met, it would be understandable that the MNC headquarters accept to purchase information with $r_2 > 0$.

Proposition 2

Negative agents' marginal efforts match negative FDI input contribution to profits

$$\frac{\partial f}{\partial e} < 0; \frac{\partial f}{\partial F} < 0 \tag{18}$$

Assuming that the first order conditions for cost minimization are met, and following the constraint of positive per unit cost of information, we are left with negative shadow costs of information ($\lambda \leq 0$), which can be seen as producing more would increase the amount of information. It results that having $r_2 > 0$ does not ensure $\frac{\partial f}{\partial e} > 0$, but headquarters with readily available production capacity would be in better position to monitor and elicit higher effort from the agent.

For consistency, let's examine the problem from an incentive design angle: from the multinational perspective, expenses abroad E are made of explicit FDI resources F and monitoring resources designed to elicit effort level e.

$$E = c_{2F}F + r_2 e \tag{19}$$

As previously agreed, setting $r_2 = 0$ or $r_2 < 0$ are both equal to situations not discussed here. Thus, the logic behind $r_2 > 0$ is to reduce the probability of shirking. r_2 may be represented as

$$r_2 = \Gamma \frac{1}{\xi} \tag{20}$$

Where ξ is the probability of shirking, and Γ is a coefficient of visibility, that depends on available monitoring resources in the neighborhood of the investment.

$$E = c_{2F}F + \frac{\Gamma}{\xi}e \tag{21}$$

From the agent's perspective, assuming that the agent is interested in extra flows of FDI, the incentive compatibility constraint can be written as:

$$F - k(e) \geq F_P \tag{22}$$

Where F_P is the private satisfactory level of investment to the agent, k is the private cost of the agent when he produces e.

Because we assume that the agent has the advantage of private information on his effort, it is logical to consider the cost of effort to the agent to be less than the cost to the multinational

$$r_2 > k \tag{23}$$

Under uncertainty about shirking, the multinational investment abroad is given by the expected value of investment level. However, investment abroad is viable only if the motivation of the agent matches the motivation of the headquarters.

$$F - k(e) \geq \xi F_0 + (1 - \xi)F \tag{24}$$

with $F_0 \geq 0$ being the penalty flow level of FDI. If $e = 0$, then

$$F = \xi F_0 + (1 - \xi)F \tag{25}$$

at the cost $k(0)$. Therefore there will be no additional investments. Assuming that the agent sets nonzero minimal effort $e \neq 0$, we can write

$$F - k(e) \geq \xi F_0 + F - \xi F \quad (26)$$

$$k(e) \leq \xi(F - F_0) \quad (27)$$

Which can be rewritten as:

$$k(e) \leq \frac{\Gamma}{r_2}(F - F_0) \quad (28)$$

With $F - F_0 > 0$ and $\frac{\Gamma}{r_2} \neq 0$; When the agent consents $k(e)$ the headquarters see $\frac{\partial f}{\partial e}$ Thus we can write:

$$\frac{\partial f}{\partial e} \leq \frac{\Gamma}{r_2}(F - F_0) \quad (29)$$

Which shows that, given r_2 and $(F - F_0) > 0$, higher Γ increases the upper margin of $\frac{\partial f}{\partial e}$. We conclude that given a per-unit cost of effort r_2, extra factors improving the visibility of headquarters Γ, increase the marginal contribution of the effort of the agent to firm's profits. There is an inverse relationship between the marginal cost of e and Γ. Γ can therefore be used to construct a good proxy for the unobservable cost of e to be used in the cost minimization problem.

The cost minimization problem can be implicitly solved for endogenous variables, Q_1,Q_2, X_1,X_2,L_1,L_2,K_1,K_2 and F in term of exogenous variables only. Thus, F can be written as:

$$F = f(c, w, c_{2N}, c_{2F}, \Gamma) \quad (30)$$

F can be further modified in various usual ways adopted in the FDI literature. This includes using the relationship between optimal factor ratio and factor price ratio, using composite capital cost to account for exchange rate depreciation and capital control regulations (Barrell and Pain, 1996). Inclusion of total demand (D) and corporate profits(PR) are also ways to augment the model with additional market seeking drivers. Implicitly, the optimal F is written as:

$$F = f\left(D, \frac{w_1}{w_2}, \frac{c_1}{c_{2N}}, c_{2F}, \Gamma, \Delta RER, PR\right) \tag{31}$$

$\Delta_R ER$ denotes the one period rate of change in the dollar real exchange rate, PR is the real level of US corporate profits. D is the total demand, and Γ is $\sum_{i \neq j} w_{ij} F_j$ the total stock of investment in neighboring countries.

Furthermore, equation (31) can be interpreted as an equation for the desired level of FDI. That is because delivery lags delay finding suitable investment abroad and delay obtaining planning permission. Following FDI literature, variables are expected to show as:

$$F_{it} = f(\overset{+}{D}, \overset{+}{\frac{w_1}{w_2}}, \overset{+}{\frac{c_1}{c_{2N}}}, c_{2F}, \overset{+-}{\Gamma}, \Delta \overset{+-}{R}ER, \overset{+}{P}R) \tag{32}$$

Since we are concerned with flows of FDI, we use the partial adjustment process, usual in the FDI literature to isolate flows (Barrell and Pain, 1996; Love, 2003)

$$F_t - F_{t-1} = \lambda(F_t^* - F_{t-1}) \tag{33}$$

where λ is a distributed lag function, and finally,

$$I_t = \lambda(F_t^* - F_{t-1}) \tag{34}$$

which can be rewritten implicitly as

$$I = g(\overset{+}{D}, \overset{+}{\frac{w_1}{w_2}}, \overset{+}{\frac{c_1}{c_{2N}}}, c_{2F}, \overset{+-}{\Gamma}, \Delta \overset{+-}{R}ER, \overset{+}{P}R, \overset{+}{M}_{t-1}) \tag{35}$$

Assuming a linear relationship, the above equation can be transformed into an empirically testable form as follows:

$$I_{it} = \beta X_{it} + \alpha F_{t-1} + \varphi \sum_{i \neq i} w_{ij} F_{jt-1} + \varepsilon_t \tag{36}$$

or

$$I_{it} = \beta X_{it} + \alpha F_{t-1} + \varphi\Gamma + \varepsilon_t \tag{37}$$

with

$$\Gamma = \sum_{i \neq i} w_{ij} F_{jt-1} \tag{38}$$

where X_t is the matrix of usual determinants of foreign FDI, the variable with coefficient α represents the persistence in the flows of FDI, and the variable with coefficient φ is the spatial effect that captures geographic spillovers.

4 Data and Empirical Methodology

Equation (36) can be rewritten as

$$\begin{aligned} FDI_{it} &= \beta_0 + \beta_1 D_{it} + \beta_2 DIST_{it} + \beta_3 C_{2F_{it}} + \beta_4 w_{it} + \beta_5 \Delta RER_{it} + \\ &\quad \beta_6 DUM_{it} + \beta_7 PR_{it} + \alpha F_{it-1} + \varphi\Gamma + \varepsilon_t \end{aligned}$$

FDI_{it} is the annual flow of FDI (in millions of dollars) from the US to country i at year t, used here as endogenous variable. FDI data were obtained from the Bureau of Economic Analysis (BEA). FDI flows are, in fact, the sum of equity capital, inter-company debt, and reinvested earnings. For consistency in cross country comparison, the conception of FDI in this paper is consistent with the definition of FDI in the International Monetary Fund's (IMF) 5th balance of payment manual. This approach is standard in the macro-view perspective of FDI analysis (Love, 2003; Barrell and Pain, 1996). FDI in the manufacturing sector (FDIMA) and FDI in the non-manufacturing sectors (FDINMA) are also considered as alternate endogenous variables.

Explicative variables comprise 8 variables obtained from various sources. First,GDP_{it} is the GDP of country i at year t. It represents the size of the market in the host country. GDP data is obtained from the IMF. Second, $DIST_{it}$ is distance between Washington, DC and the capital city of country i (the host country). Distance data are obtained from www.indo.com, where calculations are done using the Geod program available from the US Geological survey. Third, $COSTK_{it}$ is the differential cost of capital between the US and the host country i at year t. $COSTK$ is computed following Love (2003) and (Bajo-Rubio and Sosvilla-Rivero, 1994, Pg.118) as

$$C_{2F_{it}} = (\frac{K_d}{GDP_d}) * (r + 0.10 - \pi_1) \tag{39}$$

where K_d is the gross fixed capital formation deflator, GDP_d is the gross domestic product deflator, and r the medium run nominal interest rate. Data on K_d, GDP_d and r are obtained from the IMF. Depreciation rate by assumption is 0 and π_1 is the rate of change in K_d one year ahead. Fourth, $COSTL_{it}$ is the relative cost of labor in the host country. COSTL is defined as the ratio of host country wages to US wages in dollar per hour, as published in the International Labor Office yearbook. Sixth, $CHER_{it}$ is one period change in the real exchange rate between the country i currency and the US dollar at year t. The real exchange rate is defined as

$$RER = \frac{(E_n * 100)/P_d}{(USD * 100)/(USPPI)} \tag{40}$$

where E_n is the host country's nominal exchange rate in dollars, P_d is host country's price deflator, $USPPI$ is US producer price index. All necessary data are obtained from the IMF. Seventh, PR_{it} is the firms' profit in country i at year t, proxy by firms' market value. Eight and finally,

$$\Gamma = \sum_{i \neq i} wF_{jt-1} \tag{41}$$

is the spatial lag of FDI stock representing neighbors influence. Where F_{ij} is the stock of investment in all the j's countries in a 1000 miles radius from a country i. Stock of FDI carries the idea of spillovers that builds over time

The annual data used in this study span the period 1982 to 2000. Summary statistics for the data are provided in Table 1.

[Insert Table 1 about here]

We applied the panel data estimation technique to the following model:

$$I_{it} = \beta X_{it} + \alpha F_{t-1} + \varphi \Gamma + \varepsilon_t \tag{42}$$

where $\varepsilon_{it} = \mu_i + \nu_{it}$

Stocks of investments are defined as cumulative flows and can be written as

$$F_{t-1} = I_{t-1} + F_{t-2} \tag{43}$$

Using (43), we can rewrite (42) as follows:

$$I_{it} = \alpha_1 I_{t-1} + \beta X_{it} + \alpha_2 F_{t-2} + \varphi \sum_{i \neq i} w F_{jt-1} + \varepsilon_t \tag{44}$$

where $\alpha F_{t-1} = \alpha_1 I_{t-1} + \alpha_2 F_{t-2}$

which is a dynamic equation with the spatial term Γ. Nickell (1981) argued that in dynamic equations, two basic econometric problems are created by the presence of a lagged dependent variable among the regressors: 1) the autocorrelation of the error term with the lagged dependent variable, and 2) heterogeneity. Nickell (1981) added that, usual panel data techniques are not appropriate because biased and inconsistent estimates will occur. However, as the sample size increases, the bias generated by the presence of a lagged dependent will grow smaller. Moreover, the presence of the spatial term creates an additional complication. The specification supposes substantive spatial dependence.[8] Where the structure of the dependence is captured by the neighbors stock of investment. Two major estimation techniques are generally used to avoid the estimation problem discussed above. The Arellano and Bond (1991) GMM estimation technique, which is more efficient, and the Anderson and Hsiao (1982) estimator, which is more consistent (Kiviet, 1995).

Arellano and Bond dynamic panel data estimation technique is used for estimation of the equations in the next section.

5 Empirical results

Table 2 shows the regression results. All variables are instrumented by the lag level of the regressors, following the Arellano and Bond (1991) dynamic panel data estimation procedure. The coefficient of the spatial term reflects shocks (accumulated over time) to neighboring countries that help attract FDI in the host country. Because the spatial variable is a stock of flows accumulated over time, it is fair to suggest that it carries the idea of spillovers that naturally take time to integrate into the host country's economy. Moreover, it can be logically considered to be the extent to which investing in the host country is an alternative to investing in neighboring countries. Two main conclusions can be derived from the regressions below. First, the coefficient of the spatial term is positive and significant. Thus, controlling for the host country's characteristics, shocks to neighboring countries positively affect FDI to the host country. Second, after introduction of the variable representing the neighbor's influence, the country SIZE coefficient becomes negative and non-significant. This means that the host country size is less important when the country is integrated with its neighbors. This result is consistent with prior studies that show that the size of the regional market is more relevant than the size of the host country market to investment in Europe (Braunerhjelm and Svensson, 1996; Barrell and Pain, 1996; Baltagi et al., 2007).

[8] Anselin, Florax, and Rey (2004)

[Insert Table 2. Full Sample Arellano and Bond Fixed Effect Regression of FDI about here]

When restricting the analysis to flows of FDI in the non-manufacturing sector, as shown in Table 3, the two conclusions in the regressions above still hold. Stock of investment in geographically neighboring countries has a positive impact on the host country's new flows of FDI. This relationship is (exactly as above) valid when the distance between the host country and the neighbor is at most 1000 miles. The country SIZE coefficient is positive and non-significant when controlling only for home country characteristics and when including the neighbor's influence. Furthermore, the country SIZE coefficient is negative and significant when an additional control variable is introduced to capture the fact the country has received investments in the past.

[Insert Table 3. Full Sample Arrellano and Bond Fixed Effect Regression of FDI non-manufacturing, about here]

Table 4 shows results of three regressions where the dependent variable is restricted to flows of foreign investment directed to the manufacturing sector. The main result is that the two conclusions above no longer hold true. Geographical neighbors do not have a statistically significant impact on new flows of investments in the host country, and contrary to the case of non-manufacturing investments, the country SIZE coefficient is positive and significant. This suggests that manufacturing investments may be less likely to diffuse to neighboring countries.

[Insert Table 4. Full sample Arrellano and Bond fixed effect regression of FDI Manufacturing about here]

Thus, when spillover is defined as a process by which a neighboring countrys stock of investments influences new flows of investments to the host country, US FDI decisions in general seem to be influenced by prior knowledge of the neighboring country. However, this behavior only occurs when flows are directed to the non-manufacturing sector. Performing regressions on other specific regions gives similar results (available from the author upon request).

6 Conclusion

The effects of neighboring countries on new flows of FDI to a host country can be modeled using geographical spillovers stemming from monitoring resources outside the host country. Estimating an equation derived from the model shows that when the neighbor lies within a 1000 miles of the host country, US FDI depends globally upon the amount of information about the neighborhood of the investment location collected over time. However, this conclusion does not hold true when investments to only the manufacturing sector are considered. It seems that the geographical spillover from information costs fosters investments to neighboring countries in the non-manufacturing sector only. This may be due to the use of manufacturing investments regional supply platform. Further analysis may however be needed to understand the full scope of the behavior of traditional FDI determinants in this model.

This study shows that although US FDI is globally dependent upon the amount of information on the neighborhood of the investment location collected over time, there is a heterogeneous response to the importance of neighbors depending on the affectation of the FDI as manufacturing or non-manufacturing.

References

Aitken, B. J. and A. E. Harrison (1999). Do domestic firms benefit from direct foreign investment? evidence from Venezuela. *The American Economic Review 89*(3), 605–618.

Anderson, T. W. and C. Hsiao (1982, January). Formulation and estimation of dynamic models using panel data. *Journal of Econometrics 18*(1), 47–82.

Anselin, L., R. Florax, and S. Rey (2004). *Advances in spatial econometrics: methodology, tools and applications*. Springer.

Arellano, M. and S. Bond (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies 58*(2), 277–297.

Bajo-Rubio, O. and S. Sosvilla-Rivero (1994). An econometric analysis of foreign direct investment in Spain, 1964-89. *Southern Economic Journal 61*(1), 104–120.

Balasubramanyam, V. N., D. Sapsford, and D. Griffiths (2002, June). Regional integration agreements and foreign direct investment: Theory and preliminary evidence. *Manchester School 70*(3), 460–82.

Baltagi, B. H., P. Egger, and M. Pfaffermayr (2007, September). Estimating models of complex FDI: Are there third-country effects? *Journal of Econometrics 140*(1), 260–281.

Baltagi, B. H., P. Egger, and M. Pfaffermayr (2008, July). Estimating regional trade agreement effects on FDI in an interdependent world. *Journal of Econometrics 145*(1-2), 194–208.

Barrell, R. and N. Pain (1996). An econometric analysis of U.S. foreign direct investment. *The Review of Economics and Statistics 78*(2), 200–207.

Barry, F. (2003, December). Economic integration and convergence processes in the EU cohesion countries. *Journal of Common Market Studies 41*(5), 897–921.

Blomstrm, M. and A. Kokko (1996, February). Multinational corporations and spillovers. Technical Report 99, Stockholm School of Economics.

Blomstrm, M. and A. Kokko (2003). The economics of foreign direct investment incentives. *Foreign direct investment in the real and financial sector of industrial countries*, 37–56.

Blonigen, B. A., R. B. Davies, G. R. Waddell, and H. T. Naughton (2007, July). FDI in space: Spatial autoregressive relationships in foreign direct investment. *European Economic Review 51*(5), 1303–1325.

Branstetter, L. G. (2001, February). Are knowledge spillovers international or intranational in scope?: Microeconometric evidence from the U.S. and Japan. *Journal of International Economics 53*(1), 53–79.

Braunerhjelm, P. and R. Svensson (1996, July). Host country characteristics and agglomeration in foreign direct investment. *Applied Economics 28*(7), 833–40.

Conley, T. G. and E. Ligon (2002, June). Economic distance and cross-country spillovers. *Journal of Economic Growth 7*(2), 157–87.

Djankov, S. and B. M. Hoekman (2000, January). Foreign investment and productivity growth in Czech enterprises. *World Bank Economic Review 14*(1), 49–64.

Driffield, N. and M. Munday (2000, March). Industrial performance, agglomeration, and foreign manufacturing investment in the U.K. *Journal of International Business Studies 31*(1), 21–37.

Dunning, J. H. (1988). The eclectic paradigm of international production: A restatement and some possible extensions. *Journal of International Business Studies 19*(1), 1–31.

Girma, S. (2002, June). The process of european integration and the determinants of entry by non-eu multinationals in uk manufacturing. *Manchester School 70*(3), 315–35.

Haddad, M. and A. Harrison (1993, October). Are there positive spillovers from direct foreign investment? : Evidence from panel data for Morocco. *Journal of Development Economics 42*(1), 51–74.

Javorcik, B. S. (2004). Does foreign direct investment increase the productivity of domestic firms? in search of spillovers through backward linkages. *The American Economic Review 94*(3), 605–627.

Keller, W. (2002). Geographic localization of international technology diffusion. *The American Economic Review 92*(1), 120–142.

Keller, W. (2004). International technology diffusion. *Journal of Economic Literature 42*(3), 752–782.

Kiviet, J. F. (1995, July). On bias, inconsistency, and efficiency of various estimators in dynamic panel data models. *Journal of Econometrics 68*(1), 53–78.

Krugman, P. (1991). Increasing returns and economic geography. *Journal of Political Economy 99*(3), 483.

Krugman, P. and A. J. Venables (1993, December). Integration, specialization and adjustment. CEPR Discussion Papers 886, C.E.P.R. Discussion Papers.

Krugman, P. and A. J. Venables (1995). Globalization and the inequality of nations. *The Quarterly Journal of Economics 110*(4), 857–880.

Lipsey, R. and F. Sjholm (2004, June). FDI and wage spillovers in indonesian manufacturing. *Review of World Economics (Weltwirtschaftliches Archiv) 140*(2), 321–332.

Lipsey, R. E. (2002, October). Home and host country effects of fdi. NBER Working Papers 9293, National Bureau of Economic Research, Inc.

Love, J. H. (2003, October). Technology sourcing versus technology exploitation: an analysis of us foreign direct investment flows. *Applied Economics 35*(15), 1667–1678.

Love, J. H. and F. Lage-Hidalgo (2000, August). Analysing the determinants of US direct investment in Mexico. *Applied Economics 32*(10), 1259–67.

Lucas, Robert E., J. (1990). Why doesn't capital flow from rich to poor countries? *The American Economic Review 80*(2), 92–96.

Markusen, J., K. Maskus, and P. Str (2002). Discriminating among alternative theories of the multinational enterprise. *Review of International Economics 10*, 694–707.

Marshall, A. (1960). *Principles of Economics (1920).*

Neary, J. (2002). Foreign Direct Investment and the Single Market. *The Manchester School 70*(3), 291–314.

Nickell, S. J. (1981, November). Biases in dynamic models with fixed effects. *Econometrica 49*(6), 1417–26.

Pearce, R. D. (1999, March). Decentralised R&D and strategic competitiveness: globalised approaches to generation and use of technology in multinational enterprises (MNEs). *Research Policy 28*(2-3), 157–178.

Serapio Jr., M. G. and D. H. Dalton (1999, March). Globalization of industrial R&D: an examination of foreign direct investments in R&D in the united states. *Research Policy 28*(2-3), 303–316.

Weinhold, D. (2002, October). The importance of trade and geography in the pattern of spatial dependence of growth rates. *Review of Development Economics 6*(3), 369–82.

Wheeler, D. and A. Mody (1992, August). International investment location decisions : The case of U.S. firms. *Journal of International Economics 33*(1-2), 57–76.

Yeaple, S. R. (2003, 07). The role of skill endowments in the structure of u.s. outward foreign direct investment. *The Review of Economics and Statistics 85*(3), 726–734.

Table 1: Summary statistics

Variable	Mean	Std. Dev.	N
regi	3	0	475
ID	30	14.807	475
Year	1991	5.483	475
RER	349.754	3220.086	423
costl	1.442	2.993	245
uscostl	2.676	0.18	475
gdp	10.242	1.22	427
costk	0.635	1.428	294
uscostk	-0.606	1.699	450
firmprofit	4.349	0.889	302
bodrinv	11.061	1.713	473
dist	8.381	0.168	475
fdi	6.112	1.86	321
fdiman	4.987	1.884	328
fdinma	5.695	1.856	290
chrer	-4.969	2.427	135
population	2.632	1.276	455
stockin	8.039	1.641	423
relativwag	0.531	1.138	245
relativcosk	0.581	18.907	277
gdpcapita	3.765	2.8	427
difcostl	1.241	2.976	245
difcosk	-1.202	1.562	277
relativesize	113.897	24.41	425
relativesize2	28.887	14.464	453

Table 2: Cross-correlations

Variables	fdi	fdinma	fdiman	gdp	dist	costk	costl	chrer	firmprofit	bodrinv	relativcosk	relativwag	relativesize	relatives
fdi	1.000													
fdinma	0.838	1.000												
	(0.000)													
fdiman	0.686	0.306	1.000											
	(0.000)	(0.020)												
gdp	0.323	0.320	0.221	1.000										
	(0.014)	(0.015)	(0.099)											
dist	-0.199	-0.324	-0.034	-0.268	1.000									
	(0.138)	(0.014)	(0.802)	(0.043)										
costk	-0.119	-0.101	-0.182	0.031	-0.053	1.000								
	(0.378)	(0.453)	(0.175)	(0.817)	(0.693)									
costl	0.365	0.344	0.245	0.100	-0.236	-0.213	1.000							
	(0.005)	(0.009)	(0.066)	(0.457)	(0.077)	(0.112)								
chrer	0.190	0.227	0.054	-0.244	-0.078	-0.075	0.538	1.000						
	(0.156)	(0.089)	(0.692)	(0.067)	(0.566)	(0.582)	(0.000)							
firmprofit	0.452	0.341	0.368	0.166	-0.153	-0.485	0.263	-0.015	1.000					
	(0.000)	(0.009)	(0.005)	(0.216)	(0.255)	(0.000)	(0.048)	(0.910)						
bodrinv	0.289	0.299	0.265	0.011	-0.680	-0.102	0.051	0.066	0.257	1.000				
	(0.029)	(0.024)	(0.046)	(0.934)	(0.000)	(0.451)	(0.709)	(0.628)	(0.053)					
relativcosk	-0.106	-0.064	-0.079	0.083	-0.167	-0.540	0.046	-0.116	-0.031	0.086	1.000			
	(0.431)	(0.636)	(0.560)	(0.541)	(0.214)	(0.000)	(0.732)	(0.390)	(0.819)	(0.523)				
relativwag	0.353	0.342	0.229	0.112	-0.238	-0.189	0.998	0.533	0.227	0.032	0.053	1.000		
	(0.007)	(0.009)	(0.087)	(0.409)	(0.075)	(0.158)	(0.000)	(0.000)	(0.089)	(0.815)	(0.697)			
relativesize	0.400	0.400	0.345	0.428	-0.711	-0.084	0.086	-0.009	0.298	0.905	0.113	0.073	1.000	
	(0.002)	(0.002)	(0.009)	(0.001)	(0.000)	(0.532)	(0.525)	(0.945)	(0.024)	(0.000)	(0.403)	(0.590)		
relativesize2	0.178	0.152	0.267	0.720	-0.465	0.043	-0.120	-0.223	0.060	0.437	0.131	-0.115	0.714	1.00
	(0.184)	(0.260)	(0.044)	(0.000)	(0.000)	(0.749)	(0.376)	(0.095)	(0.656)	(0.001)	(0.333)	(0.393)	(0.000)	

FDI Regression results

VARIABLES	(1) Base case	(2) Augmented 1	(3) Augmented 2
LD.fdi	-0.46**	-0.69***	-0.49***
	(0.21)	(0.14)	(0.18)
D.gdp		-8.41086	-0.30291
		(6.76105)	(9.23178)
D.dist	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
D.relativcosk	0.00	0.00	0.00
	(0.01)	(0.01)	(0.01)
D.relativwag	-4.67	20.08	-2.83
	(11.58)	(15.16)	(17.54)
D.chrer	-0.09	-0.17	-0.08
	(0.47)	(0.39)	(0.64)
D.firmprofit	2.99*	4.33***	3.12*
	(1.53)	(1.27)	(1.89)
D.bodrinv	-2.48***	-3.25***	-2.38**
	(0.86)	(0.71)	(0.97)
D.population		340.48**	
		(161.78)	
D.gdpcapita	2.68586		
	(9.19598)		
Constant	0.55	-0.24	0.68
	(0.69)	(0.82)	(1.15)
Observations	11	11	11
Number of id	5	5	5
ARtest	2	2	2
Sargan	1.985	0.958	1.951

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

FDINMA Regression results

VARIABLES	(1) Base case	(2) Augmented 1	(3) Augmented 2
LD.fdinma	0.15	0.16	0.16
	(.)	(.)	(.)
D.gdp		-1.26436	-1.26436
		(.)	(.)
D.dist	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
D.relativcosk	0.03	0.03	0.03
	(.)	(.)	(.)
D.relativwag	-1.39	0.00	0.00
	(.)	(0.00)	(0.00)
D.chrer	-2.39	-2.32	-2.32
	(.)	(.)	(.)
D.firmprofit	2.63	2.77	2.77
	(.)	(.)	(.)
D.bodrinv	2.48	2.81	2.81
	(.)	(.)	(.)
D.population		0.00	
		(0.00)	
D.gdpcapita	0.00000		
	(0.00000)		
Constant	-0.40	-0.32	-0.32
	(.)	(.)	(.)
Observations	7	7	7
Number of id	4	4	4
ARtest	2	2	2
Sargan	-2	-3	-2

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

	(1)
VARIABLES	Base case
LD.fdiman	-0.50**
	(0.21)
D.gdpcapita	10.10746
	(19.67789)
D.dist	0.00
	(0.00)
D.relativcosk	-0.02**
	(0.01)
D.relativwag	-2.64
	(19.34)
D.chrer	0.94
	(0.86)
D.firmprofit	0.54
	(3.20)
D.bodrinv	-6.81
	(11.69)
Constant	0.99
	(1.35)
Observations	10
Number of id	5
ARtest	2
Sargan	0.995

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

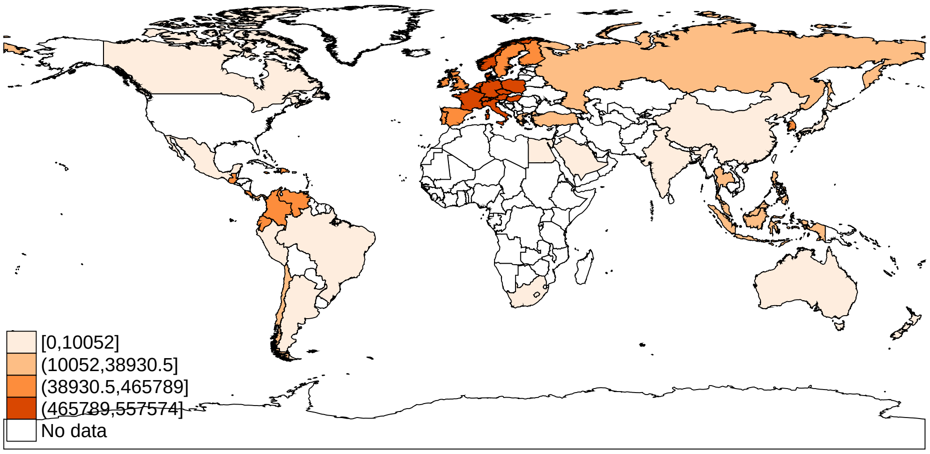

Figure 1: US FDI in the world

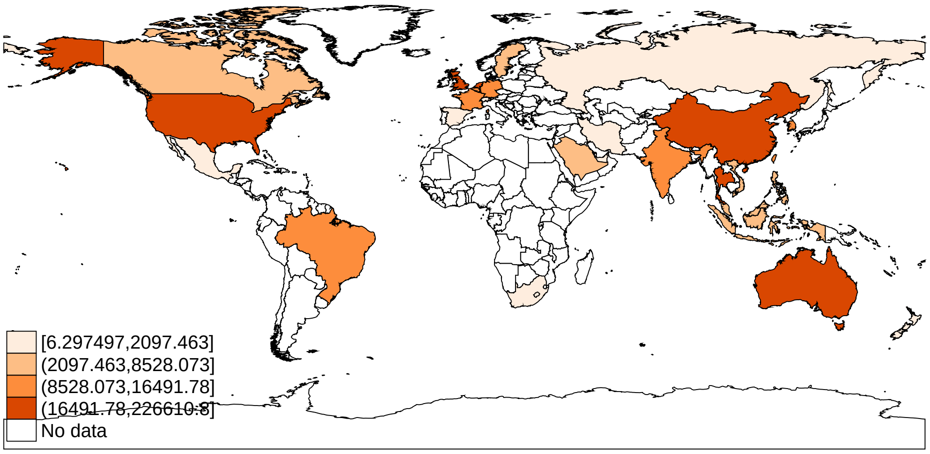

Figure 2: Japan FDI in the world