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Banks in Space: Does Distance Really Affect Cross-Border Banking?

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Banks in Space:
Does Distance Really Affect Cross-Border Banking?*

Katja Neugebauer (IAW Tübingen)†

Abstract

During the last years, gravity equations have leapt from the trade literature over into the literature on financial markets. Martin and Rey (2004) were the first to provide a theoretical model for cross-border asset trade, yielding a structural gravity equation that could be tested empirically. In this paper, I use a gravity model to evaluate factors that affect cross-border banking. Furthermore, I extend the baseline model to allow for third-country effects, which have been shown to matter for international trade, using spatial econometric techniques. I try to answer the following question: First, is there a spatial dimension in cross-border banking? Second, if so, has it changed over time, and third, what happens if this spatial dimension is ignored? I use bilateral data on cross-border banking assets for 15 countries over the time period 1995-2005, and I estimate cross-section regressions for each year. I find strong evidence for a spatial dimension in cross-border banking. Furthermore, the direct effect of distance decreases signficantly when applying spatial econometric techniques.

Keywords: spatial econometrics, gravity equation, banking market integration, distance puzzle

JEL Classification: E44, E32, G21

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1 Motivation

Financial integration is one of the buzzwords of our time. One common perception is that the integration of financial markets has proceeded up to a point where national policies are increasingly constrained by external developments and where the performance of domestic banks depends to a large degree on developments on world markets. Furthermore, the recent financial crisis has shown how fragile financial markets can be. It is commonly accepted that linkages between banks across borders have played an important role for the spreading of this crisis (BIS 2009; IMF 2009).

Obviously, studying cross-border banking linkages and the transmission of shocks requires a conceptual framework that helps structuring the analysis. Allen and Gale (2000) have set up a model of financial contagion which can provide such a theoretical underpinning. They show that different patterns of international banking market integration have different implications for the transmission of shocks across countries. One key result of Allen and Gale (2000) is that the spreading of liquidity shocks depends on the degree of financial market interconnectedness. However, evaluating the degree of banking-market interconnectedness between countries is not straightforward and will be subject of this paper.

I mainly relate to three strands of the literature in this paper.

The first strand of literature deals with classical gravity models. Gravity models are the workhorse in empirical trade literature (Egger 2000; Feenstra et al. 2001; Feenstra and Drive 2002). However, these models can also be used when measuring financial flows. The seminal paper for an application to the financial sector is by Martin and Rey (2004). The authors develop a two-country model that allows to link home bias, financial market size and asset returns to the size of an economy. This theoretical framework lays the ground for an application of gravity models to equity markets. Portes and Rey (2005) apply gravity equations to international trade in assets, also with a focus on cross-border equity transactions. They find a strong effect of distance on cross-border equity transactions, attributing this to informational asymmetries. According to Aviat and Coeurdacier (2007), the model used by Martin and Rey (2004) can be used for international trade in assets as well as for international stock holdings. They argue that it is even "more natural" to develop a gravity setup for stock holdings. Aviat and Coeurdacier (2007) then go on to estimate a gravity setup for bilateral imports and bilateral asset holdings simultaneously. They show that bilateral trade is an important determinant of bilateral asset holdings (and, to a lesser extent, vice versa). Therefore, including bilateral trade into a gravity setup with bilateral asset holdings would result in an endogeneity problem. Estimating an equation system to circumvent the endogeneity problem, they find the effect of distance on asset holdings to be reduced significantly when including bilateral trade into their gravity setup. However, the distance coefficient is still strongly significant in their application.

There are further applications of gravity models to banking data. Blank and Buch (2010) examine the long-run relationship between cross-border assets and liabilities and macroeconomic variables. By using gravity-type regressions, they can explain differences in the speed of adjustment to a new equilibrium. Buch (2003) looks at determinants of cross-border banking activities. She finds information costs, proxied through distance, and regulation to have an important impact on cross-border banking. Kalemli-Ozcan et al. (2009) use data on cross-border financial linkages to construct a measure of financial integration. Applying this to a gravity framework, they examine channels through which the Euro has spurred financial integration. They find that the elimination of currency risk is the most important component for increased financial integration, whereas trade does not play a role. They do not include standard gravity variables like distance or common language, but argue that the inclusion of country-pair fixed-effects should account for these variables.

All papers cited above that include geographical distance directly into their specifications find a significant effect of distance on cross-border financial stocks and flows. Furthermore, apart from Aviat and Coeurdacier (2007), this effect is relatively large. Since capital has not to be transported physically across borders, this is rather surprising. One shortcoming of standard gravity equations in the banking literature is that they focus on bilateral linkages only.

Therefore, the second strand of literature that this paper is looking into deals with third-country effects in gravity models. Though not widely noted, Curry (1972) seems to be the first to have recognized the importance of spatial dependence in cross-country flows (Griffith 2007). However, not until the study by Anderson and van Wincoop (2003) have third-country effects reached a wider audience. Anderson and van Wincoop (2003) have shown that including country (pair) fixed effects reduces the border effect significantly in gravity models for trade, thereby solving the border puzzle that has captured the attention of trade economists for years.

The paper by Anderson and van Wincoop (2003) has also spurred the third strand of literature that I am looking into. This strand of literature explicitly incorporates third-country effects into empirical applications of gravity models by using spatial econometric techniques. One of the first applying the idea of spatial effects in cross-border trade flows in a gravity framework is Porojan (2001). Using data on 15 EU member states and seven additional OECD countries, he finds significantly lower parameter estimates for the coefficients on GDPs and distance compared to standard OLS techniques. In another study using gravity equations, Blonigen et al. (2007) estimate third-country effects in foreign direct investment (FDI). Using data on OECD countries from 1980-2000, they examine the spatial correlation of foreign direct investment to other regions. Applying spatial autocorrelation techniques, they find evidence for export platform FDI in Europe.

In this paper, I combine these different strands of the literature. Using data on cross-border banking assets, provided by the Bank for International Settlements, I try to disentangle the pure distance effect in gravity equations from third-country effects. The idea is similar to Andersen and van Wincoop (2003), but instead of using country (pair) fixed effects, I apply spatial econometric techniques that allow for a more explicit modeling of third-country effects, as in Porojan (2001) and Blonigen et al. (2007). Relating to these different strands of the literature, I address the following questions in this paper: First, is there a spatial dimension in cross-border banking? Second, if so, has it changed over time, and third, what happens if this spatial dimension is ignored? The literature on third-country effects suggests that ignoring these effects will lead to biased coefficient estimates of standard gravity variables due to an omitted variable. In this paper, I use bilateral data on cross-border bank assets for 15 countries over the time period 1995-2005 to take a closer look at third-country effects in cross-border banking.

The remainder of this paper is organized as follows. In section 2, I will first give an overview of gravity equations. This is followed by an introduction to the subject of spatial econometrics and its application to gravity equations. In section 3, I present the data used in this paper. Results are presented in section 4. Section 5 concludes.

2 Methodology

This section starts by giving an overview of the concept of gravity equations. It then outlines the application of spatial econometric techniques to the gravity framework and details the estimation strategy applied in this paper.

2.1 Gravity Equations

Gravity equations are commonly used for the estimation of trade flows and/or financial flows between countries and rely on bilateral data. The gravity model approach explains cross-country linkages as a function of the *mass* of two countries and *distance*. Gravity models are derived from physics. The law of gravity postulates that the force of gravity between two objects is proportional to the product of the masses of the two objects, divided by the square of the distance between these objects (Baldwin and Taglioni

2006). Formally, this can be depicted as

$$G = C\frac{M_i M_j}{(dist_{ij})^2}, \tag{1}$$

where G denotes the force of gravity, C is the gravitational constant, M_i and M_j are the masses of the objects, and $dist_{ij}$ is the distance between the two objects. In economic applications, G is usually represented by bilateral imports or exports, bilateral assets, or FDI. In the trade and finance literature, the masses of two countries are usually proxied by the GDPs of the respective countries, which are a measure of the (economic) size of the countries. There is no clear guidance in the literature as to what distance measure to use. One commonly used measure is the geographical distance (in kilometers) between the capitals of two countries. Another, somewhat crude measure is contiguity. It is captured by a dummy variable which takes on a value of one if two countries share a common border, and zero otherwise.

This is the baseline setup of a gravity equation. Though this setup is very straightforward in the case of trade flows, it requires some more motivation in the case of financial flows. Martin and Rey (2004) set up a general equilibrium model to motivate a gravity equation for asset trade. Key ingredients of their model are imperfect substitutability between assets, transaction costs for cross-border asset trade, and endogenous asset supply. Risk-averse agents buy Arrow-Debreu securities which are then traded on the stock exchange. The main outcome of the model is that cross-border asset flows should depend proportionally on market size, as captured by stock market capitalization, and negatively on transaction costs. These transaction costs can be thought of as information costs due to asymmetric information.[1] In empirical applications, several other variables are often added to capture additional factors that might influence bilateral trade or financial flows. Among these are colonial links, legal systems, common currency, etc.

As mentioned in section 1, this baseline gravity setup does not take into account third-country effects. Including third-country effects allows for gaining a more complete view on the structure and determinants of cross-border linkages. Furthermore, Anderson and van Wincoop (2003) show that results from gravity equations with bilateral trade data can be seriously biased if third-country effects are left out. They call this phenomenon *Multilateral Resistance*. The inclusion of a Multilateral Resistance term controls for the effect that trade between two countries also depends on the fact that there are third countries, which also trade with the two countries under study. This effect might otherwise be picked up by the border dummy in the regression. This can be

[1] See Martin and Rey (2004), Portes and Rey (2005), or Aviat and Coeurdacier (2007) for a detailed derivation of gravity equations for financial stocks and flows.

amended by including a set of country dummies into the gravity regression. However, Baldwin and Taglioni (2006) note that this is only valid when using a cross-section of data, but not a panel dataset.

Whereas the concept of Multilateral Resistance is relatively straightforward in the case of cross-border trade, its transfer to cross-border banking needs some more intuition. One way of motivating it is by thinking about portfolio effects. The optimal portfolio shares of a country depend on the risk of the investment and the return in all other countries (Buch et al. 2010b). Therefore, countries seek to diversify their investment across different countries, which might explain possible third-country effects in cross-border banking. Using spatial econometric techniques, as explained in the following section, allows for a more flexible way of modeling third-country effects. Furthermore, by explicitly modeling third-country effects, one can determine if they have changed over time.

2.2 Gravity in Space

The literature on spatial econometrics often refers to gravity equations as *spatial interaction models*, describing models that focus on flows, e.g. trade or financial flows, between different origins and destinations (see also Sen et al. 1995; LeSage and Pace 2008). The econometric approach adopted in this paper addresses the problem that previous research in the field of cross-border banking takes the spatial dimension only insufficiently into account. Overall, such third-country effects have hardly been studied in the international finance literature. Therefore, I will enrich existing gravity models for the financial sector by taking into account third-country effects, applying methods of spatial econometrics (Anselin 1988; LeSage and Pace 2009). I start by giving a short overview of the nature of spatial econometrics and of the relevant spatial econometric techniques.

The Spatial Autoregressive Model

Generally, spatial econometrics deals with spatial interaction (spatial autocorrelation) and spatial (error) structure (spatial heterogeneity), where the former is the method most widely applied in the field of international economics. There are several tests to determine which kind of spatial relationship is present in the data. In the dataset used in this paper, there is little evidence of spatial structure in the regression errors. Therefore, I opt for the spatial autocorrelation model, which will be explained below.[2]

In its simplest form, the spatial autoregressive model (SAR model) can be depicted

[2] Note that it would be a minor problem not to include a spatial error structure into the equation to be estimated, even if it were present in the data. This would lead to inefficiently estimated standard errors, but coefficient estimates would still be unbiased.

as follows:

$$y = \rho W y + \beta X + \varepsilon, \tag{2}$$

where y denotes the dependent variable of interest, ρ is a spatial autocorrelation coefficient, W is the spatial weighting matrix, β is a coefficient vector, X is a matrix of explanatory variables, and ε is a vector of error terms with $\varepsilon \sim N(0, \sigma^2 I_n)$. The term Wy is called *spatial lag term.* Equation (2) looks very similar to the first-order autoregressive model from time-series econometrics. However, there is one important difference: The dependent variable appears on the right hand side not as a lag, but contemporaneously. Furthermore, it is multiplied by the spatial weighting matrix, which will be explained in more detail below. Since the dependent variable appears contemporaneously on the right hand side of the regression equation, simple OLS estimation techniques are not valid. Instead, the model can be estimated using Maximum-Likelihood (ML) techniques.

It is important to note that ignoring a spatial lag structure can lead to biased and inconsistent estimates, since the error term from such an equation exhibits spatial dependence. Therefore, estimating a gravity equation without a spatial lag is only valid when cross-country positions are independent of each other. However, this assumption is usually not valid. On the other hand, including a spatial lag that is unnecessary leads to inefficient estimates, but does *not* bias the results (LeSage and Pace 2008).

The Spatial Weighting Matrix

There is no clear guidance in the literature on how to define the appropriate weighting matrix. There are different ways of defining the spatial dependence between countries. The simplest approach is to use the concept of contiguity. The elements of a contiguity matrix take on the values one and zero, one indicating that two countries share a common border, and zero otherwise. However, there are other ways of defining a weighting matrix. In accordance with Baltagi et al. (2005), Egger et al. (2008), and Blonigen et al. (2007), I opt for a weighting matrix that is constructed using the inverse distances between country pairs (Anselin 1999). One reason is that not all countries in my sample have at least one neighbor within the sample, which complicates the use of a contiguity matrix. The other reason is that using geographical distances should allow for a more precise modeling of spatial relationships. As distance between an origin and a destination country is usually incorporated as an explanatory variable into standard gravity equations, a spatial weighting matrix that also incorporates distances between an origin country and other destination countries seems reasonable.

Let us define the $n \times n$ matrix of spatial dependence by

$$D = \begin{bmatrix} 0 & 1/d_{i,j} & 1/d_{i,n} \\ 1/d_{j,i} & 0 & 1/d_{j,n} \\ 1/d_{n,i} & 1/d_{n,j} & 0 \end{bmatrix},$$

where $d_{i,j}$ is the distance between two countries. For ease of interpretation, this matrix is then row-standardized. In accordance with LeSage and Pace (2008), let us define by a vector Y_1 all connections that the first country of origin has with the respective destination countries. Then DY_1 can be interpreted as the spatial average around the first destination. This notion can be extended to include all n^2 origin-destination pairs. This can be done using the Kronecker product $I_n \otimes D$, resulting in the row-standardized weighting matrix W_D with

$$W_D = \begin{bmatrix} D & 0_n & \dots & 0_n \\ 0_n & D & 0_n & \vdots \\ \vdots & 0_n & \ddots & 0_n \\ 0_n & \dots & 0_n & D \end{bmatrix},$$

where 0_n is an $n \times n$ matrix of zeros. This matrix can then be plugged into (2) to yield

$$y = \rho W_D y + \beta X + \varepsilon. \tag{3}$$

Note that, in contrast to time series applications, ρ is not bounded between -1 and 1. In the case of a row-standardized weighting matrix, the upper bound of ρ is equal to $+1$, but the lower bound can take on values smaller than -1.

2.3 Estimation Strategy

This section outlines the final estimation strategy adopted in this paper. As mentioned above, I apply the spatial autocorrelation model since I find only very weak evidence for spatial heterogeneity. Ideally, my desired gravity setup (in logs) would look as follows:

$$y_{ij} = \rho W y_{ij} + \beta_0 + \beta_1 X_i + \beta_2 X_j + \beta_3 X_{ij} + \varepsilon_{ij}, \tag{4}$$

where y_{ij} are bilateral banking assets, ρ is the spatial autocorrelation coefficient, W is the weighting matrix of inverse distances between the capital cities of two countries, β_0 is a constant, X_i and X_j are characteristics of the origin country i and destination country j (GDP, capital and trade restrictions, tax haven), respectively, and X_{ij} are characteristics of the country pairs (distance between the capital cities, common language, common legal system, bilateral imports[3]), and ε_{ij} is the error term.

The main problem with equation (4) is that bilateral imports are endogenous (see Aviat and Coeurdacier 2007). Therefore, estimates from this specification would be biased. To circumvent the endogeneity problem, I opt for the following solution. In a first step, I estimate a gravity equation using bilateral imports as the dependent variable, similar to the setup proposed by Aviat and Coeurdacier (2007). However, I use a cross-sectional setup (in logs) that is augmented by a spatial autocorrelation structure:

$$t_{ij} = \theta W t_{ij} + \gamma_0 + \gamma_1 Z_i + \gamma_2 Z_j + \gamma_3 Z_{ij} + \xi_{ij}, \tag{5}$$

where t_{ij} are bilateral imports, θ is the spatial autocorrelation coefficient, W is the weighting matrix of inverse distances between the capital cities of two countries, γ_0 is a constant, Z_i and Z_j are characteristics of the origin country i and destination country j (area, landlocked), respectively, Z_{ij} are characteristics of the country pairs (bilateral transport costs[4]), and ξ_{ij} is the error term. I then take the predicted values from this regression and plug them into the gravity setup for bilateral assets, similar to the standard two-stage least squares method (Wooldridge 2002a), thereby circumventing the endogeneity problem when including bilateral imports directly. Note that Aviat and Coeurdacier (2007) estimate the two gravity setups simultaneously. However, due to the lack of availability of simultaneous equation spatial econometric techniques at the time of writing, I refer to the approach described above. Aviat and Coeurdacier (2007) argue that while leaving bilateral trade out of a gravity equation for bilateral asset holdings results in a serious omitted variables problem, the reverse is less of a problem, i.e. gravity equations for trade can be specified without including bilateral asset holdings.

One potential problem that should be taken into account when applying the two-stage setup described above concerns standard errors of the second-stage regression. Since the trade variable is constructed from the first-stage regression, standard errors have to be adjusted, though the coefficient estimate is still unbiased. Murphy and Topel (1985) provide a solution for OLS estimations, but this is not readily applicable to the case of spatial ML. Therefore, I resort to bootstrapped standard errors (300 replications) in order to obtain valid coefficient estimates.[5] I estimate this two-step

[3] I use bilateral imports instead of bilateral exports since, according to Aviat and Coeurdacier (2007), import patterns should determine geographical portfolio holdings.

[4] Similar to Aviat and Coeurdacier (2007), transport costs are constructed using data on UPS services. More specifically, I use prices on airline freight (10kg Express Saver). Though airfreight only covers a small amount of total transportation between two countries, it should still be a reasonable proxy for bilateral trade. Furthermore, it can certainly be expected to be exogenous with respect to bilateral asset holdings.

[5] Comparing the bootstrapped standard errors to the analytical ones, the bootstrapped ones are indeed larger than the analytical ones, but the differences are relatively small.

procedure year by year over the time period 1995-2005 for two reasons: First, this allows me to compare the spatial autocorrelation coefficient over time. One might suspect that, due to increased financial market integration, spatial effects have gained in importance. This would be reflected by a larger coefficient (in absolute value) on the spatial lag term. Second, spatial econometric techniques require enormous computing power. This is especially true with Maximum-Likelihood techniques, where the calculation of the Jacobian is very cumbersome.

3 Data and Descriptive Statistics

This section briefly describes the data used in this paper. An overview over the data used and descriptive statistics can be found in Tables 1 and 2, respectively. All variables, apart from indicator variables and indices, are in logs.

3.1 Data

Bilateral Assets

The dependent variable in the gravity equations estimated in this paper is bilateral bank assets. These are taken from the Locational Banking Statistics provided by the Bank for International Settlement (BIS). The data are defined as in Tables 2A of the BIS Quarterly Review. Unpublished bilateral data have kindly been provided by the Statistics Department of the BIS. A particular strength of the BIS banking statistics is their comprehensive coverage of international banking activity due to the fact that the largest international financial centers contribute to these statistics (Wooldridge 2002b). The Locational Banking Statistics aggregate cross-border and foreign currency positions of banks, regardless of whether or not these banks are affiliated with domestic banks. For the purpose of this paper, I use a sample of 15 countries from Q4 1995 - Q4 2005.[6] Since most of the data used in this paper are available only on a yearly basis, I only use data on the fourth quarter of each year from the BIS statistics. Furthermore, there have been some changes to the reporting limits over time. However, these changes are negligible for the sample used in this paper.

The spatial gravity setup used in this paper requires the inclusion of country pairs where the reporting and recipient country are identical. Since no cross-border asset holdings are available in this case, I use domestic credit as a proxy (Cetorelli and Goldberg 2009).

[6] The list of countries includes Austria, Belgium, Denmark, Finland, France, Germany, Great Britain, Ireland, Italy, Japan, the Netherlands, Spain, Sweden, Switzerland, USA; see also Table 3.

Macroeconomic Data

I include GDP of the origin country and the destination country in the gravity framework. This variable is taken from the the World Development Indicators. As mentioned above, GDP proxies for the *mass* or economic *size* of a country. GDP of the origin country is expected to enter with a positive sign, since countries that are large in economic terms can also be expected to engage more heavily in cross-border banking. The same holds true for GDP of the destination country. The larger the destination country in economic terms, the more foreign capital it can absorb. Furthermore, I add bilateral imports (see above) as otherwise the distance coefficient might pick up effects from this variable (See Aviat and Coeurdacier (2007) for a more detailed explanation.). Imports are expected to enter with a positive sign. As was the case with bilateral asset holdings, I need to proxy for bilateral imports within a country. I follow Wei (1996) by measuring imports within a country as total production less total exports.[7]

Gravity Variables and Other Indicators

I use the Distance Database from CEPII[8] to obtain variables used in standard gravity equations. I use great circle distances between the capital cities in two countries. Standard gravity equations using trade flows find a strong negative and significant effect for the distance between two countries. Studies using cross-border assets in a simple gravity framework confirm this significant effect. However, these studies have ignored the spatial dimension in the data. Therefore, it is not clear if this strong effect prevails after taking the spatial dimension of the data into account.

I also add a variable indicating if two countries have a common official language. This indicator variable equals one if two countries have a common official language, and zero otherwise. It serves as a proxy for cultural proximity. This variable is expected to enter with a positive sign, since ease of communication between two countries might serve as an important channel to enhance cross-border banking. Finally, I also include a dummy variable that indicates if a country can be considered a tax haven (here: Switzerland, Ireland). If a country is a tax haven, it should attract more foreign capital. Therefore, I expect the variable to enter with a positive sign.

In further regressions, I also include a dummy that indicates if two countries have the same legal system. This variable is expected to enter with a positive sign, since it can be expected to reduce transaction costs in the sense of information costs. Finally, I also include an index of capital controls for different asset classes. This variable is taken from Schindler (2009) and is bounded between zero and one, zero indicating a

[7] As mentioned in Novy (2008), Wei (1996) uses data for agriculture, mining and total manufacturing to construct a measure of total production. However, due to the increased significance of technological products nowadays, I also include low- to hightech manufactures into the proxy for total production.

[8] Data are available from http://www.cepii.fr/anglaisgraph/bdd/distances.htm.

complete absence of restrictions.

3.2 Descriptive Statistics

Figure 1 shows the development of total cross-border assets per country relative to GDP over the sample period. As can be seen, total cross-border assets have increased significantly from 1995 until 2005. This is true for all countries in the sample. However the ratio of total cross-border assets over GDP varies widely across countries. It is largest for Ireland and Switzerland (up to 400%). Since these two countries can be considered tax havens, this is not surprising. The US and Italy exhibit the lowest ratios, 22% and 30%, respectively.

The vast increase in cross-border asset positions suggests an increase in banking market integration over the last decade. The stronger integration of banking markets might indicate that the spatial connectedness among these markets has changed over time.

While Figure 1 gives us an idea of how much the extent of cross-border banking has evolved over time, it gives no indication of how diversified cross-border banking activities are. However, this is an important point when looking at spatial effects in cross-border banking, as described in section 2.1. Figure 2 depicts the Grubel-Lloyd Index that measures the degree of diversification of banks' international portfolios (Obstfeld 2007). In analogy to Obstfeld (2007), I use cross-border assets and liabilities to construct this index that is well-known from the empirical trade literature. In the case of cross-border banking, the index is constructed as

$$GL = 1 - \frac{|A_{it} - L_{it}|}{A_{it} + L_{it}}, \tag{6}$$

where A_{it} and L_{it} are total cross-border assets and total cross-border liabilities of country i at time t, respectively. The index ranges between one and zero, one indicating full diversification and zero pure one-way asset trade. Figure 2 shows a somewhat diversified picture for the different countries. While the Grubel-Lloyd Index takes a value of almost one and is relatively flat over time for most countries in the sample, it has been declining in recent years for Germany and Japan. This indicates that Germany and Japan have become less diversified over time. In the case of Japan, this might be explained by low interest rates that discourage international investors and drive local investors out of the country. In the case of Germany, the result is driven by increased exposure vis-a-vis the US.

Summing up, Figure 2 suggests that cross-border diversification, with few exceptions, has remained remarkably stable over time. Therefore, one would expect that the spatial dimension in the data has not changed much over time. The next section will take a closer look at this suggestion.

4 Results

This section presents the regressions results from estimating equation (4). I first present the results from estimating the baseline regression for the years 1995 and 2005. I estimate different cross-sections instead of the whole panel simultaneously for two reasons. First, I want to illustrate possible changes in the spatial relationship over time. Second, due to lack in computing power, estimating the whole panel with spatial ML techniques is not possible. Estimations are carried out with a row-standardized weighting matrix of inverse distances. After that, some robustness checks are presented.

4.1 Baseline Regression

Table 4 presents the results from a simple 2SLS gravity setup and its ML counterpart using spatial econometrics. Furthermore, the spatial model is then augmented by further explanatory variables.

Turning first to the 2SLS estimation, we can see that the results are by and large in line with common gravity equations. The distance coefficient is negative and significant at the 1%-level. It is larger than in Portes and Rey (2005) or Aviat and Coeurdacier (2007) who also include trade into their respective specifications. However, both papers use panel data techniques and include a set of country dummies that might pick up country-specific effects that are not directly controlled for. Furthermore, both papers use a much broader set of recipient countries which is not possible in the estimation setup used in this paper. Next, I add GDPs from the origin and and destination country. Both turn out to be positive and significant. This is in line with expectations which suggest that larger countries (in terms of their GDPs) attract and issue more cross-border capital. The variable Trade is generated from the predicted values of the gravity regression using bilateral imports as the dependent variable. As expected, this variable enters with a positive sign and is highly significant. I also add a dummy variable indicating if a country can be considered a tax haven. This dummy variable enters positively and is significant at the 5%-level. The coefficient on Common Language is not statistically significant. The R^2 of this 2SLS regression is 0.70.

Turning to the results for the baseline spatial ML estimation, we see that some coefficient estimates have changed. The distance coefficient is now considerably smaller than before (in absolute value), but is still highly significant. The same holds true for the GDP of origin and destination countries, though the difference is more pronounced for GDP of the country of origin. Surprisingly, Common Language is now negative and significant (if only at the 10%-level). Trade enters significantly (positive), and the coefficient has increased markedly compared to the 2SLS estimation. Interestingly, the coefficient on Tax Haven is now insignificant.

Turning to the spatial correlation coefficient ρ, one can see that it is positive and highly significant. This indicates that forces leading to financial flows between an origin country and a destination country also lead to flows from this origin country to other destinations. Referring back to section 2.1, this might be an indicator for portfolio diversification effects. Banks that invest their assets abroad, not only look at the return they get in a certain country, but also want to diversify risk. Therefore, investments from country A in country B also lead to investments in other countries in order to create a well-diversified portfolio of cross-border assets.

In a next step, I add further variables to ensure that the significance of the spatial autocorrelation coefficient is not due to an omitted variables bias. First, I add a dummy variable that indicates if two countries have the same legal system. Since this is often the case with neighboring countries, one might suspect that the spatial lag term captures this effect. This variable enters with the expected sign, but is insignificant, leaving ρ almost unaffected. I next add capital account restrictions of the origin and destination country. Both variables enter with a negative sign and are highly significant. This is in line with expectations, since tighter capital account restrictions reduce the outflow of capital out of the origin country and reduce the inflow of foreign capital into the destination country. As before, the spatial autocorrelation coefficient remains largely unaffected.

Table 5 gives the regression results for the year 2005. Comparing these results with the ones from 1995 reveals some differences, if not in the key variables. While the coefficient estimates for Distance, GDPs, and Trade have not changed much over time, the coefficient on Tax Haven is now significant in some specifications. This might be due to the increased importance of Ireland in this respect compared to 1995. Furthermore, the coefficient on Restrictions for both countries is now much smaller and insignificant for the country of origin. This is not surprising, since barriers on cross-border financial transactions have been lifted towards the end of the sample period. However, the inclusion of these indicators leads to the insignificance of the Tax Haven variable. This can possibly explained by the fact that tax havens are probably less subject to capital account restrictions, leading to a certain correlation between these indicators. Looking at the spatial autocorrelation coefficient, we can see that it has increased slightly, but not by much. It is still highly significant, indicating that the spatial relationship has not changed much over time.

4.2 Comparison of 2SLS and Spatial ML Results

Table 6 gives an explicit comparison of the differences in results obtained by 2SLS and spatial ML. One of the most obvious results is the change in the distance coefficient. In standard gravity equations, this coefficient is relatively large and highly significant, even when looking at financial stocks or flows. The same holds true when estimating the baseline specification in this paper by 2SLS. However, this result changes markedly when employing spatial ML techniques. The respective coefficient is much smaller, though still statistically significant. This is even more pronounced when looking at the coefficient for GDP of the origin country. The coefficient on GDP of the destination country is also slightly smaller in the spatial ML estimation. In contrast to these results, 2SLS seems to underestimate the effect of bilateral trade in this sample.

These first results indicate that ignoring the spatial dimension in gravity equations can give misleading results. As we have seen, the spatial effects are to some extent picked up by other explanatory variables, making their interpretation difficult. This is especially true for the distance coefficient whose large value in gravity equations for the financial sector has puzzled researcher for years. Applying spatial econometric techniques to the sample used in this paper, the value of the respective coefficient estimate decreases significantly. This suggests that the *direct* effect of bilateral distance is much smaller. However, bilateral distance also enters via the weighting matrix of the spatial lag, which is highly significant. This suggests that distance does play a role for bilateral asset holdings, though part of its influence goes through third-country effects. Disentangling the exact nature of these effects is beyond the scope of this paper. However, one suggestion could be portfolio effects, as explained in section 2.1.

4.3 Robustness Checks

One point of scepticism often aimed at spatial econometric techniques is that the results are said to depend on the choice of the weighting matrix. As mentioned above, there is no clear guidance in the literature as to what the best weighting matrix might be. In this paper, I have opted for a weighting matrix of inverse distances. To check the robustness of the obtained results, I also present estimation results from employing a matrix of squared inverse distances and the square root of inverse distances. This allows for giving different influence to very large distances. In the case of the matrix with squared inverse distances, large distances are given less weight in the estimation, since the weights are constructed according to $\omega = 1/d_{ij}^2$. Accordingly, when using the square root of inverse distances, constructed according to $\omega = 1/d_{ij}^{1/2}$, large distances are given more weight than in the case of inverse or squared inverse distances.

Results are presented in Tables 7 and 8. Looking first at the results for the year

1995, I find that the qualitative results remain by and large unchanged. Most importantly, the spatial autocorrelation coefficient remains significant, but is slightly smaller when applying a weighting matrix with the square root of inverse distances. This indicates that stressing the importance of countries that are further apart, reduces the spatial effect in the data. However, looking at the results for 2005, this effect seems to have leveled out. These findings support the robustness of my results. The spatial relationship described in section 4.1 is confirmed when using different weighting matrices.

In a next step, I check the robustness of my results using bilateral exports instead of bilateral imports to calculate the trade variable. Results for the year 1995 and 2005 are presented in Table 9. Results are very much in line with the ones using bilateral imports.

Furthermore, I have tested if the results in this paper are due to a certain country in the sample. In unreported regressions, I have tested for the robustness of the results by excluding countries one by one. Qualitative results remain unchanged.

In a last step, I estimate a standard panel data setup with time fixed effects to separate common shocks from genuinely spatial effects. As mentioned above, the panel is too large to be estimated by spatial techniques. Results are presented in Table 10. Results for the panel estimation are very much in line with the cross-sectional ones using 2SLS. Table 10 contrasts these results with the ones from the spatial ML estimations. As can be seen, the distance coefficient is still much larger in the case of panel estimation. The same holds true for the coefficients on GDP from the origin and destination country, while the trade coefficient is very small compared to the spatial ML estimation.

5 Conclusion

Spatial econometric techniques have gained in importance over the last years. This is mainly due to two reason. From a theoretical point of view (see Anderson and van Wincoop 2003), ignoring third-country effects in gravity equations can lead to serious bias. The reason is that third-country effects that are not taken into account act as an omitted variable. This leads to biased and inconsistent results. A more practical reason lies in the increased availability of large computing power that is needed when estimating spatial econometric models, which can be used to model third-country effects.

In this paper, I have tried to answer three questions. First, I wanted to know if there is a spatial dimension in cross-border banking. Second, if so, has it changed over time? Third, how large is the bias in the estimated coefficients when ignoring the spatial dimension in the data?

This paper has three main findings.

First, regression results present strong evidence for spatial effects in cross-border banking. The spatial autocorrelation coefficient is highly significant throughout the sample. This result is robust with respect to different weighting matrices.

Second, the spatial autocorrelation coefficient has slightly increased over time, but this increase is very modest. This result is somewhat surprising for two reasons. First, the amount of cross-border assets has increased significantly over time which might be interpreted as an increase in banking market integration. Therefore, one might have suspected a larger increase in the spatial autocorrelation coefficient over time. Second, the results in this paper suggest that capital account restrictions have lost in significance over time. While inflow and outflow restrictions where highly significant at the beginning of the sample period, they are almost completely insignificant towards the end. Again, this might suggest that the spatial structure in the data has changed. However, results in section 3.2 show that the Grubel-Lloyd Index has not changed much over time for most countries, indicating that cross-border diversification has remained by and large unchanged. This is in line with a spatial autocorrelation coefficient that has not changed significantly over the sample period.

Third, when comparing the results from the spatial ML with the 2SLS model in the sample used in this paper, it seems that 2SLS results are biased. This is obvious when looking at the distance variable and at GDP of the origin country. The coefficients on these variables are much larger in absolute value in the 2SLS specification. This is probably due to the respective 2SLS coefficient picking up some spatial effects in the data. This seems to be a step towards solving the distance puzzle in gravity equations on financial stocks, indicating that the direct effect for distance in cross-border asset holdings is much smaller than found in earlier contributions. The large distance coefficients in earlier studies probably pick up omitted spatial effects that are explicitly accounted for in this study.

Results in this paper show that spatial effects are present in cross-border banking. Ignoring these effects results in biased estimates and can lead to wrong conclusions when interpreting these results. These findings are in line with Blonigen et al. (2007) and LeSage and Pace (2008). These results are a first step in looking at the spatial dimension in cross-border banking. A next step could be a more thorough analysis of the nature of the spatial effect identified in this paper. One explanation proposed in this paper is portfolio effects, which lead investors to diversify their cross-border asset holdings across countries. Another field of application could be the contagion literature, where knowing more about the structure of third-country effects might help to identify the spreading of financial shocks across countries.

References

Allen, F., & Gale, D. (2000). Financial Contagion. *Journal of Political Economy*, *108*(1), 1-33.

Anderson, J., & Van Wincoop, E. (2003). Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review*, *93*(1), 170-192.

Anselin, L. (1988). *Spatial Econometrics: Methods and Models.* Springer.

Anselin, L. (1999). *Spatial Econometrics* (Tech. Rep.). Bruton Center, School of Social Sciences, University of Texas at Dallas, Richardson, TX.

Aviat, A., & Coeurdacier, N. (2007). The Geography of Trade in Goods and Asset Holdings. *Journal of International Economics*, *71*(1), 22-51.

Baldwin, R., & Taglioni, D. (2006). *Gravity for Dummies and Dummies for Gravity Equations* (NBER Working Papers No. 12516). National Bureau of Economic Research, Inc.

Baltagi, B. H., Egger, P., & Pfaffermayr, M. (2005). *Estimating Models of Complex FDI: Are There Third-Country Effects?* (Center for Policy Research Working Papers No. 73). Center for Policy Research, Maxwell School, Syracuse University.

Bank for International Settlements (BIS). (2009). *79th Annual Report. Basle.*

Blank, S., & Buch, C. M. (forthcoming). International Bank Portfolios: Short- and Long-Run Responses to Macroeconomic Conditions. *Review of International Economics*.

Blonigen, B. A., Davies, R. B., Waddell, G. R., & Naughton, H. T. (2007). FDI in Space: Spatial Autoregressive Relationships in Foreign Direct Investment. *European Economic Review*, *51*(5), 1303-1325.

Buch, C. M. (2003). Information or Regulation: What Drives the International Activities of Commercial Banks? *Journal of Money, Credit and Banking*, *35*(6), 851-69.

Cetorelli, N., & Goldberg, L. (2009). *Global Banks and International Shock Transmission: Evidence from The Crisis.* (Federal Reserve Bank of New York, mimeo.)

Curry, L. (1972). A Spatial Analysis of Gravity Flows. *Regional Studies*, *6*(2), 131-147.

Egger, P. (2000). A Note on the Proper Econometric Specification of the Gravity Equation. *Economics Letters*, *66*(1), 25-31.

Egger, P., Larch, M., Pfaffermayr, M., & Walde, J. (2008). The EU's Attitude towards Eastern Enlargement in Space. *Journal of Comparative Economics*, *36*(1), 142-156.

Feenstra, R., & Drive, O. (2002). Border Effects and the Gravity Equation: Consistent Methods for Estimation. *Scottish Journal of Political Economy*, *49*, 491-506.

Feenstra, R., Markusen, J., & Rose, A. (2001). Using the Gravity Equation to Differentiate among Alternative Theories of Trade. *Canadian Journal of Economics*, 430-447.

Griffith, D. (2007). Spatial Structure and Spatial Interaction: 25 Years Later. *The Review of Regional Studies*, *37*(1), 28-38.

International Monetary Fund (IMF). (2009). *Global Financial Stability Report, April. Washington D.C.*

Kalemli-Ozcan, S., Papaioannou, E., & Peydró, J.-L. (2009). *What Lies Beneath the Euro's Effect on Financial Integration: Currency Risk, Legal Harmonization, or Trade?* (NBER Working Papers No. 15034). National Bureau of Economic Research, Inc.

LeSage, J., & Pace, R. (2009). *Introduction to Spatial Econometrics*. Chapman & Hall/CRC.

LeSage, J. P., & Pace, R. K. (2008). Spatial Econometric Modeling Of Origin-Destination Flows. *Journal of Regional Science*, *48*(5), 941-967.

Martin, P., & Rey, H. (2004). Financial Super-Markets: Size Matters for Asset Trade. *Journal of International Economics*, *64*(2), 335-361.

Murphy, K. M., & Topel, R. H. (1985). Estimation and Inference in Two-Step Econometric Models. *Journal of Business & Economic Statistics*, *3*(4), 370-79.

Novy, D. (2008). *Gravity Redux : Measuring International Trade Costs with Panel Data* (The Warwick Economics Research Paper Series (TWERPS)). University of Warwick, Department of Economics.

Obstfeld, M. (2007). *International Risk Sharing and the Costs of Trade*. The Ohlin Lectures, Stockholm School of Economics.

Porojan, A. (2001). Trade Flows and Spatial Effects: The Gravity Model Revisited. *Open Economies Review*, *12*(3), 265-280.

Portes, R., & Rey, H. (2005). The Determinants of Cross-Border Equity Flows. *Journal of International Economics*, *65*(2), 269-296.

Sen, A., Smith, T., & Nijkamp, P. (1995). *Gravity Models of Spatial Interaction Behavior*. Springer.

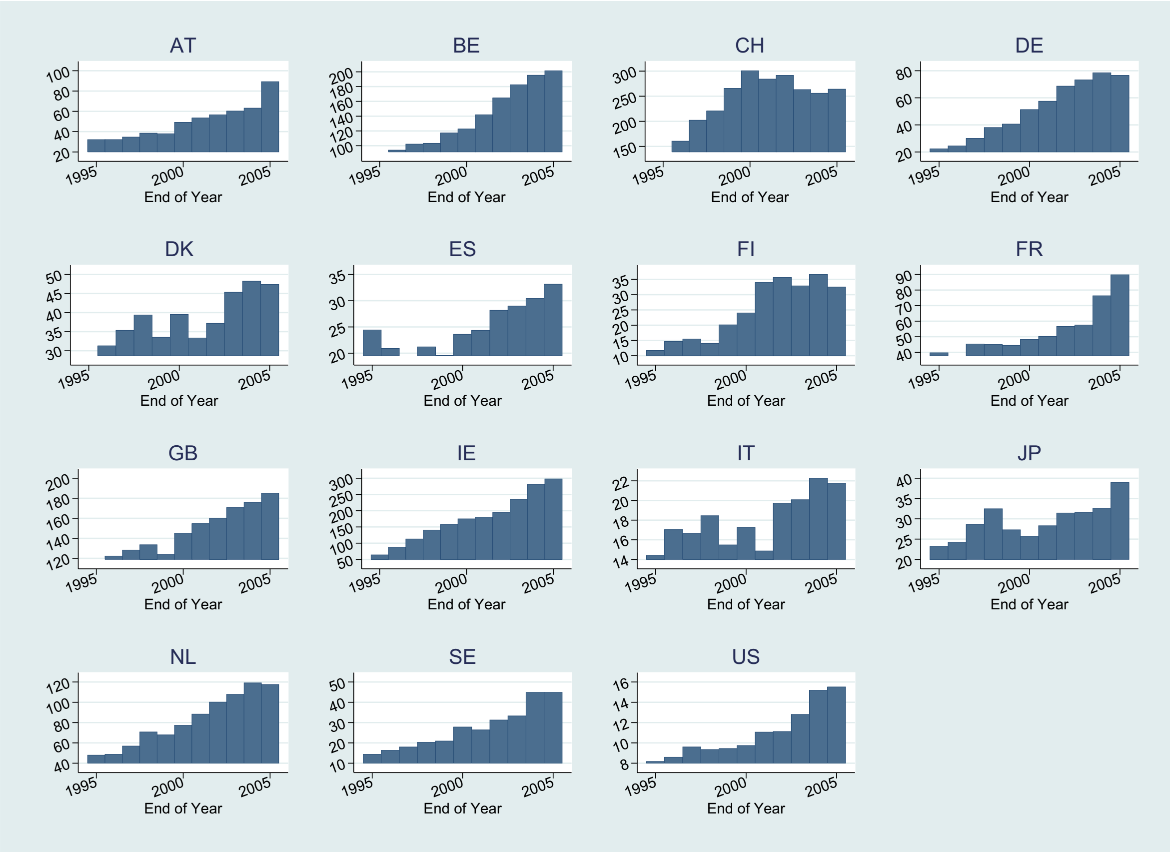
Wooldridge, J. (2002a). *Econometric Analysis of Cross Section and Panel Data*. The MIT Press.

Wooldridge, P. (2002b). Uses of the BIS Statistics. An Introduction. *BIS Quarterly Review*, *March 2002*.

Figures

Figure 1: Total Assets / GDP (in %)

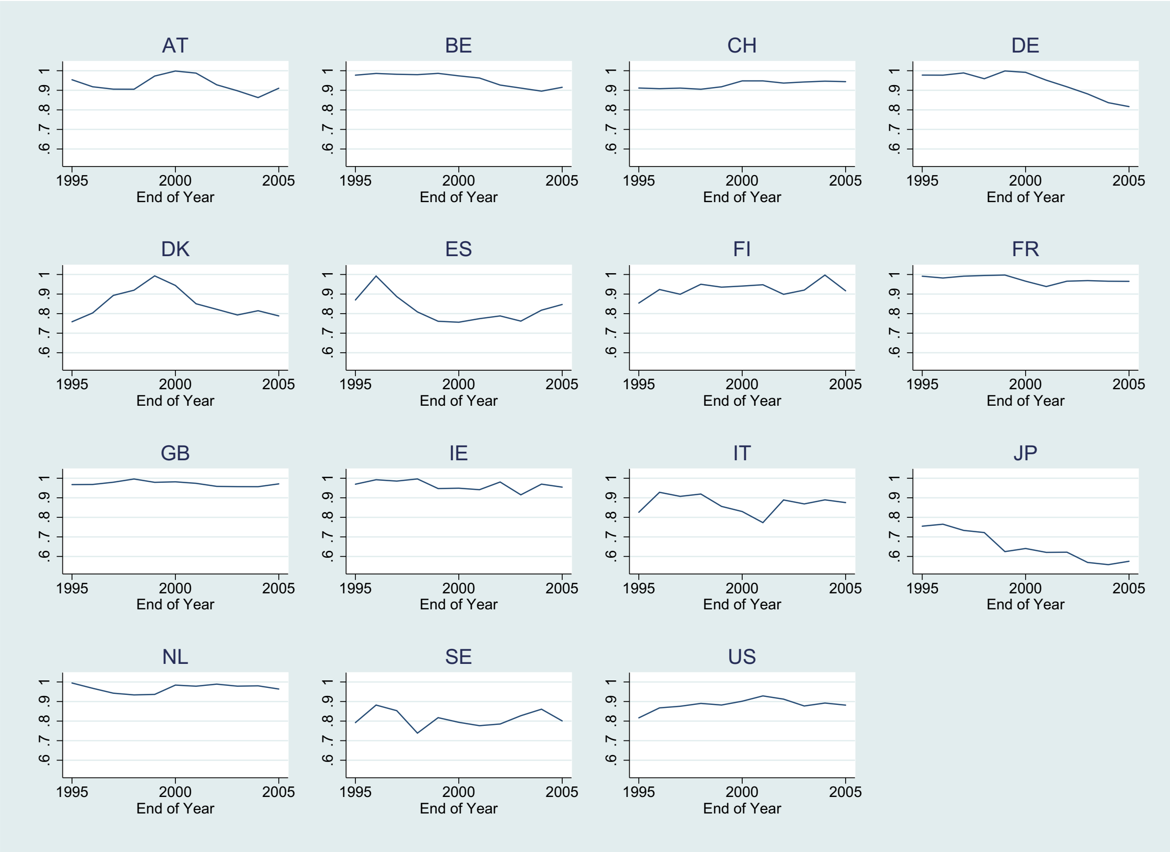
This Figure shows the development of total cross-border banking assets, scaled by GDP, of the countries under study over time.



Source: Own calculations from BIS Locational Statistics and WDI.

Figure 2: Grubel-Lloyd Index

This Figure shows the development of the Grubel-Lloyd Index for the countries under study over time.



Source: Own calculations from BIS Locational Statistics.

Tables

Table 1: List of Variables

This Table lists the variables used in this paper, their definition and sources.

Variable Name	Description	Source
Assets	cross-border banking assets in billions of current USD	Locational Statistics, Bank for International Settlements
Imports	bilateral imports of manufactured goods in billions of current USD	STAN database, Source OECD
Trade Costs	bilateral trade costs of transporting a 10kg parcel (Express Saver) by airfreight	collected from UPS websites
GDP	nominal GDP in billions of current USD	World Development Indicators, World Bank
Distance	distance between capital cities in km	CEPII, www.cepii.fr/anglaisgraph/bdd/distances.htm
Area	area of a country in sq.km	CEPII, www.cepii.fr/anglaisgraph/bdd/distances.htm
Restrictions	overall restrictions index for different asset categories, defined between 0 and 1, 0 indicating no restrictions	Schindler (2009)
Landlocked	dummy that indicates if a country is completely surrounded by other countries	CEPII, www.cepii.fr/anglaisgraph/bdd/distances.htm
Common Language	dummy that indicates if two countries have a common official language	CEPII, www.cepii.fr/anglaisgraph/bdd/distances.htm
Tax Haven	dummy that indicates if a country can be considered a tax haven (here: Switzerland, Ireland)	own calculations
Same Law	dummy variable that indicates if two countries have a common legal system	own calculations using data from Andy Rose, http://faculty.haas.berkeley.edu/arose/RecRes.htm

Table 2: Descriptive Statistics

Variable	No. Of obs.	Mean	Std. Dev.	Minimum	Maximum
Assets	2475	31.43	73.06	0.00	1221.32
Imports	2475	128.38	838.26	0.07	12309.72
Trade Costs	2475	290.22	139.81	30.76	790.82
GDP	2475	1611.96	2549.52	67.10	13163.87
Distance	2475	2718.87	3107.78	68.44	10918.79
Area	2475	864180.30	2322956.00	33114.00	9529106.00
Restrictions	2475	0.04	0.07	0.00	0.35
Landlocked	2475	0.13	0.34	0.00	1.00
Common Language	2475	0.12	0.33	0.00	1.00
Tax Haven	2475	0.13	0.34	0.00	1.00
Same Law	2475	0.37	0.48	0.00	1.00

Table 3: Country List

This Table lists the countries that are used in this paper.

Europe	North America	Asia
Austria	USA	Japan
Belgium		
Denmark		
Finland		
France		
Germany		
Great Britain		
Ireland		
Italy		
Netherlands		
Spain		
Sweden		
Switzerland		

Table 4: Regression Results for the Year 1995

This Table reports regression results for the year 1995. The first column gives the 2SLS results, while the other columns report results from the spatial ML model. The dependent variable is always the log of total cross-border assets between country pairs. Explanatory variables, apart from dummy variables and the restrictions index, are measured in logs. “Trade” is calculated from the predicted values of a gravity regression of imports on standard gravity variables, similar to Aviat and Coeurdacier (2007), see also section 2.3. ***, **, and * denote significance at the 1%-, 5%-, and 10%-level, respectively.

	2SLS	Spatial ML		
Distance	-1.045***	-0.702***	-0.667***	-0.744***
	(0.103)	(0.112)	(0.109)	(0.100)
Common Language	-0.190	-0.424*	-0.480**	-0.389*
	(0.233)	(0.221)	(0.241)	(0.203)
GDP_i	0.887***	0.476***	0.460***	0.532***
	(0.072)	(0.078)	(0.079)	(0.075)
GDP_j	0.871***	0.732***	0.725***	0.812***
	(0.104)	(0.100)	(0.105)	(0.092)
Trade	0.396***	0.582***	0.587***	0.634***
	(0.080)	(0.083)	(0.089)	(0.080)
Tax Haven	0.559**	0.402	0.415	0.255
	(0.235)	(0.261)	(0.253)	(0.241)
Same Law			0.213	
			(0.182)	
$Restrictions_i$				-2.851***
				(0.946)
$Restrictions_j$				-3.912***
				(1.049)
ρ		0.548***	0.564***	0.588***
		(0.121)	(0.117)	(0.115)
Observations	225	225	225	225
R^2	0.70			
LM		56.07	57.38	71.07
Wald		45.80	51.85	73.53

Table 5: Regression Results for the Year 2005

This Table reports regression results for the year 2005. The dependent variable is always the log of total cross-border assets between country pairs. Explanatory variables, apart from dummy variables and the restrictions index, are measured in logs. "Trade" is calculated from the predicted values of a gravity regression of imports on standard gravity variables, similar to Aviat and Coeurdacier (2007), see also section 2.3. ***, **, and * denote significance at the 1%-, 5%-, and 10%-level, respectively.

	2SLS	Spatial ML		
Distance	-1.103***	-0.713***	-0.675***	-0.650***
	(0.109)	(0.109)	(0.109)	(0.108)
Common Language	0.051	-0.172	-0.252	-0.005
	(0.215)	(0.220)	(0.209)	(0.223)
GDP_i	0.992***	0.494***	0.478***	0.456***
	(0.086)	(0.087)	(0.088)	(0.089)
GDP_j	0.849***	0.661***	0.661***	0.600***
	(0.106)	(0.101)	(0.098)	(0.097)
Trade	0.381***	0.601***	0.602***	0.649***
	(0.094)	(0.095)	(0.091)	(0.084)
Tax Haven	0.627**	0.464*	0.492*	0.299
	(0.276)	(0.264)	(0.265)	(0.279)
Same Law			0.293	
			(0.202)	
$Restrictions_i$				-1.037
				(0.823)
$Restrictions_j$				-1.886*
				(0.996)
ρ		0.583***	0.602***	0.594***
		(0.123)	(0.123)	(0.128)
Observations	225	225	225	225
R^2	0.68			
LM		51.77	54.92	54.57
Wald		49.49	57.98	52.11

Table 6: Comparing Differences in Coefficient Estimates

This Table compares coefficient estimates from the 2SLS and the spatial ML regression. Ratios between the different coefficient estimates are given in the columns labeled 2SLS/ML. ***, **, and * denote significance at the 1%-, 5%-, and 10%-level, respectively.

	1995			2005		
	2SLS	ML	2SLS/ML	2SLS	ML	2SLS/ML
Distance	-1.045***	-0.702***	1.489	-1.103***	-0.713***	1.547
	(0.103)	(0.112)		(0.109)	(0.109)	
Common Language	-0.190	-0.424*	0.448	0.051	-0.172	-0.294
	(0.233)	(0.221)		(0.215)	(0.220)	
GDP_i	0.887***	0.476***	1.863	0.992***	0.494***	2.008
	(0.072)	(0.078)		(0.086)	(0.087)	
GDP_j	0.871***	0.732***	1.190	0.849***	0.661***	1.284
	(0.104)	(0.100)		(0.106)	(0.101)	
Trade	0.396***	0.582***	0.680	0.381***	0.601***	0.634
	(0.080)	(0.083)		(0.094)	(0.095)	
Tax Haven	0.559**	0.402	1.391	0.627**	0.464*	1.351
	(0.235)	(0.261)		(0.276)	(0.264)	

Table 7: Robustness Check for the Year 1995: Different Weighting Matrices

This Table reports robustness checks with respect to the weighting matrix for the results from the baseline regression for the year 1995. Inv. Dist. refers to the simple inverse distance matrix from the baseline specification. (Inv. Dist.)^2 refers to the weighting matrix of squared inverse distances, (Inv. Dist.)$^{1/2}$ to the weighting matrix using the square root of inverse distances. The dependent variable is always the log of total cross-border assets between country pairs. "Trade" is calculated from the predicted values of a gravity regression of imports on standard gravity variables, similar to Aviat and Coeurdacier (2007), see also section 2.3. ***, **, and * denote significance at the 1%-, 5%-, and 10%-level, respectively.

	2SLS	Spatial ML		
		Inv. Dist.	(Inv. Dist.)^2	(Inv. Dist.)$^{1/2}$
Distance	-1.045***	-0.702***	-0.717***	-0.734***
	(0.103)	(0.112)	(0.113)	(0.098)
Common Language	-0.190	-0.424*	-0.348*	-0.533**
	(0.233)	(0.221)	(0.210)	(0.221)
GDP_i	0.887***	0.476***	0.478***	0.519***
	(0.072)	(0.078)	(0.075)	(0.073)
GDP_j	0.871***	0.732***	0.740***	0.748***
	(0.104)	(0.100)	(0.106)	(0.096)
Trade	0.396***	0.582***	0.588***	0.538***
	(0.080)	(0.083)	(0.087)	(0.082)
Tax Haven	0.559**	0.402	0.447*	0.321
	(0.235)	(0.261)	(0.239)	(0.232)
ρ		0.548***	0.549***	0.480***
		(0.121)	(0.135)	(0.085)
Observations	225	225	225	225
R^2	0.70			
LM		56.07	60.76	43.50
Wald		45.80	46.36	40.97

Table 8: Robustness Check for the Year 2005: Different Weighting Matrices
This Table reports robustness checks with respect to the weighting matrix for the results from the baseline regression for the year 2005. Inv. Dist. refers to the simple inverse distance matrix from the baseline specification. (Inv. Dist.)^2 refers to the weighting matrix of squared inverse distances, (Inv. Dist.)$^{1/2}$ to the weighting matrix using the square root of inverse distances. The dependent variable is always the log of total cross-border assets between country pairs. "Trade" is calculated from the predicted values of a gravity regression of imports on standard gravity variables, similar to Aviat and Coeurdacier (2007), see also section 2.3. ***, **, and * denote significance at the 1%-, 5%-, and 10%-level, respectively.

	2SLS	Spatial ML		
		Inv. Dist.	(Inv. Dist.)^2	(Inv. Dist.)$^{1/2}$
Distance	-1.103***	-0.713***	-0.753***	-0.714***
	(0.109)	(0.109)	(0.106)	(0.104)
Common Language	0.051	-0.172	-0.087	-0.305
	(0.215)	(0.220)	(0.209)	(0.220)
GDP_i	0.992***	0.494***	0.511***	0.526***
	(0.086)	(0.087)	(0.087)	(0.086)
GDP_j	0.849***	0.661***	0.683***	0.658***
	(0.106)	(0.101)	(0.101)	(0.095)
Trade	0.381***	0.601***	0.599***	0.563***
	(0.094)	(0.095)	(0.089)	(0.087)
Tax Haven	0.627**	0.464*	0.519*	0.356
	(0.276)	(0.264)	(0.292)	(0.281)
ρ		0.583***	0.564***	0.535***
		(0.123)	(0.150)	(0.087)
Observations	225	225	225	225
R^2	0.68			
LM		51.77	53.29	47.01
Wald		49.49	43.97	51.31

Table 9: Robustness Check: Exports

This Table reports regression results for the years 1995 and 2005. The dependent variable is always the log of total cross-border assets between country pairs. Explanatory variables, apart from dummy variables and the restrictions index, are measured in logs. "Trade" is calculated from the predicted values of a gravity regression of exports on standard gravity variables, similar to Aviat and Coeurdacier (2007), see also section 2.3. ***, **, and * denote significance at the 1%-, 5%-, and 10%-level, respectively.

	1995		2005	
	2SLS	Spatial ML	2SLS	Spatial ML
Distance	-1.037***	-0.687***	-1.080***	-0.718***
	(0.113)	(0.108)	(0.109)	(0.102)
Common Language	-0.192	-0.428*	0.053	-0.172
	(0.220)	(0.219)	(0.210)	(0.211)
GDP_i	0.888***	0.477***	1.004***	0.538***
	(0.078)	(0.073)	(0.091)	(0.092)
GDP_j	0.867***	0.724***	0.804***	0.621***
	(0.110)	(0.098)	(0.104)	(0.098)
Trade	0.397***	0.586***	0.402***	0.593***
	(0.085)	(0.085)	(0.090)	(0.085)
Tax Haven	0.519**	0.343	0.600**	0.437
	(0.262)	(0.240)	(0.277)	(0.275)
ρ		0.550***		0.567***
		(0.111)		(0.122)
Observations	225	225	225	225
R^2	0.70		0.69	
LM		56.02		50.79
Wald		45.84		47.12

Table 10: Robustness Check: Panel Estimation

This Table compares the results from the spatial ML estimations for the years 1995 and 2005 with the results from a standard panel regression with time fixed effects. The dependent variable is always the log of total cross-border assets between country pairs. Explanatory variables, apart from dummy variables and the restrictions index, are measured in logs. "Trade" is calculated from the predicted values of a gravity regression of imports on standard gravity variables, similar to Aviat and Coeurdacier (2007), see also section 2.3. ***, **, and * denote significance at the 1%-, 5%-, and 10%-level, respectively.

	1995	2005	Panel (1995-2005)
Distance	-0.702***	-0.713***	-1.225***
	(0.112)	(0.109)	(0.084)
Common Language	-0.424*	-0.172	-0.102
	(0.221)	(0.220)	(0.185)
GDP_i	0.476***	0.494***	1.008***
	(0.078)	(0.087)	(0.060)
GDP_j	0.732***	0.661***	0.973***
	(0.100)	(0.101)	(0.075)
Trade	0.582***	0.601***	0.228***
	(0.083)	(0.095)	(0.066)
Tax Haven	0.402	0.464*	0.699***
	(0.261)	(0.264)	(0.236)
Observations	225	225	2475

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