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# Spacey Parents and Spacey Hosts in FDI

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## Abstract

Empirical trade economists have found that shocks on foreign direct investment (FDI) of some parent country in a host country affect the same parent country's FDI in other hosts (interdependent hosts). Independent of this, there is evidence that shocks on a parent country's FDI in some host economy affect other parent countries' FDI in the same host (interdependent parents). In general equilibrium, shocks on FDI between any country pair will affect all country-pairs' FDI in the world, including anyone of the two countries in a pair as well as third countries (interdependent third countries). No attempt has been made so far to allow simultaneously for all three modes of interdependence of FDI. Using cross-sectional data on FDI among 22 OECD countries in 2000, we employ a spatial feasible generalized two-stage least squares and generalized moments estimation framework to allow for all three modes of interdependence across all parent and host countries, thereby distinguishing between *market-size-related* and *remainder* interdependence. Our results highlight the complexity of multinational enterprises' investment strategies and the interconnectedness of the world investment system.

**Keywords:** Foreign direct investment; Spatial econometrics; Generalized method of moments estimation

**JEL Classification:** C21; F21; F23

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*“Although [previous] work has focused on outward investment and the choice among host locations, it is just as important to recognize that third country effects may be important for inbound FDI as well.”*  
(Blonigen et al., 2008, p.183)

## 1 Introduction

Two arguments have been put forward in the literature about the interdependence or ‘spaceyness’ of bilateral foreign direct investment (FDI). First, shocks on a given parent country’s outward FDI in some host country affect the same parent country’s FDI in other host countries. Second, shocks on a given host country’s inward FDI from some parent country affect inward FDI from other parent countries in the same host country.

The first line of reasoning roots in theoretical work on export platform FDI and vertically organized networks of multinational enterprises (MNEs), where the location and output decisions of MNEs are interdependent across host markets and partly depend on the openness to trade in final goods (Yeaple, 2003; Baltagi et al., 2007; Ekholm et al., 2007) or intermediate goods (Grossman et al., 2007; Bergstrand and Egger, 2008) across potential host countries. Hence, this literature motivates a *Spacey-Hosts* hypothesis for empirical work: a smaller distance between host countries should lead to stronger interdependence of a given parent country’s (outward) FDI across hosts, since, e.g., it facilitates exports of foreign affiliates to other host countries as well as intermediate goods trade among affiliates there.

As to the second line of reasoning, there is a smaller body of work that suggests that the location and output decisions of MNEs from different parent countries in a given host economy are interdependent too. Blonigen et al. (2008) illustrate that the interrelationship of bilateral FDI across parents is related to trade costs among the parent countries. Hence, this literature motivates a *Spacey-Parents* hypothesis for empirical work: a smaller distance between parent countries should lead to stronger interdependence of a given host country’s (inward) FDI across parents, since, e.g., learning about the host market happens more likely between headquarters in similar, neighboring parent countries.

Taking this argument one step further, an implication of multi-country general equilibrium models is that bilateral FDI decisions are not only interdependent across parents for a given host and across hosts for a given parent, but that FDI for a given parent-host country pair will also affect

and depend on (determinants of and shocks on) FDI between other, third parent and host countries. This third mode of interdependence, which has been entirely ignored in empirical work so far, motivates what we refer to as *Spacey-Third-Countries* hypothesis.

Indeed, empirical evidence is supportive to the *Spacey-Hosts* hypothesis (Baltagi et al., 2007; Blonigen et al., 2007) and the *Spacey-Parents* hypothesis in bilateral FDI (Blonigen et al., 2008). However, so far these two hypotheses have only been assessed in isolation from each other. Moreover, no attempt has been made to find empirical evidence on the *Spacey-Third-Countries* hypothesis.

This has several fundamental consequences. First, allowing for only one mode of interdependence at a time and omitting the others may lead to biased estimates and a misattribution of the effects of omitted modes of interdependence to the one considered in the empirical model. Second, it precludes a quantification of the relative importance of the *Spacey-Parents*, the *Spacey-Hosts*, and the *Spacey-Third-Countries* hypotheses. Finally, ignoring relevant modes of interdependence in the model specification will result in heteroskedastic error terms, e.g., rendering maximum likelihood estimates of spatial econometric models inconsistent (Lee, 2004) and invalidating standard inference.

Using cross-sectional data on bilateral stocks of outward FDI from 22 parent and host countries (i.e., 462 parent-host pairs) in the year 2000, this paper specifies and estimates an integrated spatial econometric cross-section model to assess the three aforementioned modes of interdependence simultaneously. It distinguishes explicitly between *market-size-related* and *remainder* interdependence in FDI across parents and hosts. For estimation, we use a heteroskedasticity-robust spatial generalized two-stage least squares approach, building on Kelejian and Prucha (2010) and the extension of that estimator to higher order spatial models by Badinger and Egger (2011), which permits considering simultaneously alternative modes of interdependence.

Our results support the following conclusions. First, spaceyness matters both in terms of *market-size-related* and *remainder* interdependence. For instance, larger and close-by parent countries investing in a particular host country increase the magnitude of a given parent country's FDI there relative to the FDI of smaller and more distant parent countries. Moreover, larger host countries in the neighborhood of a particular host increase a given parent country's FDI there relative to its FDI in smaller and more distant host countries. The latter result is consistent with and may be interpreted as indirect evidence for export-platform FDI or information spillovers

through correlated learning about host markets (Egger et al., 2011). We also find evidence in support of the *Spacey-Parents* and the *Spacey-Hosts* hypotheses with regard to *remainder* (unobservable) determinants of FDI. To a somewhat lesser extent, we find support of the *Spacey-Third-Countries* hypothesis. These findings suggest a relative dominance of interdependence through learning and horizontal motives (e.g., through export platforms) as well as vertical integration motives (e.g., through intermediate goods trade at arm’s length or among affiliates) over the interdependence flowing from general equilibrium effects (through resource constraints and multilateral factor as well as output price effects).

The remainder of the paper is organized as follows. Section 2 outlines the specification of alternative modes of interdependence in FDI that will be used in the empirical analysis. Section 3 sets up the empirical model, distinguishes between *market-size-related* and *remainder* interdependence, and discusses the econometric issues involved. Section 4 presents the estimation results. The final section 5 summarizes the main findings and concludes.

## 2 Modes of Interdependence in FDI

To provide a formal specification of the three aforementioned modes or channels of interdependence, denote (the log of the stock of outward) FDI from parent country  $i$  in host country  $j$  by  $y_{ij}$ . With  $I$  parent countries and  $J$  host countries, a typical cross-sectional data-set of bilateral FDI then consists of  $N = I \times (J - 1)$  observations, which can be collected in the  $N \times 1$  vector  $\mathbf{y} \equiv \{y_{ij}\}$ . The structure of interdependence between FDI of two parent-host country pairs is reflected in the  $N \times N$  matrix  $\mathbf{S} \equiv \{s_{ij,i'j'}\}$ , whose elements depict the interdependence between FDI from parent  $i$  to host  $j$  and FDI from parent  $i'$  to host  $j'$ .

According to theoretical models of multinational enterprises (MNEs), interdependence will typically be stronger among large, well integrated countries, such that the elements  $s_{ij,i'j'}$ , which will be specified more precisely below, are expected to increase in the size of the parent and host country and to decrease in their distance from each other.

### 2.1 Spacey Hosts

The *Spacey-Hosts* hypothesis put forward by Blonigen et al. (2007) states that FDI from parent country  $i$  in host country  $j$  does not only depend on FDI

in (characteristics of) host country  $j$  but also on FDI in (characteristics of) other host countries  $j'$ . In terms of the interdependence matrix  $\mathbf{S}$  this implies that  $\{s_{ij,i'j'}\} \neq 0$  for  $i = i', j \neq j'$ , whereas  $\{s_{ij,i'j'}\} = 0$  for  $i \neq i'$  or  $j = j'$ . We collect these *Spacey-Hosts* relationships in the matrix  $\mathbf{S}_H \equiv \{s_{ij,i'j'}^H\}$ .

If MNEs are mainly of the horizontal type and set up foreign affiliates only to serve the host country market, one might expect that larger neighboring markets of a given host country reduce MNE activity in that economy. The reason are resource constraints, whereby the same investment could *ceteris paribus* serve a larger neighboring market and generate higher profits there than in the host country at stake. Alternatively, one might expect export-platform MNE activity to increase in a given host country if neighboring countries are larger. The reason is that export-platform MNEs set up foreign subsidiaries not only to serve the host market but also other surrounding markets. Which of these two effects dominates is an empirical question.

As outlined above, according to theoretical models, interdependence is expected to be larger for larger countries that are located close-by to each other. Specifically, we *ceteris paribus* expect large host countries  $j'$  in the neighborhood of host country  $j$  to exert a larger influence on bilateral FDI of parent country  $i$  than others. Country size and geographical distance together determine economic distance (this argument is in line with a large literature on gravity models of international trade). Hence, as a measure of (inverse) ‘economic distance’ between two host countries  $j$  and  $j'$ , we specify  $s_{ij,i'j'}^H = \exp(\ln GDP_j + \ln GDP_{j'} - \ln DIST_{jj'})$  along the lines of gravity models of bilateral trade (which assume unitary coefficients on the log of exporter and importer countries’ GDPs and typically find a unitary coefficient on the log of bilateral distance).

## 2.2 Spacey Parents

The *Spacey-Parents* hypothesis put forward by Blonigen et al. (2008) states that FDI from parent country  $i$  in host country  $j$  does not only depend on FDI in (characteristics of) parent country  $i$  but also on FDI from (characteristics of) other parent countries  $i'$  in host country  $j$ . In terms of the interdependence matrix  $\mathbf{S}$  this implies that  $\{s_{ij,i'j'}\} \neq 0$  for  $i \neq i', j = j'$ , whereas  $\{s_{ij,i'j'}\} = 0$  for  $j \neq j'$  or  $i = i'$ . We collect these *Spacey-Parents* relationships in the matrix  $\mathbf{S}_P \equiv \{s_{ij,i'j'}^P\}$ .

As discussed in Blonigen et al. (2008), there are two main channels through which spaceyness across parents should matter. First, FDI in a particular host country requires the use of resources there. Accordingly, an

increase in FDI from other parent countries in a particular host leaves fewer resources available to the parent of interest. Alternatively, an increase in other parent countries' FDI in that host could lower marginal costs and create positive externalities (e.g., information spillovers) to a given parent country's outward FDI there (Blomstrom and Kokko, 1998). Moreover, the presence of many foreign firms may signal high institutional quality and an attractive environment for foreign firms (Baird, 2010; Fahn et al., 2009). Again, the direction of the bottom line effect remains to be determined empirically.

Following the same logic as with host countries, we expect large parent countries  $i'$  in the neighborhood of parent country  $i$  to exert a larger influence on the FDI decisions of parent country  $i$ . Akin to host country economic neighborhood, we measure (inverse) economic distance between two parent countries  $i$  and  $i'$  as  $s_{ij,i'j'}^P = \exp(\ln GDP_i + \ln GDP_{i'} - \ln DIST_{ii'})$ .

### 2.3 Spacey Third Countries

In multi-country general equilibrium models of FDI (see, e.g., Yeaple, 2003; Egger et al., 2007), complex effects from third countries other than a specific parent and host will arise, resulting in the dependence of (determinants of) FDI for a given parent-host country pair on other, third parent and host countries. In terms of the interdependence matrix  $\mathbf{S}$  this implies that  $\{s_{ij,i'j'}\} \neq 0$  for  $i \neq i', j \neq j'$ , whereas  $\{s_{ij,i'j'}\} = 0$  for  $i = i'$  or  $j = j'$ . We collect these *Spacey-Third-Countries* relationships in the matrix  $\mathbf{S}_T \equiv \{s_{ij,i'j'}^T\}$ , whose elements are again defined in terms of economic distance between two third countries  $i$  and  $j$ , i.e.,  $s_{ij,i'j'}^T = \exp(\ln GDP_i + \ln GDP_j - \ln DIST_{ij})$ .

The sign of the effect of this mode of interdependence on bilateral FDI will depend on the fundamental sources of interdependence. E.g., competition for globally mobile or tradable resources in third countries might deter bilateral FDI elsewhere while third-country information spillovers might raise it.

### 2.4 Summary

Summing up, we have defined three  $N \times N$  (weights) matrices reflecting one mode of interdependence each, corresponding to the *Spacey-Parents* hypothesis ( $\mathbf{S}_P$ ), the *Spacey-Hosts* hypothesis ( $\mathbf{S}_H$ ), and the *Spacey-Third-Countries* hypothesis ( $\mathbf{S}_T$ ):

$$\mathbf{S}_P \equiv \{s_{ij,i'j'}^P\} \equiv \begin{cases} 0 & \text{for } j \neq j' \text{ or } i = i', \\ \exp(\ln RGDP_i + \ln RGDP_{i'} - \ln DIST_{ii'}) & \text{otherwise,} \end{cases}$$

$$\begin{aligned}
\mathbf{S}_H &\equiv \{s_{ij,i'j'}^H\} \equiv \begin{cases} 0 \text{ for } i \neq i' \text{ or } j = j', \\ \exp(\ln RGDP_j + \ln RGDP_{j'} - \ln DIST_{jj'}) \text{ otherwise,} \end{cases} \\
\mathbf{S}_T &\equiv \{s_{ij,i'j'}^T\} \equiv \begin{cases} 0 \text{ for } i = i' \text{ or } j = j', \\ \exp(\ln RGDP_i + \ln RGDP_j - \ln DIST_{ij}) \text{ otherwise.} \end{cases}
\end{aligned} \tag{1}$$

In order to rule out self-influence, i.e., a direct feedback of FDI of a given parent-host pair on itself, the main diagonal elements of the weights matrices are assumed to be zero throughout the paper, i.e.,  $s_{ij,i'j'}^P = s_{ij,i'j'}^H = s_{ij,i'j'}^T = 0$  for  $i = i', j = j'$ . Moreover, as it is standard in the spatial econometrics literature, each weights matrix is row-normalized to ensure well-behaved asymptotic properties. Hence, the rows of each matrix sum to one such that the elements of the normalized matrices reflect the structure of interdependence in terms of relative economic distance.

Previous empirical studies considering the interdependence in FDI have either ruled out interdependence among parents for a given host, assuming that  $\mathbf{S}_P = \mathbf{0}$  (Baltagi et al., 2007; Blonigen et al., 2007), or ruled out interdependence among hosts for a given parent, assuming that  $\mathbf{S}_H = \mathbf{0}$  (Blonigen et al., 2008). Moreover, no study so far has considered third country interdependence allowing for  $\mathbf{S}_T \neq \mathbf{0}$ .

### 3 Empirical Model

In order to integrate these arguments into an econometric analysis, we set up a baseline empirical model that will be extended to allow for the three aforementioned modes of interdependence. A number of determinants have been proposed and found to influence bilateral activity of MNEs (see Markusen, 2002; Navaretti and Venables, 2004; Blonigen et al., 2003, for instance). Empirical studies point to a relative dominance of the importance of market size (parent and host country GDP) along with (differences) in parent and host income per capita and geographical distance.

Hence, our starting point is the following parsimonious specification including the key economic and geographical variables:

$$\begin{aligned}
y_{ij} &= \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln GDP_{PC_i} \\
&\quad + \beta_4 \ln GDP_{PC_j} + \beta_5 \ln DIST_{ij} + \beta_6 CB_{ij} + \mathbf{q}_{ij} \boldsymbol{\delta} + u_{ij}.
\end{aligned} \tag{2}$$



The dependent variable  $y_{ij}$  is the (natural log of the) stock of nominal outward FDI from parent  $i$  to host  $j$ .<sup>1</sup> The cross-sectional sample refers to the year 2000 and comprises  $i = 1, \dots, I = 22$  parent and  $j = 1, \dots, J = 21$  host countries, making a total of  $N = 462$  observations. The right-hand-side variables include  $GDP$  and GDP per capita ( $GDP_{PC}$ ) of the parent and host country, geographical distance between the parent and the host country ( $DIST_{ij}$ ) and a common border indicator variable ( $CB_{ij}$ ).

Data on bilateral FDI stocks are taken from the United Nations Conference on Aid and Development (UNCTAD) and from the Organization for Economic Cooperation and Development (OECD), GDP is from the World Bank's World Development Indicators, and the geographical variables are from the geographical database of the Centre d'Études Prospectives et d'Informations Internationales. A more detailed description of the data and summary statistics are provided in the Appendix of the paper.

The vector  $\mathbf{q}$  includes a set of control variables that will be added in the robustness analysis. There, we include indices related to parent and host countries' institutional quality taken from the International Country Risk Guide database: rule of law ( $LAW$ ), government stability ( $GOVSTAB$ ), international investor profile ( $INVPROF$ ), bureaucracy ( $BUREAU$ ), corruption ( $CORRUPT$ ), international confidence ( $INTCONF$ ), as well as socio-economic conditions ( $SOCOEC$ ). For an interpretation, note that all indices are increasing in institutional quality. Alternatively, in the most comprehensive empirical model, the vector  $\mathbf{q}$  will be specified to include parent and host country fixed effects. Finally,  $u_{ij}$  is a stochastic error term, whose properties will be discussed below.

Most of previous empirical work on bilateral FDI (or other forms of MNE activity) used models similar to Equation (2), where FDI from country  $i$  to  $j$  is modeled as a function of characteristics of countries  $i$  and  $j$  along with  $ij$ -specific bilateral variables only (e.g., Brainard, 1997; Carr et al., 2001; Blonigen et al., 2003; Markusen and Maskus, 2002; Egger and Pfaffermayr, 2005). Hence, interdependence across country pairs has been ruled out by assumption.

Only recently, empirical work illustrated that this assumption seems contradicted not only by theoretical models with more than two countries (e.g., Yeaple, 2003; Ekholm et al., 2007) but also by data (Coughlin and Segev,

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<sup>1</sup>We also employed a specification with real FDI stocks as dependent variable, calculated using the host country's GDP deflator, along with real parent and host country GDP on the right-hand-side of Equation (2) and obtained very similar results.

2000; Baltagi et al., 2007; Blonigen et al., 2007, 2008).

### 3.1 Specifying Spaceyness in FDI

We next we integrate the three aforementioned modes of interdependence into Equation (2). Economic theory suggests that bilateral FDI is determined by parent and host as well as third country market size. The extent to which third (parent or host or other) country market size matters depends on economic distance between a country pair and third countries. Hence, we will first introduce *market-size-related* interdependence into Equation (2), and then go on to specify and test for *remainder* interdependence, which will be modeled through the disturbance process  $u_{ij}$ .

#### 3.1.1 Market-Size-Related Spaceyness in FDI

Measuring (economic) country size in terms of GDP, the *market-size-related Spacey-Parents* hypothesis is incorporated into Equation (2) by including an (economic) distance weighted average of all parent countries' GDP, which we collect in the  $N \times 1$  vector  $\bar{\mathbf{s}}^P$ . For observation  $ij$ , we have

$$\bar{s}_{ij}^P = \sum_{i'=1}^I \sum_{j'=1}^J s_{ij,i'j'}^P \ln GDP_{i'}.$$

Accordingly, the *market-size-related Spacey-Hosts* hypothesis is associated with the explanatory variable  $\bar{\mathbf{s}}^H$ , given by

$$\bar{s}_{ij}^H = \sum_{i'=1}^I \sum_{j'=1}^J s_{ij,i'j'}^H \ln GDP_{j'}$$

and the *market-size-related Spacey-Third-Countries* hypothesis is associated with explanatory variable  $\bar{\mathbf{s}}^T$ , given by

$$\bar{s}_{ij}^T = \sum_{i'=1}^I \sum_{j'=1}^J s_{ij,i'j'}^T \ln GDP_{i'j'}^T,$$

where  $GDP_{ij}^T$  is GDP of the rest of the world (ROW), i.e.,  $GDP_{i'j'}^T \equiv GDP_W - GDP_i - GDP_j$ .<sup>2</sup>

Collecting the explanatory and control variables in Equation (2) in the matrices  $\mathbf{X}$  and  $\mathbf{Q}$ , and using the  $(N \times 1)$  vectors  $\mathbf{s}^P \equiv \{\ln GDP_i\}$ ,  $\mathbf{s}^H \equiv \{\ln GDP_j\}$ , and  $\mathbf{s}^T \equiv \{\ln GDP_{i'j'}^T\}$  to denote (the log of) parent GDP, host GDP, and ROW GDP, respectively, Equation (2), augmented by the three modes of *market-size-related* interdependence can be written succinctly in matrix notation as

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{Q}\boldsymbol{\delta} + \gamma_P \bar{\mathbf{s}}^P + \gamma_H \bar{\mathbf{s}}^H + \gamma_T \bar{\mathbf{s}}^T + \mathbf{u}, \quad (3)$$

where the spatial lags of the GDP variables are defined as  $\bar{\mathbf{s}}^P \equiv \mathbf{S}_P \mathbf{s}^P$ ,  $\bar{\mathbf{s}}^H \equiv \mathbf{S}_H \mathbf{s}^H$ , and  $\bar{\mathbf{s}}^T \equiv \mathbf{S}_T \mathbf{s}^T$ . Since the weights matrices are row-normalized, the spatial lags of GDP reflect the structure of *market-size-related* interdependence in FDI, whereas the parameters  $\gamma_P$ ,  $\gamma_H$ , and  $\gamma_T$  measure the strength of interdependence and are thus informative about the relative importance of the three alternative modes of interdependence.

### 3.1.2 Remainder Spaceyness in FDI

While *market-size-related* spillovers are an important and possibly the predominant source of interdependence, we do not a priori expect them to capture spaceyness in FDI completely. First, in a sample of highly integrated countries, the size of the domestic market is only an imperfect measure of the market relevant for firms located in a particular host or parent country. Moreover, externalities, specific factors, and economic success are not necessarily tied to the size of an economy alone but could relate to preferences and cultural aspects that are hard to measure. Hence, we summarize these channels of interdependence unrelated to market size as *remainder* interdependence.

Since interdependence in FDI materializing through these remainder channels is not included as an explanatory variable in Equation (3), it will be captured by the error term  $u_{ij}$  and can thus be modeled and estimated by using a spatial regressive disturbance process, which is given by

$$\mathbf{u} = \rho_P \mathbf{S}_P + \rho_H \mathbf{S}_H + \rho_T \mathbf{S}_T + \boldsymbol{\varepsilon}, \quad (4)$$

<sup>2</sup>World GDP is from the World Bank's World Economic Outlook Database. As an alternative, we used the sum of the 22 countries in our sample and obtained virtually identical results.

where  $\boldsymbol{\varepsilon} \equiv \{\varepsilon_{ij}\}$  is an idiosyncratic error term, which is assumed to be independently though not necessarily identically distributed, i.e.,  $\varepsilon_{ij} \sim \text{i.d. } (0, \sigma_{ij}^2)$ .

Notice that the specification in Equation (4) implies that a unit shock to the error term  $\boldsymbol{\varepsilon}$ , denoted as  $\mathbf{e}$ , has a magnified impact on FDI through spillover effects and the associated repercussions, given by  $(\mathbf{I} - \rho_P \mathbf{S}_P - \rho_H \mathbf{S}_H - \rho_T \mathbf{S}_T)^{-1} \mathbf{e}$ . In our case with row normalized weights matrices the multiplier effect is equal across observations and amounts to  $1/(1 - \rho_P - \rho_H - \rho_T)$ .

In contrast to the specification of *market-size-related* interdependence in Equation (3), the spatial regressive structure in (4) does not allow a linearly additive decomposition of the effects of the three alternative modes of interdependence, since the multiplier implied by  $(\mathbf{I} - \rho_P \mathbf{S}_P - \rho_H \mathbf{S}_H - \rho_T \mathbf{S}_T)^{-1}$  is a nonlinear function of its arguments  $\mathbf{S}_P$ ,  $\mathbf{S}_H$ ,  $\mathbf{S}_T$ ,  $\rho_P$ ,  $\rho_H$ , and  $\rho_T$ .<sup>3</sup> However, Equation (4) still allows to test for the significance of each single mode of interdependence, the direction of their effects, and the respective coefficients are indicative of their relative magnitude.

## 3.2 Econometric Issues

In the estimation of *market-size-related* interdependence in the main Equation (3) and the estimation of *remainder* interdependence in Equation (4) there are several issues that deserve discussion.

### 3.2.1 LS and 2SLS Estimation of Market-Size-Related Interdependence

Regarding Equation (3), while it is unlikely that there is relevant reverse causality from *bilateral* FDI on *aggregate* GDP, we will – in light of the parsimonious specification – nevertheless use a two-stage least squares (2SLS) approach, instrumenting spatially weighted parent GDP ( $\bar{\mathbf{s}}_P$ ), spatially weighted host GDP ( $\bar{\mathbf{s}}^H$ ), and spatially weighted ROW GDP ( $\bar{\mathbf{s}}^T$ ) by spatial weights of (the log of) population, which is an arguably exogenous measure of country size.

Moreover, to address potential endogeneity concerns related to the interdependence matrices  $\mathbf{S}$ , their elements defined in Equation (1) are constructed using GDP in 1995, whereas the variables in our cross-sectional model (3) refer to the year 2000. However, for conservativeness, we also

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<sup>3</sup>To see this consider the Leontief expansion  $(\mathbf{I} - \rho_P \mathbf{S}_P - \rho_H \mathbf{S}_H - \rho_T \mathbf{S}_T)^{-1} = (\mathbf{I} + \sum_{m=1}^{\infty} (\rho_P \mathbf{S}_P + \rho_H \mathbf{S}_H + \rho_T \mathbf{S}_T)^m)$ .

pursue an alternative approach and construct weights matrices  $\mathbf{P} \equiv \{p_{ij,i'j'}\}$  that are based on a purely population and geography related gravity model in the spirit of Frankel and Romer (1999). In line with Equation (1), its elements are defined as  $p_{ij,i'j'} = \exp(\ln POP_i + \ln POP_j - \ln DIST_{ij})$ .

Summing up, the instruments that will be used for  $\bar{\mathbf{s}}^P$ ,  $\bar{\mathbf{s}}^H$ , and  $\bar{\mathbf{s}}^T$  in the estimation of Equation (3) are given by  $\bar{\mathbf{p}}^P \equiv \mathbf{P}_P \mathbf{p}^P$ ,  $\bar{\mathbf{p}}^H \equiv \mathbf{P}_H \mathbf{p}^H$ , and  $\bar{\mathbf{p}}^T \equiv \mathbf{P}_T \mathbf{p}^T$ , where  $\mathbf{p}^P$ ,  $\mathbf{p}^H$ , and  $\mathbf{p}^T$  are  $N \times 1$  vectors of (the log of) parent, host, and ROW population respectively.

### 3.2.2 Generalized Moments (GM) Estimation of Remainder Interdependence

Having obtained consistent estimates of the parameters in Equation (3), the residuals  $\hat{\mathbf{u}}$  can be used for estimation of Equation (4) in a second step. Our estimation procedure builds on the GM estimator introduced in the seminal paper by Kelejian and Prucha (1999) and their extension to the case of heteroskedastic error terms in Kelejian and Prucha (2010).

While the procedure in Kelejian and Prucha (2010) is designed for first order processes with one channel of interdependence in the disturbances (or spatial autocorrelation), Equation (4) involves a third-order process with three parameters to be estimated. For this, we employ the generalization of the GM estimator by Kelejian and Prucha (2010) to higher order spatial regressive models by Badinger and Egger (2011). This approach is based on the following moment conditions related to Equation (4):

$$\begin{aligned} N^{-1} [\mathbf{E}(\boldsymbol{\varepsilon}' \mathbf{S}'_m \mathbf{S}_{m'} \boldsymbol{\varepsilon}) - \text{Tr} \{ \mathbf{S}_{m'} [\text{diag}_{n=1}^N \mathbf{E}(\varepsilon_n^2)] \mathbf{S}'_m \}] &= 0, \\ N^{-1} \mathbf{E}(\boldsymbol{\varepsilon}' \mathbf{S}_m \boldsymbol{\varepsilon}) &= 0, \end{aligned}$$

where  $m' = \{P, H, T\}$  for  $m = \{P\}$ ,  $m' = \{H, T\}$  for  $m = \{H\}$ , and  $m' = \{T\}$  for  $m = \{T\}$ , i.e., there is a total of 6 moment conditions. (Tr indicates the trace operator.)

Again, to avoid endogeneity concerns with respect to the weights matrices  $\mathbf{S}$ , we will use both the preferred measure of economic distance defined in Equation (1), as well as population-based weights matrices  $\mathbf{P}$  in the estimation of the disturbance process (4).

### 3.2.3 Spatial Feasible Generalized Two-Stage Least Squares Estimation

Having estimated the disturbance process (4), the main Equation (3) can be estimated more efficiently by using a spatial feasible generalized two-stage least squares (FG2SLS) transformed version thereof, which is given by

$$\hat{\mathbf{T}}\mathbf{y} = \hat{\mathbf{T}}\mathbf{X}\boldsymbol{\beta} + \hat{\mathbf{T}}\mathbf{Q}\boldsymbol{\delta} + \gamma_P\hat{\mathbf{T}}\bar{\mathbf{s}}^P + \gamma_H\hat{\mathbf{T}}\bar{\mathbf{s}}^H + \gamma_T\hat{\mathbf{T}}\bar{\mathbf{s}}^T + \hat{\mathbf{T}}\mathbf{u}, \quad (5)$$

where  $\hat{\mathbf{T}} = (\mathbf{I} - \hat{\rho}_P\mathbf{S}_P - \hat{\rho}_H\mathbf{S}_H - \hat{\rho}_T\mathbf{S}_T)$  is the estimated spatial GLS transformation matrix, the scalars  $\hat{\rho}_P$ ,  $\hat{\rho}_H$ , and  $\hat{\rho}_T$  denote the estimates of the spatial regressive parameters from Equation (4),  $\hat{\mathbf{T}}\mathbf{u} = \hat{\boldsymbol{\varepsilon}}$ , is a consistent estimate of  $\boldsymbol{\varepsilon}$ , and the transformed instruments are given by  $\hat{\mathbf{T}}\bar{\mathbf{p}}^P$ ,  $\hat{\mathbf{T}}\bar{\mathbf{p}}^H$ , and  $\hat{\mathbf{T}}\bar{\mathbf{p}}^T$ . Badinger and Egger (2011) also provide results for a (consistent estimate of the) variance-covariance matrix of the spatial FG2SLS and the GM parameter estimates, which is robust against heteroskedasticity of arbitrary form in the error term  $\boldsymbol{\varepsilon}$ .

## 4 Estimation Results

In the following, we report the least squares (LS) and two-stage least squares (2SLS) estimates of Equation (3). We then turn to the results of the generalized moments (GM) estimates of the spatial regressive disturbance process (4) and the feasible generalized two-stage least squares (FG2SLS) estimates of Equation (3).

### 4.1 LS and 2SLS Estimates of Market-Size-Related Interdependence

The first column in Table 1 presents the LS estimates of our basic specification in Equation (3) without controls. Results are as expected and in line with previous studies: FDI is larger between larger parent and host countries that are located close-by to each other and share a common border.

Parent country GDP per capita also enters positively, whereas host country GDP per capita shows a negative sign, though it is not statistically significant. This suggests that differences in per capita income (which also approximate differences in capital-labor ratios) have a positive effect on bilateral FDI, which is consistent with vertical motives of FDI and a separation

of headquarters services in the parent country and production in host countries. In spite of the fact that host country GDP per capita is insignificant in most specifications, we proceed with an unrestricted version of Equation (3) to avoid biased estimates by imposing a wrong restriction and include parent and host GDP per capita (separately) in the subsequent analysis.

Column (2) acknowledges the *Spacey-Parents* and the *Spacey-Hosts* hypotheses by adding  $\bar{s}^P$  and  $\bar{s}^H$  to the basic specification. Both variables turn out to be statistically significant (at 1 and 5 percent, respectively) and are roughly equal in magnitude in statistical terms judged by their standard errors. Hence, there is no evidence for a predominant role of either mode of *market-size-related* interdependence – a finding that will be endorsed by other specifications below.

Moreover, notice that both coefficients  $\hat{\gamma}_P$  and  $\hat{\gamma}_H$  exhibit a positive sign. This suggests a dominance of *positive* market-size-related spillovers from increases in GDP of other host countries, which can be interpreted as evidence for the relevance of export-platform FDI. Moreover, it suggests a dominance of *positive* market-size-related spillovers from increases in GDP of other parent countries, which can be interpreted as evidence for existence of positive (possibly information-related) externalities among parents for a given host. Quantitatively, the results indicate that an increase in other parent and host countries' GDP by 1 percent increases FDI of a given parent-host country pair by 0.168 percent through the *Spacey-Hosts* channel and by 0.297 percent through positive spillovers from the *Spacey-Parents* channel.

Column (3) acknowledges the *Third-Country-Spacey-Parents-and-Spacey-Hosts* hypothesis by including the variable  $\bar{s}^T$ . The coefficient turns out negative as expected from a theoretical perspective though it is not significant at conventional levels. Hence, at least as *market-size-related* spillovers are concerned, there is no strong evidence for third-country effects beyond parent and host country spaceyness.

– Table 1 –

Column (4) presents the 2SLS estimates of the specification given in Column (2), where weighted parents' GDP ( $\bar{s}^P$ ) and weighted hosts' GDP ( $\bar{s}^H$ ) are instrumented by weighted parents' population ( $\bar{p}^P$ ) and weighted hosts' population ( $\bar{p}^H$ ), using weights matrices  $\mathbf{P}$  that are constructed based on a purely geographical gravity model (see Section 3.2). Notice first that a Hausman test rejects the null hypothesis of exogenous regressors at the 10 percent level (with a  $p$ -value of 0.064); this result is confirmed by further

specifications considered, such that we report only the 2SLS estimates in what follows.

Second, the 2SLS estimates are similar to the LS estimates. In particular, the spatial lags  $\bar{s}^P$  and  $\bar{s}^H$  turn out significant at 1 percent. Moreover their coefficients are larger than in the LS regression and virtually identical with values of 0.310 and 0.314, respectively. This confirms the positive effects and quantitatively equal role of *market-size-related* parent and host interdependence obtained in the LS estimates in Column (2).<sup>4</sup>

To ensure that our results are not driven by outliers, Column (5) reports the results of the specification in Column (4), where 5 outlying observations with standardized residuals larger than 3 are neutralized.<sup>5</sup> Results are identical in qualitative terms and very similar in quantitative terms, whereas the standard error decreases and the explanatory power of the model in terms of the  $R^2$  rises from 0.610 to 0.719. In the subsequent analysis we proceed with this approach towards treating outliers, though we add that our results hold up when disregarding them.

While the choice of a parsimonious specification is intentional, allowing to capture spillover effects materializing through various channels, we check the robustness of the results against including a set of indicators related to the institutional quality of the parent and the host country (see Section 3.1) in Column (6). Overall, a marginal increase in the attractiveness (in terms of institutional quality) of domestic investment in the parent country tends to reduce bilateral FDI, whereas better institutional quality in the hosts increases FDI. This finding may be interpreted as reflecting the trade-off between domestic and foreign investment under constrained resources, though it should be noted that most of the institutional indicators turn out insignificant at conventional levels. Most importantly, however, the variables  $\bar{s}^P$  and  $\bar{s}^H$  are robust against the inclusion of institutional controls and the findings concerning the *Spacey-Hosts* and *Spacey-Parents* hypotheses remain unchanged.

This also holds true for the specification in Column (7), where parent and

<sup>4</sup>Spatially weighted third countries' GDP ( $\bar{s}^T$ ), instrumented by  $\bar{p}^T$ , turns out insignificant as in the LS regression in Column (3).

<sup>5</sup>These are observations on the following parent-host country pairs: Czech Republic-Portugal, Greece-Slovenia, Poland-Norway, Portugal-Slovak Republic, and Slovak Republic-Portugal. We exclude the corresponding data points from the sample. Notice that this is almost equivalent to neutralizing them by pair-specific indicator variables, except that the latter procedure would rely on slightly differently normalized weights matrices for remainder spillovers in the disturbances.



host country fixed effects are included, along with the two bilateral variables  $DIST_{ij}$  and  $CB_{ij}$ . In fact, in this most comprehensive specification, the variables  $\bar{s}^P$  and  $\bar{s}^H$  assume their largest coefficients, suggesting that an increase in other parent and host countries GDP by 1 percent increases FDI of a given parent-host country pair by 0.461 percent through spillovers from other hosts and by 0.478 percent through spillovers from other parents.

## 4.2 GM Estimates of Remainder Interdependence and Spatial FG2SLS Estimates

In the following we test for *remainder*, i.e., other than *market-size-related* interdependence in the error term  $\mathbf{u}$  as specified in Equation (4) and present the results along with the FG2SLS estimates of Equation (3).

Columns (1a)-(1c) in the lower panel of Table 2 report the estimates of the preferred specification from Column (5) of Table 1, separately testing for each of the three modes of remainder interdependence associated with weights matrices  $\mathbf{S}_P$ ,  $\mathbf{S}_H$ , and  $\mathbf{S}_T$ . The coefficients point to statistically significant spillover effects resulting from *Spacey-Parents* and *Spacey-Hosts* relationships, and to negative spillovers from *Spacey-Third-Countries* relationships, though the latter are insignificant with a  $p$ -value of 0.180. When the GDP-based weights matrices  $\mathbf{S}$  are replaced by the population-based matrices  $\mathbf{P}$  the estimates of  $\rho_P$  and  $\rho_H$  are almost unchanged, whereas the estimate of  $\rho_T$  increases in magnitude to  $-1.900$  and becomes significant at the 5 percent level.

Column (1d) adds all three modes of interdependence simultaneously as specified in the third-order spatial regressive model in Equation (4). Compared with the results in Columns (1a)-(1c) the signs of the coefficients remain unchanged, though now all three spillover parameter estimates are significant at 1 percent. The multiplier effect associated with a simultaneous, unitary shock in the disturbances to all country-pairs implied by the estimates in Column (1d) amounts to 3.172. Hence, such a shock is amplified by a factor of more than three, alluding to the importance of spillovers.

Column (1e) reports the estimates, when the GDP-based weights matrices  $\mathbf{S}$  in Equation (4) are replaced by population based weights matrices  $\mathbf{P}$ . While there is no change in the qualitative conclusions relative to the previous model, the multiplier effect turns out smaller, amounting to 1.468.

Columns (2a)-(2d) of Table 2 report the results from the same estimation approach for the specification in Column (6) of Table 1, which extends the

baseline equation by the institutional control variables. Remainder spillover effects resulting from *Spacey-Parents* and *Spacey-Hosts* relationships still enter significantly, whereas *Spacey-Third-Country* effects now turn out insignificant with a t-statistic smaller than unity. When all three modes of interdependence are included jointly they all turn out significant, though with a multiplier effect smaller than one, amounting to 0.788. However, these results should not be over-stressed in light of the relatively large standard errors: in particular, the hypothesis that the multiplier effect in Column (2d) amounts to 1.5 (as in the specification in Column (1d)) cannot be rejected at the 10 percent level.

– Table 2 –

Finally, Columns (3a)-(3c) provide the corresponding results with parent and host country fixed effects included in the main Equation (3). In that case only *remainder spacey-hosts* effects remain significant in the estimation. It should be noted, however, that the parent and host country fixed effects are likely to capture not only demand side effects and institutional characteristics but also remainder spillover effects to some extent, partialling them out of the error term  $\mathbf{u}$ . In that case, controlling for these fixed effects would imply underestimating the role and magnitude of remainder interdependence when considering the disturbances alone. On the other hand, omitting parent and host country effects beyond observable variables might lead to an upward bias of *remainder* interdependence effects. This reasoning suggests interpreting the estimated *remainder* interdependence effects in Columns (1) and (3) as upper and lower bounds, respectively.

Results of the spatial FG2SLS estimation of Equation (3) are reported in the upper panel of Table 2. In fact, they turn out very similar to the ones of the 2SLS estimates in Section 4.1. Both *market-size related Spacey-Hosts* and *market-size related Spacey-Parents* effects enter significantly with coefficients of equal magnitude of around 0.4, suggesting that an increase in other parent and host countries' GDP by 1 percent increases FDI of a given parent-host country pair by some 0.8 percent through the export platform motive and positive spillovers from other parents.<sup>6</sup>

Taken together these results confirm the importance of the *market-size related and remainder Spacey-Parents* and *Spacey-Hosts* hypotheses and provide some weaker evidence for the existence of *remainder Spacey-Third-Countries* effects.

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<sup>6</sup>Again, we do not find a significant and robust effect of *market-size related Spacey-Third-Countries* effects.

## 5 Conclusions

This paper provides evidence on the relative importance of three modes of interdependence ('spaceyness') of bilateral foreign direct investment (FDI): (i) interdependence across parent countries' outward FDI in a given host country (*Spacey-Parents*), (ii) interdependence across host countries' inward FDI from a given parent country (*Spacey-Hosts*), and (iii) interdependence among FDI for a given parent-host country pair across other, third countries (*Spacey-Third-Countries*). It explicitly distinguishes between interdependence related to the market size of countries (*market-size-related* interdependence) and other, not further specified *remainder* determinants.

The paper considers a cross section of bilateral FDI among 22 European OECD countries referring to the year 2000, since FDI is expected to react to spillovers and fundamentals suggested by economic theory in the long run. A spatial econometric approach is employed to simultaneously test for the relevance of all three aforementioned modes of interdependence. According to our findings, both *market-size related* and *remainder* interdependence across host countries are important.

The evidence supports an interdependence of investments through both export-platform and vertical (intra-firm trade in intermediate goods) motives of FDI, consistent with the *Spacey-Hosts* hypothesis. Moreover, the paper provides evidence of the simultaneous role of interdependence of parent countries, consistent with the *Spacey-Parents* hypothesis. The latter may root in information spillovers and learning across parent countries about a given host country. Apparently, none of these modes of interdependence should be excluded from an empirical model a priori. There is somewhat weaker evidence on the role of *remainder* interdependence related to countries other than a given parent-host pair. The strongest and most robust mode of both *market-size-related* and *remainder* interdependence appears to be due to *Spacey-Hosts* relationships.

Overall, the results are supportive to multi-country theoretical models emphasizing the complexity of MNEs' integration strategies. They suggest a co-existence of various modes of interdependence in the world economy's bilateral FDI relationships that should be considered more closely in future theoretical work and be accounted for in empirical studies on MNE activity.

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## Appendix

Our cross-sectional sample refers to the year 2000 and consists of 22 European OECD countries, which enter the data-set as both parents and hosts of FDI, yielding a total of 462 observations. The countries are: Austria, Belgium-Luxembourg, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, and United Kingdom.

Data on aggregate stocks of outward FDI in nominal U.S. dollars at the bilateral level are from the United Nations Conference on Aid and Development (UNCTAD) and from the Organization for Economic Cooperation and Development (OECD). While the OECD provides data on inward as well as outward FDI of OECD countries only, UNCTAD reports data for a larger set of economies. Data on FDI tend to be incomplete from either source. Our aim is to focus on the largest possible set of countries, for which we can gather a complete cross-section of FDI stocks. Using data from both UNCTAD and OECD and interpolating missing values of outward FDI stocks by using inward FDI stocks from mirror statistics of the same sources, we obtain a cross-sectional dataset of bilateral stocks of outward FDI for the aforementioned 22 European OECD countries (excluding Iceland).<sup>7</sup>

Data on nominal and real GDP per capita (in 2000 USD) are taken from the World Bank's World Development Indicators database. The geographical variables, i.e., distance between country's capitals and the common border dummy, are from the the geographical database of the Centre d'Études Prospectives et d'Informations Internationales (CEPII). Finally, the variables related to the various institutional characteristics of the parent and host countries are from the International Country Risk Guide (ICRG) database. Summary statistics of the key variables used in the empirical analysis are provided in Table A1.

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<sup>7</sup>Apart from obtaining a balanced dataset, the focus on European OECD countries has two advantages. First, criteria of FDI data collection are more homogeneous than in a broader set of economies. Second, motives of FDI should be more similar than in a larger set of countries (with more pronounced differences in, e.g., factors costs and endowments).

Table A1: Descriptive Statistics of Key Variables

	mean	median	max	min	st. dev.
<i>FDI</i> <sup>a)</sup>	3902	274	272,990	0.01	15,684
<i>GDP</i> <sup>a)</sup>	439,364	184,000	2,140,000	20,600	570,147
<i>GDPPC</i> <sup>b)</sup>	17,866	21,837	36,390	2800	9820
<i>DIST</i> <sup>c)</sup>	1310	1242	3363	60	684
<i>CB</i>	0.1	0	1	0	0.6
<i>LAW</i>	5.4	6.0	6.0	4.0	0.7
<i>GOVSTAB</i>	10.1	10.1	11.0	9.1	0.6
<i>INVPROF</i>	9.2	9.0	11.0	6.0	1.3
<i>BUREAU</i>	3.6	4.0	4.0	2.0	0.6
<i>CORRUPT</i>	4.6	5.0	6.0	2.0	1.0
<i>INTCONF</i>	11.0	12.0	12.0	4.3	2.0
<i>SOCEC</i>	6.9	7.3	10.0	2.0	1.8

*Notes:* Descriptives based on 457 observations (excluding 5 outlying observations), referring to the year 2000. <sup>a)</sup> nominal GDP and stocks of outward FDI in mill. USD, <sup>b)</sup> real GDP per capita in USD (base year 2000), <sup>c)</sup> Distance in kilometers between countries' capitals.



Table 1: LS and 2SLS Estimates of Equation (3)

	Dependent variable is $\ln FDI_{ij}$						
	(1) LS	(2) LS	(3) LS	(4) 2SLS	(5) 2SLS	(6) 2SLS	(7) 2SLS
$\ln GDP_i$	1.180*** (0.088)	1.419*** (0.177)	1.416*** (0.178)	1.613*** (0.172)	1.678*** (0.147)	1.551*** (0.145)	.
$\ln GDP_j$	1.026*** (0.122)	1.430*** (0.221)	1.427*** (0.221)	1.454*** (0.219)	1.232*** (0.144)	1.449*** (0.152)	.
$\ln GDPPC_i$	1.973*** (0.180)	1.870*** (0.184)	1.874*** (0.185)	1.819*** (0.179)	1.731*** (0.154)	1.846*** (0.299)	.
$\ln GDPPC_j$	-0.055 (0.154)	-0.183 (0.158)	-0.178 (0.157)	-0.209 (0.162)	-0.105 (0.130)	-0.934*** (0.273)	.
$\ln DIST_{ij}$	-1.180*** (0.206)	-1.586*** (0.271)	-1.603*** (0.276)	-1.723*** (0.265)	-1.707*** (0.215)	-1.353*** (0.241)	-1.994*** (0.339)
$CB_{ij}$	0.279 (0.314)	0.568* (0.307)	0.551* (0.311)	0.666** (0.323)	0.539* (0.294)	0.949*** (0.312)	0.947*** (0.325)
$\bar{s}_{ij}^P$	.	0.297*** (0.096)	0.265*** (0.096)	0.310*** (0.102)	0.241*** (0.084)	0.292*** (0.088)	0.478*** (0.166)
$\bar{s}_{ij}^H$	.	0.168** (0.085)	0.136 (0.090)	0.314*** (0.102)	0.341*** (0.092)	0.305*** (0.091)	0.461** (0.199)
$\bar{s}_{ij}^T$	.	.	-3.375 (3.484)	.	.	.	.
$LAW_i$	.	.	.	.	.	0.507** (0.223)	.
$LAW_j$	.	.	.	.	.	0.206 (0.214)	.
$GOVSTAB_i$	.	.	.	.	.	0.271 (0.180)	.
$GOVSTAB_j$	.	.	.	.	.	0.336* (0.176)	.
$INVPROF_i$	.	.	.	.	.	-0.150** (0.076)	.
$INVPROF_j$	.	.	.	.	.	0.107 (0.082)	.
$BUREAU_i$	.	.	.	.	.	-0.310 (0.341)	.
$BUREAU_j$	.	.	.	.	.	0.729** (0.332)	.
$CORRUPT_i$	.	.	.	.	.	0.009 (0.113)	.
$CORRUPT_j$	.	.	.	.	.	-0.068 (0.118)	.
$INTCONF_i$	.	.	.	.	.	-0.153*** (0.045)	.
$INTCONF_j$	.	.	.	.	.	0.033 (0.051)	.
$SOCOEC_i$	.	.	.	.	.	-0.167* (0.090)	.
$SOCOEC_j$	.	.	.	.	.	0.178** (0.084)	.
$R^2$	0.601	0.612	0.612	0.610	0.719	0.753	0.800
$\sigma_u$	2.434	2.406	2.408	2.412	1.818	1.733	1.605
Observations	462	462	462	462	457	457	457

Notes: In 2SLS estimates (columns (4)-(7)),  $\bar{s}_{ij}^P$ ,  $\bar{s}_{ij}^H$ ,  $\bar{s}_{ij}^T$  are instrumented by  $\bar{p}_{ij}^P$ ,  $\bar{p}_{ij}^H$ ,  $\bar{p}_{ij}^T$  (see Section 3.2). Columns (5)-(7) excludes 5 outliers, defined as observations where the standardized residual in column (4) exceeds a value of 3. \*, \*\*, \*\*\* indicate significance at the 10, 5, and 1 percent level. Heteroskedasticity-robust standard errors in parentheses.

Table 2: Spatial FG2SLS Estimates of Equation (3) and GM Estimates of Equation (4)

	Dependent variable is $\ln FDI$											
	(1a)	(1b)	(1c)	(1d)	(1e)	(2a)	(2b)	(2c)	(2d)	(3a)	(3b)	(3c)
$\ln GDP_i$	1.568*** (0.135)	1.754*** (0.231)	1.730*** (0.155)	1.607*** (0.219)	1.568*** (0.218)	1.499*** (0.136)	1.668*** (0.219)	1.651*** (0.165)	1.636*** (0.212)	.	.	.
$\ln GDP_j$	1.112*** (0.205)	1.287*** (0.139)	1.281*** (0.149)	1.207*** (0.219)	1.149*** (0.221)	1.374*** (0.191)	1.425*** (0.138)	1.537*** (0.166)	1.410*** (0.189)	.	.	.
$\ln GDP_{PPC_i}$	1.725*** (0.149)	1.918*** (0.278)	1.749*** (0.155)	1.799*** (0.268)	1.904*** (0.269)	1.839*** (0.292)	1.361*** (0.487)	1.699*** (0.314)	1.217*** (0.512)	.	.	.
$\ln GDP_{PPC_j}$	-0.036 (0.212)	-0.202 (0.127)	-0.090 (0.132)	-0.157 (0.228)	-0.022 (0.243)	-0.984*** (0.355)	-0.877*** (0.254)	-1.030*** (0.284)	-0.966** (0.364)	.	.	.
$\ln DIST_{ij}$	-1.454*** (0.231)	-2.038*** (0.229)	-1.793*** (0.227)	-1.828*** (0.274)	-1.831*** (0.282)	-1.280*** (0.246)	-1.571*** (0.247)	-1.485*** (0.293)	-1.554*** (0.260)	-2.001*** (0.322)	-1.904*** (0.321)	-2.136*** (0.312)
$CB_{ij}$	0.627** (0.295)	0.748** (0.294)	0.535* (0.292)	0.828*** (0.287)	0.752*** (0.279)	0.885*** (0.297)	1.013*** (0.291)	0.921*** (0.302)	0.918*** (0.281)	0.951*** (0.309)	0.858*** (0.284)	0.909*** (0.316)
$\bar{s}_{ij}^P$	0.216* (0.125)	0.288*** (0.080)	0.267*** (0.092)	0.326** (0.132)	0.294** (0.132)	0.248** (0.112)	0.302*** (0.077)	0.333*** (0.115)	0.287*** (0.112)	0.479*** (0.157)	0.325** (0.129)	0.444*** (0.166)
$\bar{s}_{ij}^H$	0.261*** (0.080)	0.555*** (0.177)	0.371*** (0.102)	0.398*** (0.149)	0.351** (0.143)	0.267*** (0.083)	0.427*** (0.155)	0.357*** (0.122)	0.535** (0.147)	0.469** (0.190)	0.436** (0.184)	0.455** (0.209)
inst. controls	no	no	no	no	no	yes	yes	yes	yes	no	no	no
parent, host FE	no	no	no	no	no	no	no	no	no	yes	yes	yes
$R^2$	0.719	0.702	0.718	0.711	0.713	0.753	0.738	0.749	0.735	0.799	0.646	0.787
$\sigma_u$	1.818	1.878	1.823	1.954	1.839	1.733	1.784	1.749	1.796	1.605	2.245	1.681
Disturbance process												
$\rho_P$	0.430*** (0.091)	.	.	0.475*** (0.084)	0.498*** (0.107)	0.272** (0.108)	.	.	0.303*** (0.082)	-0.024 (0.220)	.	.
$\rho_H$	.	0.532*** (0.066)	.	0.515*** (0.010)	0.501*** (0.024)	.	0.441*** (0.065)	.	0.440*** (0.054)	.	0.734*** (0.037)	.
$\rho_T$	.	.	-0.802 (0.598)	-0.306*** (0.172)	-0.681*** (0.109)	.	.	-2.762 (3.202)	-1.022*** (0.356)	.	.	7.579 (31.396)
multiplier	1.754	2.136	0.555	3.172	1.468	1.374	1.788	0.266	0.782	0.977	3.757	-0.152
$\sigma_\varepsilon$	1.058	1.056	1.061	1.052	1.052	1.055	1.053	1.055	1.051	1.048	1.048	1.046

Notes: All models are based on a cross-section of 457 observations. Column (1e) uses  $\mathbf{P}$  instead of  $\mathbf{S}$  in Equation (4). \*, \*\*, \*\*\* indicate significance at the 10, 5, and 1 percent level. Heteroskedasticity-robust standard errors in parentheses.