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Austrian Outbound Foreign Direct Investment in Europe: A spatial econometric study

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Abstract

This paper focuses on Austrian outbound foreign direct investment (FDI, measured by sales of Austrian affiliates abroad) in Europe over the period 2009–2013, using a spatial Durbin panel data model specification with fixed effects, and a spatial weight matrix based on the first-order contiguity relationship of the countries and normalised by its largest eigenvalue. Third-country effects essentially enter the empirical analysis in two major ways: *first*, by the endogenous spatial lag on FDI (measured by FDI into markets nearby the host country), and, *second*, by including an exogenous market potential variable that measures the size of markets nearby the FDI host country in terms of gross domestic product. The question whether the empirical result is compatible with horizontal, vertical, export-platform or complex vertical FDI then depends on the sign and significance levels of both the coefficient of the spatial lag on FDI and the direct impact estimate of the market potential variable. The paper yields robust results that provide significant empirical evidence for horizontal FDI as the main driver of Austrian outbound FDI in Europe. This result is strengthened by the indirect impact estimate of the market potential variable indicating that spatial spillovers do not matter.

Key words: Foreign direct investment, panel econometrics, spatial econometrics, spatial Durbin model, fixed effects

JEL classification: C21, F23, R12

1 Introduction

Foreign direct investment (FDI)[1] may be defined as investment from one country to another (usually by multinational corporations) that involves significant equity stake in – or effective management control of – companies located in foreign countries (see de Mello 1997). FDI has expanded rapidly throughout the world economy in recent years, helped by relaxing restrictions on capital transfer and increased efforts of many countries to attract foreign capital[2]. This growth in FDI has led to a proliferation of scholarly efforts to analyse the economic factors/conditions in the host countries that pull in FDI flows (see Blonigen 2005 for a review of the empirical literature on FDI determinants).

Most empirical studies on the determinants of FDI over recent decades have relied on a gravity-type two-country (bilateral) framework where market size of the host country, measured in terms of gross domestic product (GDP), and distance provide explanatory power. This framework assumes that the decision of a multinational company to invest in a particular host country is independent of the decision whether or not to invest in any other country. But both export-platform and complex vertical motivations for FDI imply that FDI decisions are multilateral in nature (Blonigen et al. 2007). Thus, countries cannot be treated as independent entities.

Recent econometric studies recognise the multilateral nature of FDI decisions and account for third-country effects in two different ways: *first*, by the endogenous spatial lag on FDI (measured by FDI into markets nearby the host country), and, *second*, by including an exogenous market potential variable that measures the size of markets nearby the FDI host country in terms of GDP. Baltagi, Egger and Pfaffermayr (2007), Blonigen et al. (2007), Poelhekke and van der Ploeg (2009), and Regelink and Elhorst (2015) focus on US outbound FDI, while Garretsen and Peeters (2009) on Dutch, and Chou, Chen and Mai (2010) on Chinese outbound FDI. All these studies, though using different data, and spatial cross-section as well as spatial panel data models, find significant third-country effects, but

[1] Note that FDI ought to be distinguished from portfolio management (i.e. the purchase of one country's securities by another country) by the element of control.

[2] FDI may involve constructing a new plant in a foreign country (the so-called greenfield case). But the most important form of FDI come in the form of cross-border mergers and acquisitions where a foreign company purchases an existing firm in the host country (Neary 2009). Four types of FDI may be distinguished: horizontal, vertical, export-platform and complex vertical FDI.

generally produce empirical results that are inconsistent with formal theory on horizontal, vertical, export-platform or complex vertical FDI.

This paper focuses on Austrian outbound FDI into European countries and departs from previous research in several respects: *first*, by using a fixed effects spatial Durbin model that generalises the spatial lag of FDI model specification, the workhorse model of empirical research on FDI; *second*, by specifying the spatial weight matrix in form of a binary contiguity rather than an inverse distance matrix to describe the connectivity structure between the host countries in the sample, and *finally* and perhaps most importantly, by using a partial derivative interpretation of the impact of changes in the market potential variable on the dependent variable in the model as a more valid basis for testing. The question whether the empirical result obtained is compatible with horizontal, vertical, export-platform or complex vertical FDI, then depends on the sign and significance levels of both the coefficient of the spatial lag on FDI and the direct impact estimate of the market potential variable.

The remainder of the paper is organised as follows. The next section presents details on the econometric approach. Section 3 describes the data and the specification of the spatial weight matrix. Section 4 reports the findings of the study. The final section summarises and concludes.

2 The econometric approach

We start with a spatial model specification that encompasses those used in prior work by Blonigen et al. (2007), Garretsen and Peeters (2009), Ledyaeva (2009) Poelhekke and van der Ploeg (2009), Regelink and Elhorst (2015) among others. This (spatial autoregressive) model specification can be written as[3]

$$FDI_t = \rho\, W\, FDI_t + GDP_t\, \gamma + W\, GDP_t\, \theta + X_t\, \beta + \mu + \zeta_t\, \iota_N + \varepsilon_t \tag{1}$$

[3] There are differences in covariates used across FDI studies, there are also differences across studies in whether variables are in levels or in logs (for a review see Blonigen and Piger 2014). But models in logs are typically preferable from an econometric point of view, as pointed out by Mutti and Grubert (2004).

for $t = 1,...,T$. All variables are in log form. FDI_t denotes an N-by-1 vector of time t observations on the dependent variable for the N host countries in the sample. W is an N-by-N matrix of known constants that describes the connectivity structure of the host countries in the sample, and assumed to be constant over time. The main diagonal elements are set to zero by convention, since no country can be viewed as its own neighbour. All entries of W are row-normalised or, alternatively, normalised by the largest eigenvalue. The N-by-1 vector $W\,FDI_t$ is the spatial lag of (logged) FDI at time t reflecting a linear combination of neighbouring country values for the dependent variable. The scalar parameter ρ (called spatial autoregressive coefficient) measures the strength of spatial dependence with boundaries on the permissible (stationary) parameter space determined by minimum and maximum eigenvalues of the N-by-N matrix W (for details see Le Gallo 2014).

X_t represents an N-by-K matrix of time t observations on K explanatory variables of foreign direct investment, and β denotes the K-by-1 vector of associated parameters. The variable gross domestic product (GDP) with the associated scalar parameter γ is taken apart from this set of variables, since it is also used to measure the market potential surrounding the FDI host country. The N-by-1 vector $W\,GDP_t$ represents the market potential[4] at time t, and θ is the associated scalar parameter. $\mu = (\mu_1,...,\mu_N)'$ is the N-by-1 vector of country-specific fixed effects, and $\zeta_t\,\iota_N$ the N-by-1 vector of time-period specific fixed effects, with ι_N denoting the N-by-1 vector of ones associated with ζ_t. Country specific and time-period specific fixed effects are optional. $\varepsilon_t = (\varepsilon_{1t},...,\varepsilon_{Nt})'$ is a vector of disturbances, where the ε_{it} are independently and identically distributed for $i = 1,...,N$ and $t = 1,...,T$ with zero mean and variance σ^2.

The scalars ρ, γ, θ and the K-by-1 vector β represent unknown parameters that may be estimated by maximum likelihood (for mathematical details see Elhorst 2010). The response parameters of the model can be estimated by concentrating out the fixed effects

[4] Note that most previous studies take instead the logarithm of the weighted average of GDP in neighbouring countries, that is $\ln W\,GDP_t$, rather than $W \ln GDP_t$.

first. Then the resulting equation can be estimated by the maximum likelihood procedure developed by Anselin (1988) for the cross-sectional spatial lag model, provided that this procedure is generalised from a single cross-section of *N* observations to *T* cross-sections of *N* observations (Elhorst 2014a). Lee and Yu (2010) show that the maximum likelihood estimator of the spatial autoregressive model with country specific fixed effects, as set out in Elhorst (2010) will lead to an inconsistent parameter estimate of the variance parameter, σ^2, if *N* is large and *T* is small, and inconsistent estimates of all parameters of the spatial lag of FDI model with country and time-period fixed effects if both *N* and *T* are large. To correct for this, Lee and Yu (2010) suggest a simple bias correction procedure based on the parameter estimates of the uncorrected approach (for details see Elhorst 2014a, b).

Blonigen et al. (2007) and subsequent studies use the point estimates ρ of the spatially lagged FDI variable and θ of the market potential variable to distinguish between four types of FDI. The parameter combination $\rho = \theta = 0$ points to *horizontal FDI* where the decision of a parent country to invest in a country is motivated to save on trade costs by serving markets locally rather than trading. by market access and avoidance of trade friction in the host country. An outcome $\rho < 0$ and $\theta = 0$ is seen to be consistent with *vertical FDI* where the parent company fragments its production process to foreign sites to get cheaper factor inputs.

A result $\rho < 0$ and $\theta > 0$ is regarded to support the hypothesis of *export-platform FDI*, in which case a multinational corporation establishes a plant in one of the potential host countries to sell in both the host and other nearby markets. $\rho > 0$ and $\theta \geq 0$ is taken as evidence for *complex vertical FDI*, that is characterised as investment whereby a multinational company off-shores one or more steps of its production chain over various host countries in order to exploit factor cost differences among these countries[5]. The outcome $\theta < 0$, finally, is inconsistent with any formal FDI theory (Regelink and Elhorst 2015).

But using the point estimate of θ for testing which motive predominantly drives FDI may lead to erroneous conclusions. An examination of the data generating process for this model,

[5] In other words, export-platform and complex vertical FDI involve exports to third markets, the difference is that complex vertical multinational activities would be associated with exports of intermediate inputs from affiliates to third countries for further processing before being shipped to final destinations (Blonigen et al. 2007).

shown in Eq. (2), makes it clear that the model reflects a non-linear relationship between FDI_t and the right-hand side terms GDP_t, X_t and $W\,GDP_t$:

$$FDI_t = (I_N - \rho\, W)^{-1}(GDP_t\,\gamma + X_t\,\beta + W\,GDP_t\,\theta) + R \tag{2}$$

where R is a rest term that contains the country and time-period effects, and the error terms. The matrix inverse $(I_N - \rho W)^{-1}$ can be expressed as an infinite sequence: $I_N + \rho\, W + \rho^2 W^2 + \rho^3 W^3 + \ldots$, and the product $W\,GDP_t$ reflects a linear combination of (logged) GDP from neighbouring countries. The matrix product $W^2\,GDP_t$ creates a linear combination involving neighbours to the neighbouring countries, or what are sometimes called second-order neighbours. The main diagonal elements of W^2 are not zero, since countries will be by definition neighbours to their neighbours. This means that feedback effects are present in the model (see LeSage and Pace 2014).

One implication of the non-linear relationship in the model between the dependent and independent variables is that the coefficients β, γ and θ cannot be interpreted as if they reflect linear regression slope estimates. The spatial econometrics literature interprets coefficients of models of this type using marginal effects that reflect partial derivatives indicating how changes in each explanatory variable impact (or affect) the expected FDI_t outcomes (see LeSage and Pace 2009).

The matrix of partial derivatives of the expected value of FDI_t with respect to $W\,GDP_t$ in country 1 up to country N at a particular point in time can be seen to be

$$\left(\frac{\partial E(FDI_t)}{\partial W\,GDP_{1t}} \quad \cdots \quad \frac{\partial E(FDI_t)}{\partial W\,GDP_{Nt}}\right) = \begin{bmatrix} \frac{\partial E(FDI_{1t})}{\partial W\,GDP_{1t}} & \cdots & \frac{\partial E(FDI_{1t})}{\partial W\,GDP_{Nt}} \\ \vdots & & \vdots \\ \frac{\partial E(FDI_{Nt})}{\partial W\,GDP_{1t}} & \cdots & \frac{\partial E(FDI_{Nt})}{\partial W\,GDP_{Nt}} \end{bmatrix} =$$

$$= (I_N - \rho W)^{-1} \begin{bmatrix} \theta & 0 & \cdots & 0 \\ 0 & \theta & \cdots & 0 \\ \vdots & \vdots & & \vdots \\ 0 & 0 & \cdots & \theta \end{bmatrix}. \quad (3)$$

Note that if a particular explanatory variable (such as the market potential variable $W\,GDP_t$) in a particular country changes, not only will the dependent variable in that country change but also the dependent variables in other countries. The first is called a *direct impact* or effect and the second an *indirect impact* or spillover effect. Every main diagonal element of the matrix of partial derivatives in Eq. (3) represents a direct impact, and every off-diagonal element represents an indirect impact. Consequently, indirect effects do not occur if both $\rho = 0$ and $\theta = 0$, since all off-diagonal elements will then be zero [see Eq. (3)].

Since both direct and indirect impacts are different for different countries in the sample, the presentation of the effects is a problem. If we have N countries and $(K+2)$ explanatory variables, we get $(K+2)$ different N-by-N matrices of direct and indirect impacts. Even for smaller values of N and $(K+2)$, it may be difficult to report these results completely. LeSage and Pace (2009) therefore suggest to report one scalar measure for the direct impact, given by the mean of the main diagonal elements of the matrix on the right-hand side of Eq. (3), and one scalar summary measure for the indirect impact, calculated as the average of the column (or row) sums[6] of the off-diagonal elements of that matrix. In order to draw inferences regarding the statistical significance of the direct and indirect impact estimates, these authors suggest simulating the distribution of the impact estimates using the variance-covariance matrix implied by the maximum likelihood estimates.

Recall that the fixed effects spatial lag of FDI model given by Eq. (1) allows for two types of spatial interaction: the endogenous spatial lag on FDI_t, and the market potential variable that measures the size of markets nearby the FDI host country in terms of GDP. In

[6] Note that the numerical magnitudes of these two calculations of the indirect impact are the same (LeSage and Pace 2009) so it does not matter which one is used.

this study, we suggest shifting attention to the fixed effects spatial Durbin model[7] that extends the fixed effects spatial lag of FDI model by including not only the potential market variable, but also all the spatially lagged X_t variables. More specifically, this model specification is given by

$$FDI_t = \rho\, W\, FDI_t + GDP_t\, \gamma + W\, GDP_t\, \theta + X_t\, \beta + W\, X_t\, \delta + \mu + \zeta\, \iota_N + \varepsilon_t\,. \tag{4}$$

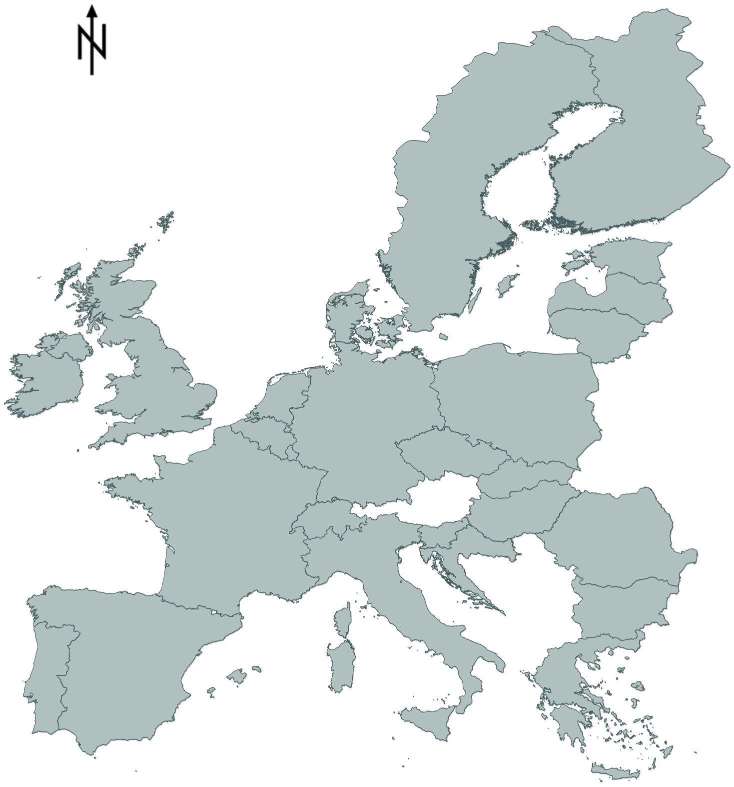
Note that this model can be estimated as a fixed effects spatial lag of FDI model with explanatory variables $(X_t\ WX_t)$ instead of X_t. The model produces unbiased coefficient estimates even if the true data generating process is a spatial lag model. This is because the fixed effects spatial lag model is a special case of the fixed effects spatial Durbin model (Elhorst 2014b).

3 Sample data and the spatial weight matrix

To test for third-country effects and the motivations behind investing in a particular host country, we use a panel of annual data on Austrian outbound FDI in Europe, covering the period from 2009 to 2013. Figure 1 shows a map of the European countries considered. Our sample contains a total of 26 host countries including fifteen countries in Western Europe (Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden, Switzerland and the UK) and eleven countries in Central and Eastern Europe (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia).

[7] The use of the spatial Durbin model, moreover, is known to help protecting against the omitted variables bias (see LeSage and Pace 2009).

Figure 1. **A map of the host country coverage**



There are various measures of FDI (for example, cross-border mergers and transactions, and FDI stocks). But – following Carr, Markusen and Maskus (2001), Bergstrand and Egger (2007), and Beugelsdijk et al. (2010) – foreign direct investment is measured in this study by sales of Austrian-owned affiliates in the host country, converted to millions of real Euro using a chain-type price index for gross domestic investments[8]. The data come from Statistik Austria. Sales of Austrian-owned affiliates abroad is only available from 2009 onwards, for a significant number of countries. This limits our analysis to the time period 2009–2013.

As in previous studies, including those of Blonigen et al. (2007), Poelhekke and van der Ploeg (2009), and Regelink and Elhorst (2015), we use standard host country gravity model variables, such as GDP, trade costs, distance [from Austria], institutional quality, and a variable that measures skilled labour endowments (see Appendix A for the definition and

[8] This measure that corresponds to affiliates' volume of activity rather than historical book value appears to be more appropriate than FDI stock data that can be significantly affected by financial transactions of firms not related to their current productivity activities (Blonigen and Piger 2014).

data sources of the variables). Parent country characteristics are left aside. Since the parent country is always Austria, these variables would have no effect on its outbound FDI into different countries.

The variable GDP_{it} (in million Euro) measures the size of the host country *i* at time *t*. We expect this variable to be positively related to FDI. Following some recent studies (see Poelhekke and van der Ploeg 2009, and Chou, Chen and Mai 2011), we also include GDP per capita (pc). One variable of major interest is the market potential variable, $W\,GDP_t$, that measures the market potential surrounding a host country. The expected sign of this variable is not clear cut. If Austrian outbound FDI is mainly driven by export-platform considerations, we expect that the market potential variable enters with a positive sign. But if FDI is predominantly of the horizontal or vertical type, there is no reason to expect market potential to matter.

Trade costs, a proxy capturing the barriers that might hamper trade between Austria and the host country, are measured just as in Blonigen et al (2007), as the inverse of the openness measure, which itself is equal to exports plus imports divided by GDP. As in standard gravity regressions, we include the distance between the parent and the host country, measured using great circle distances between their capital cities (in kilometres). Distance may be proxying for factors other than trade costs, such as the costs of managing a distant subsidiary.

Similar to but not exactly following Garretsen and Peeters (2009), and Regelink and Elhorst (2015), we measure the risk of investing in a particular country by the quality of institutions calculated as the mean of three indicators, namely corruption, rule of law and property rights. This variable is based on data provided by the Quality of Government Institute, Göteborg University (see Teorell et al. 2016), and ranges between zero and one hundred. Higher values manifested by good rules of law, low corruption and well enforced property rights indicate low risk of investment.

Host country skilled labour endowment is proxied by the skills of the workforce as given by the level of tertiary education attainment of the active population relative to the total workforce (aged 25–64 years) in the host country. This variable is expected to be positively correlated with FDI. If, however, FDI is undertaken to benefit from low skilled labour abundance, the effect will be negative, which is the case when vertical FDI dominates.

Spatial weight matrices widely used in applied research are *q*-order binary contiguity matrices, inverse distance matrices (with or without a cut-off point), and *k*-nearest neighbour matrices where *q* and *k* are positive integers. In the empirical FDI literature, *W* is generally specified as an inverse distance matrix without a cut-off point, where the off-diagonal elements are of the form d_{ij}^{-1}, with d_{ij} denoting the distance between countries i and j. *W* is then row-standardised. As noted by Elhorst (2014a), this spatial weight matrix specification may sometimes – and does in the current study – lead to numerical problems and unexpected outcomes in empirical application. This is why we use a first-order contiguity rather than an inverse distance matrix.

It is common practice to row-normalise the spatial weight matrix *W* such that the elements of each row sum up to unity. Since *W* is non-negative, this guarantees that all weights are between zero and one, and implies that the weighting operation can be interpreted as an averaging of neighbouring values. But row-normalisation is not free of criticism. Kelejian and Prucha (2010) show that normalisation of the elements of the weighting matrix by a different factor for each row as opposed to a single factor may lead to a misspecification problem.[9] For this reason, we follow Elhorst (2001), and Kelejian and Prucha (2010), and use a normalised procedure where each element of the first-order contiguity matrix is divided by its largest eigenvalue.

4 Estimation results

Table 1 reports the estimation results when adopting the spatial lag of FDI model given by Eq. (1). Impact estimates were produced by simulating parameters using the maximum likelihood multivariate normal parameter distribution. A series of 10,000 simulated draws were used. The reported means and *t*-statistics (in parentheses) were constructed from the simulation output. Performance is expressed in terms of two goodness-of-fit measures: *R*-squared and the squared correlation coefficient between actual and fitted values (for a definition of the measures see Elhorst 2014a, pp 59–60). Note that the difference between

[9] This problem arises especially when an inverse distance matrix is row-normalised because then its economic interpretation in terms of distance decay will be no longer valid (Elhorst 2014a).

both indicates how much of the variation is explained by the fixed effects, and the difference in this study is quite substantial.

The first two columns present the results of the spatial lag of FDI model without fixed effects. As is common in gravity models of FDI, we find that the size of the host country enhances and distance lowers FDI. The main objection to this model specification is that it does not account for spatial and temporal heterogeneity. Countries are likely to differ in their background variables, which are usually country specific time-invariant variables that do affect the dependent variable, but which are difficult to measure or hard to obtain. Failing to account for these variables increases the risk of generating biased estimation results. One way to overcome this issue is to include country specific fixed effects.

The results of the country fixed effects specification, estimated by maximum likelihood (see Lee and Yu 2010) using Elhorst's (2014a) Matlab routines with a bias correction procedure, are given in the next two columns of Table 1. Distance is dropped from the model specification to avoid perfect multicollinearity. Inclusion of country specific effects

Table 1. Results obtained by estimating the spatial lag of FDI model given by Eq. (1), *t*-statistics in parentheses

	Without fixed effects		**With country specific fixed effects**		**With country and time-period fixed effects**	
Determinants	**Coefficient**	**Direct Impact**	**Coefficient**	**Direct Impact**	**Coefficient**	**Direct Impact**
GDP	0.6189 (5.6375)	0.6199 (0.5769)	2.7723 (1.7865)	2.7740 (1.7703)	2.6235 (1.5485)	2.6391 (1.5478)
GDP pc	– 0.7272 (– 3.3428)	– 0.7272 (– 3.3133)	– 4.2398 (– 2.7087)	– 4.2747 (– 2.7066)	– 4.1790 (– 2.4411)	– 4.2026 (– 2.4274)
Trade costs	0.3181 (1.0343)	0.3226 (1.0449)	– 1.4794 (– 3.4564)	– 1.4880 (– 3.4460)	– 1.4784 (– 2.2453)	– 1.4769 (– 2.2634)
Distance from Austria	– 1.0806 (– 6.8802)	– 1.0855 (– 6.8912)	— —	— —	— —	— —
Skilled labour	0.5652 (1.3393)	0.5690 (1.3405)	0.5744 (0.9551)	0.5730 (0.9377)	– 0.0201 (– 0.0228)	– 0.0168 (– 0.0189)
Institutional quality	0.0646 (0.0959)	0.0589 (0.0883)	0.2258 (0.4728)	0.2315 (0.4816)	0.2257 (0.4560)	0.2273 (0.4570)
Market potential	0.0448 (0.4748)	0.0447 (0.4726)	1.2030 (0.6681)	1.2026 (0.6720)	1.2762 (0.7079)	1.2817 (0.7142)
Spatial lag on	– 0.0180	—	– 0.0090	—	0.0748	—

FDI	(– 0.1265)	___	(– 0.0607)	___	(0.4803)	___
R-squared	0.6189		0.9788		0.9792	
Corr-squared	0.6184		0.3248		0.0818	

Notes: All variables are in log form; number of observations is 130; distance is dropped from the model specifications with fixed effects to avoid perfect multicollinearity; parameters estimated by maximum likelihood with bias correction (see Lee and Yu 2010) using Elhorst's Matlab routines (Elhorst 2014a); measures of dispersion for inference calculated by simulating 10,000 values for the parameters from the estimated variance-covariance matrix.

improves the fit a lot. The fixed effects are individually and jointly significant, but they do not help much to understand the distribution of FDI. Given the shortage of space, they are not reported here. Turning to the variables of major interest, we find the coefficient on the spatially lagged value of FDI to be negative, but not significantly different from zero, and the coefficient of the market potential to be positive and not significant.

But rather than the point estimate the direct effects estimate of the market potential variable should be considered, otherwise one might draw invalid conclusions. The direct impact estimate calculated from the partial derivatives of the model is not significantly different from zero, which together with the insignificant coefficient on the spatially lagged value of FDI points to horizontal motivations.

It is worth noting that the difference between the parameter estimate and the direct impact estimate is rather small. The difference equals to 0.0004 representing feedback effects that arise as a result of impacts passing through neighbouring countries and back to the country itself. The discrepancy is negative since the coefficient exceeds the impact estimate, reflecting some negative feedback. Since the difference between the coefficient estimate and the direct impact estimate is rather small, we may conclude that feedback effects are small and not likely of economic significance.

The final two columns in Table 1 add controls for time-period fixed effects. If we compare the results with those of the country specific fixed model specification, we see that the point estimate of the spatially lagged value of FDI changes sign, but the estimate is still not significantly different from zero. This together with the insignificant direct impact estimate of the market potential variable points to horizontal motivation as main driver of FDI. Overall considered, the fixed effects spatial lag of FDI model specifications generate robust results. The results obtained from the country fixed effects specification and those from the country and time-period fixed effects specification provide clear and robust evidence consistent with horizontal FDI motives.

The results obtained by estimating the spatial Durbin model are reported in Table 2. The first three columns of the table present the results when controlling for country specific fixed effects, and the next three columns those when controlling for both country and time-period fixed effects. The parameter estimates are given in the first and fourth columns, followed by the direct impact estimates in the second and fifth, and the indirect impact estimates in the third and sixth columns. The *t*-statistics are reported in parentheses. Recall that the fixed effects spatial Durbin model specifications extend the spatial lag versions by including not only the market potential variable, but also the spatially lagged *X* variables. For matter of completeness the indirect impact estimates are reported, since one may also consider the in-direct effect of the market potential variable to test the hypothesis as to whether a change in

Table 2 Results obtained by estimating the fixed effects spatial Durbin model specification given by Eq. (4), *t*-statistics in parentheses

	Country specific fixed effects			Country and time specific fixed effects		
Determinants	**Coefficient**	**Direct Impact**	**Indirect Impact**	**Coefficient**	**Direct Impact**	**Indirect Impact**
GDP	2.4080 (1.4097)	2.4182 (1.4237)	– 0.0454 (– 0.1511)	2.3596 (1.2893)	2.3690 (1.2824)	0.0399 (0.1207)
GDP pc	– 3.6659 (– 2.0152)	– 3.6824 (– 2.0409)	0.0667 (0.1608)	– 3.6541 (– 1.9000)	– 3.6647 (– 1.8930)	– 0.0638 (– 0.1407)
Trade costs	– 1.7249 (– 3.4080)	–1.7343 (– 3.4155)	0.0286 (0.1552)	– 1.7747 (– 2.6332)	– 1.7771 (– 2.6151)	– 0.0317 (– 0.1550)
Skilled labour	0.9122 (1.2889)	0.9142 (1.3191)	– 0.0126 (– 0.1082)	0.2322 (0.2560)	0.2396 (0.2657)	0.0089 (0.0872)
Institutional quality	0.1646 (0.3449)	0.1605 (0.3304)	– 0.0057 (– 0.1083)	0.2050 (0.4188)	0.2012 (0.4092)	0.0012 (0.0209)
Market potential	4.9894 (1.0566)	4.9905 (1.0527)	– 0.1324 (– 0.1894)	5.5635 (1.1532)	5.5900 (1.1574)	0.0797 (0.1018)
Spatial lag on FDI	– 0.0450 (– 0.2791)	— —	— —	0.0131 (0.0831)	— —	— —
R-squared	0.9793			0.9799		
Corr-squared	0.3406			0.1109		

Notes: All variables are in log form; number of observations is 130; distance is dropped from the model specifications with fixed effects to avoid perfect multicollinearity; parameters estimated by maximum likelihood with bias correction (see Lee and Yu 2010) using Elhorst's Matlab routines (Elhorst 2014a); measures of dispersion for inference calculated by simulating 10,000 values for the parameters from the estimated variance-covariance matrix.

the market potential of a particular host country causes spatial spillover effects on FDI in neighbouring countries.

If we compare the results in the first column with those in the fourth, we see that the point estimate of the spatially lagged value of FDI changes sign when controlling for time-period fixed effects, but the coefficient estimate remains insignificant. The direct impact estimate of the market potential variable is positive and insignificant in both cases [see the second column when controlling for country fixed effects and the fifth column when controlling for both country and time specific fixed effects]. The direct impact estimate of the market potential variable ($\theta = 0$) in combination with the insignificant spatial autoregressive coefficient ($\rho = 0$) clearly points to the horizontal explanation as the main driver of Austrian FDI in Europe.

This conclusion is strengthened by the indirect (or spillover) impact estimates of the market potential variable. Although the indirect effect is negative when controlling for country specific fixed effects, and positive when time-period fixed effects are added, neither of them is significant [see the third and the sixth column of Table 2]. None of the explanatory variables generates significant spatial spillovers and this is in line with horizontal FDI too. Evidence in favour of horizontal FDI is, moreover, suggested by the fact that trade costs are significantly negative [see columns two and five]. This argument is consistent with Brainard (1997), who argues that higher levels of trade costs are associated with an influx of horizontal FDI, as exports will be replaced by affiliate sales.

5 Concluding remarks

Recent econometric studies recognise the multilateral nature of FDI decisions, but had difficulties to produce results consistent with formal theory on horizontal, vertical, export-platform or complex vertical FDI. As pointed out by Regelink and Elhorst (2015) this might be due to the suboptimal use of spatial econometric techniques, such as the choice of a row-normalised inverse distance matrix to describe the connectivity structure of the host countries, and the incorrect use of the point estimate rather than the direct and indirect impact estimates of the market potential variable.

This current paper focuses on Austrian outbound FDI in Europe and considers only affiliates where the Austrian parent company has at least fifty percent control, to analyse whether horizontal, vertical, export-platform or complex vertical motivation drive Austrian FDI in Europe. In doing so, the paper departs methodologically from previous research by, *first*, relying on a fixed effects spatial Durbin model that generalises the workhorse spatial lag of FDI model specification, and, *second*, by specifying the spatial weight matrix in form of a (first-order) binary contiguity matrix normalised by the largest eigenvalue. Finally, and most importantly, we adopt a partial derivative interpretation of the impact of changes in the market potential variable in the model as a more valid basis for analysing the question whether the empirical result achieved is compatible with horizontal, vertical, export-platform or complex vertical FDI.

Replacing the standard spatial lag of FDI model by its spatial Durbin counterpart not only enhances the predictive power of the model, as seen by the higher squared correlation statistic, but also yields robust results that provide empirical evidence for horizontal FDI as the main driver of Austrian outbound FDI in Europe. This result is strengthened by the indirect impact estimate of the market potential variable indicating that spatial spillovers do not matter.

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Appendix A: Variables, data and descriptive statistics

Our measure of outbound FDI is sales of Austrian affiliates in the host country as reported by Statistik Austria, which we converted into millions of Euro at constant prices using a chain-type price index for gross domestic investments. The data – available from 2009 onwards – consider only affiliates where the Austrian parent company has at least 50 percent control. This should allow the parent company to exercise control and influence and participate in the affiliate. Therefore, our FDI data merely measure revenue flows from FDI rather than flow changes due to changes in the valuation of the existing stock of FDI. Table A-1 describes the data sources and definitions of the variables used in the study, and Table A-2 summarises the descriptive statistics.

Table A-1 Data sources and definition of variables

FDI	FDI: sales of Austrian affiliates abroad, converted to millions of Euro at constant prices using a chain-type price index for gross domestic investments; *Source:* Statistik Austria
GDP [=size of the host country]	Gross domestic product in millions of Euro at constant prices; *Source*: Eurostat
GDP per capita	Gross domestic product per capita in Euro at constant prices; *Source*: Eurostat
Trade costs	Measured as inverse of openness to trade which itself is equal to values of exports and imports divided by GDP; *Source*: Eurostat
Distance	Measured using great circle distances between capital cities (in kilometres)
Skilled labour	Percentage of active population with tertiary educational attainment of the total workforce (aged 25–64 years); *Source*: Eurostat
Institutional quality	Lack of investment risk from rule of law, property rights and corruption. A higher score corresponds to a lower risk. *Source*: Quality of Government Institute, Göteborg University
Market potential [$= W \ln GDP$]	Market potential surrounding a host country in terms of $W \ln GDP$ with W denoting an N-by-N first-order contiguity matrix

The panel covers the following host countries: Belgium, Bulgaria, Croatia, Czech Republic, Estonia, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, The Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, and United Kingdom.

Table A-2 Descriptive statistics

Variable	Mean	Median	Std. Dev.	Min.	Max.
FDI	8.16	8.29	1.47	5.12	11.38
GDP	12.16	12.11	1.46	9.57	14.81
GDP per capita	9.88	9.98	0.68	8.45	11.26
Trade costs	4.55	4.65	0.45	3.42	5.34
Skilled labour	3.29	3.37	0.31	2.58	3.73
Institutional quality	4.26	4.30	0.23	3.38	4.56
Distance from Austria	6.61	6.79	0.79	4.09	7.74
Market potential [$= W \ln GDP$]	7.71	6.15	5.18	2.37	24.65

Notes: All variables are in logs. The number of observations is 130, based on N=26 and T=5

Appendix B: Robustness Check

Empirical results obtained by estimating the country and time-period fixed effects spatial Durbin model with first-order and second-order contiguity matrices, *t*-statistics in parentheses

	First-order contiguity matrix			**Second-order contiguity matrix**		
Determinants	**Coefficient**	**Direct Impact**	**Indirect Impact**	**Coefficient**	**Direct Impact**	**Indirect Impact**
GDP	2.3596 (1.2893)	2.3690 (1.2824)	0.0399 (– 0.1207)	3.2528 (1.9391)	3.2570 (1.9240)	– 0.2262 (– 0.3509)
GDP pc	– 3.6541 (– 1.9000)	– 3.6647 (– 1.8930)	– 0.0638 (– 0.1407)	– 4.4265 (– 2.4740)	– 4.4267 (– 2.4562)	0.3049 (0.3350)
Trade costs	– 1.7747 (– 2.6332)	– 1.7771 (– 2.6151)	– 0.0317 (– 0.1550)	– 2.0157 (– 2.9666)	– 2.0140 (– 2.9313)	0.1411 (0.3219)
Skilled labour	0.2322 (0.2560)	0.2396 (0.2657)	0.0089 (0.0872)	0.2126 (0.2389)	0.2133 (0.2407)	– 0.0085 (– 0.0362)
Institutional quality	0.2050 (0.4188)	0.2012 (0.4092)	0.0012 (0.0209)	0.3004 (0.6216)	0.3053 (0.6234)	– 0.0253 (– 0.2029)
Market potential	5.5635 (1.1532)	5.5900 (1.1574)	0.0797 (0.1018)	6.6354 (0.9888)	6.6745 (0.9880)	– 0.5537 (– 0.2100)
Spatial lag on FDI	0.0131 (0.0831)	— —	— —	– 0.1578 (– 0.6489)	— —	— —
R-squared	0.9799			0.9807		
Corr-squared	0.1109			0.1287		

Notes: All variables are in log form; number of observations is 130; distance is dropped from the model specifications with fixed effects to avoid perfect multicollinearity; parameters estimated by maximum likelihood with bias correction (see Lee and Yu 2010) using Elhorst's Matlab routines (Elhorst 2014a); measures of dispersion for inference calculated by simulating 10,000 values for the parameters from the estimated variance-covariance matrix.