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ON THE GEOGRAPHY OF INTERNATIONAL BANKING: THE ROLE OF THIRD-COUNTRY EFFECTS

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ABSTRACT

International banking is a complex phenomenon. Among its determinants, distance has been found to be critical. But does distance only have a simple negative direct effect? Or is the role of geography more intricate? Applying spatial analysis techniques on BIS data of bank foreign claims in 178 countries in 2006, evidence of positive spatial autocorrelation under alternative spatial weights schemes is brought to light. The geographical aspects of international banking are further explored by a spatial autoregressive gravity model. The results obtained support that the operation of a spatial lag leads to important indirect or third-country effects. Evidence of such financial spillovers is further corroborated by results of a spatial autoregressive Tobit model. Geography is more important than the effect of distance on its own would suggest. Third-country effects operate in a manner that subsequently connects countries through links beyond those immediately involved in borrowing (destination) and lending (origin) relationships. Confirming earlier results, the economic size of sending and recipient countries, cultural similarity and in-phase business cycles enhance international banking, while distance and exchange rate volatility hinder it. Also, while lower political risk has a positive role, so do higher financial and economic risks, reflecting-to some extent-some of the reasons behind the current financial crisis.

JEL-classification:

Keywords: international banking, financial spillovers, gravity model, spatial econometrics

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1. Introduction

The aim of this study[1] is to examine the role of geography in international banking by using exploratory and spatial econometrics techniques. The main motivation first lies in that distance has been found to be a significant determinant of international banking, and second because ‘third-country’ effects have been revealed in recent studies of foreign direct investment (FDI) using spatial econometrics. In so far as FDI relates to international banking, third-country effects might also be found in the case of international banking. This may be of importance, especially in an era when efforts are being taken to understand the workings of financial contagion. If such third-country effects indeed are evident in international banking, then this would mean that geography operates in more complicated manner than the mere role of distance would suggest. Within such a context, indirect effects or financial spillovers would become important and international banking activities between countries would be affected by changing economic fundamentals in countries beyond those that are directly involved.

To the best of our knowledge there has been only one other recent study (Neugerbauer, 2010)[2] that uses spatial econometrics in a international banking context to uncover third-country effects and further investigate the effect of distance on cross-border banking. The present research, however, differs from that of Neugerbauer (2010) in several aspects. Specifically, the differences lie in the definition of international banking used, the explanatory variables employed, the spatial coverage, as well as the exploratory and econometric analyses performed.

The main results obtained by the present research suggest that spatial dependency is present in international banking, and that indirect effects (or spillover effects) are not only present but almost as large as the direct effects. The effect of distance remains negative and significant in the presence of accounted for spatial effects.

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[1] An earlier version this paper entitled “On the Geography of International Banking: a case for spatial Econometrics?” was presented at the 50th ERSA congress (Jönköping Sweden 19-23 August 2010).

[2] This research has been progressing with the present study.

The study is organized as follows: Section 2 discusses determinants of international banking by separating the effect of geography (Section 2.1) from that of other determinants (Section 2.2). Section 3 analyses spatial dependency in international banking, presents the data used and discusses the relevant distance concepts, and presents the results of spatial autocorrelation test results. The econometric analysis is pursued in Section 4 where the econometric model and techniques are discussed first and the results of a spatial lag model are presented (Section 4.1) In the next section the results obtained are further disentangled to account for direct and indirect (spillover) effects as well as for the spatial gradation of these results (Section 4.2). To account for the problem of zero values in the dependent variable the results of a spatially autoregressive Tobit are presented and discussed in Section 4.3. Section 5 offers some concluding remarks.

2. The determinants of international banking and finance

This section reviews theoretical motivation and empirical results that relate to the determinants of international banking and finance. This discussion separates the role of geography from other determinants as it is of main interest to the present study.

2.1 The role of geography

Distance as a one-dimensional expression of geography has emerged as a significant factor in a number of related research contexts. Buch (2005) provides evidence for the continued importance of distance as a determinant of international banking. This is taken as a sign of the importance of information costs, which despite technological progress in banking, have not diminished (Berger and Young, 2006). Portes et al (2001) study international transactions in financial assets using a gravity model and find that there is a strong negative effect between asset trade and distance. Portes and Rey (2005) explore a panel data set on bilateral gross cross-border equity flows between 14 countries in the 1989–1996 period. Commenting on the negative effect of distance, they maintain that "*we view our empirical work as strong evidence that there is a very important geographical component in international asset flows. International capital markets are not frictionless: they are segmented by informational asymmetries or* *familiarity effects"* (p. 271). In Buch (2004), information costs are proxied by geographical distance as well as variables capturing cultural similarity (i.e. common language, common legal system, etc.) and found to be the main factor segmenting international financial markets. Lane and Milesi-Feretti (2008) study international investment patterns (bilateral portfolio equity holdings) and find that these are—to a great extent—determined by bilateral trade in goods and services as well as proxies of informational distance. The location of a country greatly determines its access to international financial markets, while its remoteness can hinder its development prospects (Ghosh and Wolf, 2000). Indeed, according to Papaioannou's (2009) findings, distance in conjunction with poorly performing institutions may explain why banking capital flows are not directed from rich to poor countries.

Sarisoy Guerin (2006), maintaining that theoretical and empirical work on the effects of geography in international finance is limited, explores the role of geography in three aspects of economic integration, namely foreign direct investment, trade, and portfolio investment flows. The evidence produced suggests that geographical factors have a significant role in explaining the spatial allocation of all three, while controlling for the macroeconomic fundamentals.

As pointed out by Ghosh and Wolf (2000), one of the most prominent stylized facts regards the effect of distance on trade and, as it is well known that FDI and trade reinforce each other, it would not be unreasonable to expect financial links to depend on FDI and trade. Serge and Micu (2002), examining the determinants of international bank lending to Asian and Latin American countries, find bilateral trade between lending and borrowing countries to be a significant explanatory factor. It seems that a strong trading relationship encourages lending through a reduction in informational costs. Aviat and Coeurdacier (2007) use BIS data on asset holding and, taking into account the effect of trade in goods, find that the impact of distance on asset holding is drastically reduced while the coefficient of distance remains statistically significant.

Voinea and Mihaescu (2006), who study the determinants of foreign bank activity (foreign claims) in South East Europe, find a significant role for trade and (less so) for FDI, but not for distance. In contrast, Heuchemer et al (2008), focusing on European cross-border banking, find that distance and borders in addition to cultural differences and different legal origins are important for financial integration.

Turning to studies using bank level data to study banks' foreign expansion, Focarelli and Pozzolo (2005), exploring a sample of 260 major banks of OECD countries, provide explicit evidence suggesting that banks are less likely to expand in distant foreign countries. One of the ways in which banks accomplish foreign expansion is through cross-border mergers and acquisitions. Here there is evidence that distance (together with cultural integration and regulation) is a significant determinant (Buch and Delong, 2004; Focarelli and Pozzolo, 2008).

There might, however, be more to the role of geography in international banking and finance than the mere effect of distance might suggest. The literature on financial contagion and financial spillovers may be of relevance here. Curry et al. (1998) maintain that "adverse economic events in one nation may spill over to, and compound problems for, that nation's trading partner(s) [which, in turn] influence the ability of borrowers in these nations to repay loans to foreign creditors". From a financial geographer's point-of-view (Wojcik, 2009), the role of geography in financial crises has not been given the attention it deserves.

A channel for the transmission of shocks, through the banking system, is that of international lending. This, as shown earlier, is geographically confined. As explained by Sbracia and Zaghini (2003), if a bank has been lending to firms in a country in crisis and the resulting increase in non-performing loans affects its value at risk, then in order to meet binding capital adequacy constraints, capital may need to be withdrawn from other countries. This is often called the *common lender effect* and reflects a situation where two countries (A and B) borrow from a third country (C). If a crisis hits A, then C faces defaults on its loans to A and—as a reaction to meet its constraints—it withdraws capital from B. This thus relates to the problem of regional overlapping international banking claims where, when a region faces a bank crisis, the other, most often neighboring, regions suffer losses as their claims on the troubled region lose value (Allen and Gale, 2000). Such concerns have led to the development of indices measuring a country's exposure to risk through common lender effects (Sbracia and Zaghini 2003, Avrai et al.

2009) and to the analysis of regional financial interconnection and contagion. In the literature on contagion, evidence has been found for such a regional component and efforts have made to spatially model the contagion (Kelejian et al. 2006). Van Rijckeghem and Weder (2001) employ a measure for the competition for funds from a common lender and provide evidence in support of the role of spillovers, through common lender effects, when transmitting crises. Sbracia and Zaghini (2003) point out that "the common lender might have had a better knowledge of the borrowers' economies, given their past relationship or because of geographical proximity". Moreover, van Rijckeghem and Weder's (2003) findings suggest that spillovers caused by the exposure of banks to a crisis country help predict flows in third countries.

2.2 Other determinants

In reviewing the possible determinants of international banking and finance two strands of literature seems relevant, although one more directly than the other. These strands relate to the determinants of banks' foreign expansion, on the one hand, and to the literature studying international banking and finance aggregates, on the other.

Focarelli and Pozzolo (2005) maintain that there are three major factors explaining bank internationalization: economic integration, institutional characteristics, and profit opportunities. Bank internationalization is closely related to integration between the parent (where the bank headquarters are located) and the host country (the location of a bank's foreign affiliates). Integration is not only related to economic aspects such as bilateral trade and FDI flows (Goldberg and Johnson 1990; Brealey and Kaplanis, 1996; Buch 2000) but also to non-economic aspects such as linguistic and cultural proximity (Focarelli and Pozzolo, 2005). Institutional environment and regulatory restrictions (Buch, 2000; Buch, 2003; Focarelli and Pozzolo, 2005; Buch and Lipponer, 2007) are also significant. According to Focarelli and Pozzolo (2005), among the factors explaining bank internationalization, the most important is the existence of profit opportunities. The latter, in turn, relates to bank-specific characteristics, characteristics of the country of origin, and characteristics of the host (destination) country. The size of a bank is also found to be closely related to its internationalization. This is because a larger bank may have greater and more internationalized customers thus making the "follow your client" motive more relevant. According to this, *"the growth in multinational banking is due to foreign direct investment abroad by corporations. Banks respond to the expansion of their clients abroad to defend their client-bank relationship. If the banks do not accompany their client abroad, the client will establish a banking relationship that could expand to supplant any domestic banking relationships… This expansion may not be aimed at generating profits in the new location, but is instead considered...as aimed at preventing losses in some pre-existing activity"* (Williams, 1997, p. 86). The larger bank may have a stronger urge for the international diversification of its activities in order to take advantage of the asynchronous fluctuations in loans and deposits. A bank's growth opportunities in a foreign country are usually proxied by that country's GDP (Goldberg and Johnson 1990; Brealey and Kaplanis, 1996; Buch 2000). However, according to Focarelli and Pozzolo (2005), this use of GDP may be problematic on the grounds that bank profits are more likely to be lower in more developed countries, when, at the same time and in an economic convergence context, countries that are poorer may grow faster than their wealthier counterparts. Bank profitability may also be related to a country's growth prospects and not to its current level of development. Thus, it is assumed that countries with lower initial output, lower inflation, higher levels of schooling and more developed financial markets are more likely to have faster future growth prospects. The characteristics of the banking sector of host countries (i.e. concentration, efficiency and profitability proxies) are also relevant. Buch and Lipponer (2007) include a composite host country risk variable and Buch (2000) adds exchange rate volatility as a proxy of the risk involved.

The major modeling vehicle in the research examining international banking and finance aggregates is that of the gravity model. This has been widely used in empirical studies in international trade. It is a simple model that explains the size of international trade between countries and has a remarkably consistent history of success. Based on Newton's theory, the core form of the gravity model predicts that the bilateral trade of two countries is positively related to the product of their GDP and negatively related to the distance between them. Economic theory justification and related empirical evidence has been put forward by Anderson (1979), Anderson and Van Wincoop (2002) and

Bergstrand (1985). Gravity models belong to the family of spatial interaction models dealt with in regional science (see Fotheringham and O'Kelly, 1989).

In two influential papers, Portes et al (2001) and Portes and Rey (2005) argue that the gravity model does a good job in explaining international transactions in financial assets (equities, corporate and government bonds) as well as in international trade. In their basic gravity model formulation, the place of mass variables in both origin and destination is taken by market capitalization variables. These are accompanied by a distance measure in order to complete the basic formulation. The latter is augmented by the inclusion of control variables such as financial market sophistication in the origin country, a covariance measure of stock returns in the pair countries, telephone call traffic between the countries involved, and the degree of insider trading in the destination country's stock market. Ghosh and Wolf (2000) estimate gravity models to account for trade and four types of capital flows (FDI, bank lending, portfolio debt, and portfolio equity) between G7 countries and a number of recipient counties. Their gravity formulations—apart from mass and distance—include variables capturing common language and border (adjacency) and, more interestingly, a remoteness variable that is a GDP weighted average distance of a country to the G7.

Buch (2005) puts emphasis on the role of distance and uses BIS (Bank for International Settlements) data on assets and liabilities for five reporting countries (France, Germany, Italy, UK, and US) and 50 host countries for the years 1983-1999. Apart from the GDP of both origin and destination countries and the distance between them, further variables include the correlation of GDP growth rates of the countries in each origin-destination pair, and the exchange rate volatility to capture possible portfolio considerations as they relate to diversification and risk respectively. The existence of a major financial centre and capital controls are also taken into consideration. In Papaioannou (2009), BIS data on assets and liabilities for 19 reporting countries and 50-140 recipient countries were used in an augmented gravity model that focused on the quality of institutions in the recipient countries and various risks associated with them (i.e. political, financial, repudiation of contracts by governments, and the risk of expropriation of private investment). Other controls included population density, average years of schooling, life expectancy and legal system origin. The findings of this paper highlight the importance of institutions in determining international financial flows. Heuchemer et al (2008) share a similar focus with Papaioannou (2009) as they are particularly interested in the effect of political as well as cultural factors on cross-border banking, although they have a more limited geographical coverage, i.e. Europe. As a result, apart from the mass and distance variables of the basic gravity formulation, a plethora of variables relating to cultural and political features are included (common legal family, common language, political risk, control of corruption, government effectiveness, political stability and absence of violence, rule of law, voice and accountability coming primarily from World Bank datasets). It is interesting to note that this study uses indices of financial development in both origin and destination countries, such as credit to the private sector as a percentage of the GDP, market share of foreign banks, deposit insurance coverage, and variables based on Euclidean distance measuring similarity in credit to the private sector and foreign bank shares between paired countries.

Voinea and Mihaescu (2006) use, as a dependent variable, foreign claims as reported by BIS and focus on claims of 12 reporting countries in South-East European and Central-East European countries. In their augmented gravity model the authors include trade, FDI, real interest rate differentials between reporting and recipient country as well as a corruption index for recipient countries. As trade and interest rate differentials were found to be significant in all alternative formulations, it is argued that foreign banks follow their customers and exploit profit opportunities.

3. Spatial dependency in international banking: motivation and exploratory results

Spatial analysis deals with non independent observations in the sense that values observed in one location (i.e. region, country) depend on values of neighboring observations. This phenomenon called spatial dependence “is determined by a notion of relative space or relative location, which emphasizes the effect of distance” (Anselin, 1988 p. 8).

In the international trade literature, spatial dependency has been modeled in a context of the gravity model (see next section) by Porojan (2001) who draws attention to the fact that the spatial econometrics estimation of the gravity model changes the perspective on results reported in the literature. More recently there has been a number of studies on FDI that rely on spatial econometrics as they opt to examine whether FDI flows between two countries are affected by flows to third countries (Abreau and Melendez 2006; Baltagi et al 2007; Blonigen et al 2007; Garretsen and Peeters 2008; Hall and Petroulas 2008). "Third-country" effects appear to be significant and such spatial econometric explorations draw motivation from recent developments in the theory of multinationals (Yeaple 2003, Ekholm et al 2007) where 'complex multinationals' can produce intermediate inputs in different countries and export them to third countries; or locate in one country and then export from there to a third country ('export platform'). These studies deal with one origin and multiple destinations (FDI host countries), the exceptions being Abreau and Melendez (2006) and Petroulas and Hall (2008) who all have multiple origin and destinations. The treatment of spatial dependency, however, differs in these studies.

As international banking and finance appears to be responsive to both international trade and FDI, the results discussed above provide motivation for the exploration of the possible role of spatial dependency in international banking. This is the chief novelty of this study as the related evidence is scarce (Fotopoulos and Louri 2010; Neugerbauer, 2010). If spatial dependency is present, accounting for it would reveal possible indirect channels in which borrowing from and lending to foreign countries through international banking might affect the risks to which the banking system of a country is exposed. The key word here is "indirect effects" or spillovers that may be operating in a way that subsequently connects countries beyond those immediately involved in borrowing and lending relationships with each other.

In analyzing international banking, the present study utilizes data from the Bank of International Settlements (BIS). In particular, the prime variable of interest is drawn from the BIS Consolidated Statistics (see BIS 2008 for a detailed description and McGuire and Wooldridge (2005) for a discussion of structure and uses of this data set) and is defined as the sum of “international claims” (cross border claims and local claims of foreign affiliates in foreign currencies) plus “local claims in local currency” of bank foreign affiliates (branches and subsidiaries). This sum is called “foreign claims” and inter-office positions are netted out. Whereas cross-border claims may be extended outside of the recipient country (i.e. host countries), local claims in both foreign and local currency of bank foreign affiliates involve some form of banking foreign direct investment (Herrero and Martinez Peria, 2007). The BIS Consolidated Statistics data pertain to foreign claims of banks residing in each of the reporting countries (26 reporting countries have been used here-see appendix A1) and on residents of a multiple of host (or recipient) countries. The group of reporting countries is a subset of the host countries (178 countries, see appendix Table A2). However, this data source does not report any liabilities other than those of foreign affiliates in local currency. In a concurrent research, Neugerbauer (2010) uses BIS locational banking statistics on bilateral asset holdings in a sample of fifteen countries and there is no counterpart for the analysis provided in this subsection in her research.

Spatial dependence is the source of spatial autocorrelation. In turn, spatial autocorrelation simultaneously deals with both locational and attribute data information. As Goodchild (1986, p.4) aptly describes, "if features which are similar in location also tend to be similar in attributes, then the pattern as a whole is said to show positive spatial autocorrelation. Conversely, negative spatial autocorrelation exists when features which are close together in space tend to be more dissimilar in attributes than features which are further apart. And finally the case of zero autocorrelation occurs when attributes are independent of location".

The Moran measure of spatial autocorrelation (Moran, 1948) is positive when nearby areas also tend to be similar in attributes, negative when nearby locations tend to be dissimilar in attributes, and zero when attribute values are arranged independently and randomly in space.

$$I = \sum_{ij} w_{ij} z_{ij} \Big/ s^2 \sum_{ij} w_{ij}$$

where N is the number of spatial units, $s^2 = (x_i - \bar{x})^2 / N$, $z_{ij} = (x_i - \bar{x})(x_j - \bar{x})$, w_{ij} is an element of a spatial weights matrix. If the spatial weights matrix is row standardized, $\sum_i w_{ij} = 1$,then $\sum_{ij} w_{ij} = N$.

Here a distance-based row standardized spatial weights matrix is used where d_{ij}^{-2} is a typical element if $i \neq j$ and zero otherwise. Distances are taken from CEPII (see Mayer and Zignago, 2006).

Moran's I has been calculated and its statistical significance assessed under the permutation assumption (see Cliff and Ord, 1983 pp. 63-65). Under this assumption, each value is taken to be equally observable at any location. Instead of using a reference distribution for the theoretical mean and standard deviation of Moran's I, these are calculated empirically by permuting the values over all locations.[3]

The BIS Foreign Claims data refer to pairs of countries. There are actually 26 reporting countries (where claims originate) and 178 destination countries. The set of countries of origin is a subset of the destination countries set.

Since an alternative restricted version of the dataset with 135 countries (providing for more explanatory variables) is also used in the econometric estimation (Section 4), Moran's I is reported for both cases. The lists of countries are provided in an appendix. In the case where the data refer to pairs of locations (countries in our case), spatial autocorrelation is defined between pairs. This creates a set of possibilities as to which is the relevant distance.

The relevant distance may be between the destinations of the pairs considered (especially when the pairs have the same origin); in this case the spatial dependency is said to be destination driven. Alternatively, spatial dependency may be modeled as origin driven. Here the relevant distance between country pairs is that which exists between their origins (especially when pairs have the same destination). It is possible, however,

[3] The calculation of Moran's I relevant moments under the permutation assumption was performed by using Bivand's spdep package in R.

apart from those *direct distance* effects, to additionally include *cross-distance* (see Bolduc et al 1992) effects in the sense that the relevant distance may be that which exists between one pair's origin and another's destination. As noted by LeSage and Pace (2008), in the case of origin-destination flows, "neighboring regions include neighbors to the origin, neighbors to the destination, and perhaps a link between neighbors of the origin and neighbors of the destination region". Fischer and Griffith (2008) point out that "while a voluminous literature exists for spatial autocorrelation with a focus of interest on the specification and estimation of models for cross-sectional attribute data, there is scant attention paid to its counterpart in spatial interaction data". Notable exceptions are the work of Brandsma and Ketellapper (1979), Griffith and Jones (1980), Bolduc et al (1992), and, more recently, the work of LeSage and Pace (2008) and Fisher and Griffith (2008). From the recent FDI papers including multiple origin and destinations countries, the above mentioned possibilities are explored only in Abreau and Melendez (2006).

Griffith and Jones (1980, p. 190) suggest that flows from an origin are "enhanced or diminished in accordance with the propensity of the emissiveness of its neighboring origin locations." They also state that flows associated with a destination are "enhanced or diminished in accordance with the propensity of attractiveness of its neighboring destination locations."

In terms of our variable, exploring spatial dependency in the ways described above may be seen in the context of competing destinations where countries compete for capital flows from the same origin (destination driven spatial dependency) and are thus subject to common lender effects in the advent of crisis in one of them. Or it may be the case that spatial dependency relates to competing origins (banking systems) over the same destination financial market within an--as seen before--geographically confined range. Finding evidence on spatial dependency crucially depends on the way in which spatial dependency is formulated.

In the case where the relevant distance is between destinations of pairs with common origin then the spatial weights matrix is a block diagonal $W_d = I_O \otimes W_D$ provided that the data are arranged first by country of origin and then by destination, that is destination is the "faster" index. Here I_O is an identity matrix, the dimensions of which are given by the number of countries of origin (*O*) and W_D is a row standardized $D \times D$ spatial weights matrix based on distances between destination countries. In the case where the relevant distance is between countries of origin in pairs sharing the same destination country, then $W_o = W_O \otimes I_D$. Such possibilities were initially discussed in the regional science literature on spatial autocorrelation in spatial interaction models (Brandsma and Ketellapper, 1979; Griffith and Jones 1980).

The typical element of W_D is $w_d(i,j;r,s) = \begin{cases} d_{js}^{-2} \text{ if } i = r \text{ and } j \neq s \\ 0 \text{ otherwise} \end{cases}$. Likewise a typical element of W_O is $w_o(i,j;r,s) = \begin{cases} d_{ir}^{-2} \text{ if } j = s \text{ and } i \neq r \\ 0 \text{ otherwise} \end{cases}$

Let us consider, for example, a case of 2 countries of origin and 3 countries of destination. Then the origin-centric arrangement of the data becomes:

pair ID	*origin* ID	*destination* ID
1	1	1
2	1	2
3	1	3
4	2	1
5	2	2
6	2	3

In this example spatial autocorrelation is defined among pairs and since there are six of them the relevant spatial weight matrices become:

$$W_O = \begin{bmatrix} 0 & d(1,2) \\ d(2,1) & 0 \end{bmatrix}, \text{ and}$$

$$W_o = W_O \otimes I_D = \begin{bmatrix} 0 & 0 & 0 & d(1,2) & 0 & 0 \\ 0 & 0 & 0 & 0 & d(1,2) & 0 \\ 0 & 0 & 0 & 0 & 0 & d(1,2) \\ d(2,1) & 0 & 0 & 0 & 0 & 0 \\ 0 & d(2,1) & 0 & 0 & 0 & 0 \\ 0 & 0 & d(2,1) & 0 & 0 & 0 \end{bmatrix}$$

$$W_D = \begin{bmatrix} 0 & d(1,2) & d(1,3) \\ d(2,1) & 0 & d(2,3) \\ d(3,1) & d(3,2) & 0 \end{bmatrix}, \text{and}$$

$$W_d = I_O \otimes W_D = \begin{bmatrix} 0 & d(1,2) & d(1,3) & 0 & 0 & 0 \\ d(2,1) & 0 & d(2,3) & 0 & 0 & 0 \\ d(3,1) & d(3,2) & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & d(1,2) & d(1,3) \\ 0 & 0 & 0 & d(2,1) & 0 & d(2,3) \\ 0 & 0 & 0 & d(3,1) & d(3,2) & 0 \end{bmatrix}$$

Apart from the matter of selecting the relevant distance concept, the significance of appropriately accounting for the relevant size of foreign claims is also an issue. Using levels of foreign claims data, it may become the apparent that foreign claims are greater between larger countries. Whereas in the gravity model used in the next section this is dealt with by using appropriate right hand side variables, at this exploratory stage there are two options available. In one, all claims originating from a country by the originating country total are divided, that is $fc_{ij} \Big/ \sum_j fc_{ij}$ (where fc stands for foreign claims). In the other, all claims raised against a destination country by this country's total foreign liabilities (as opposed to claims) are divided, that is $fc_{ij} \Big/ \sum_i fc_{ij}$.

The results presented in Table 1 provide evidence for positive spatial autocorrelation throughout the years considered. The spatial autocorrelation parameter, however, is larger when the like concepts are used for both the normalization of foreign claims and the spatial weights matrix. That is, when normalization by origin total is used together ($fc_{ij} \Big/ \sum_j fc_{ij}$) with origin based spatial weights (W_o), and when normalization by destination total is used along with destination based spatial weights (W_d). In addition, the use of origin-based normalization with destination-based spatial weights produces significant but relatively smaller Moran's I statistics, whereas the reverse has produced insignificant results.

________________________**Table 1 about here**_____________________

Since spatial dependence is evident in foreign claims data, we next proceed to account for spatial autocorrelation in a Spatial-Lag Gravity Model of international banking in the following section.

4. Spatial econometric approaches

In modeling spatial dependence within the context of an econometric model, the analysis will first resort to the so-called spatial autoregressive model in the context of spatial interaction data (LeSage and Pace, 2008).[4] The spatial lag model is considered as we are primarily interested in financial spillovers. A spatial lag of the variable of interest is constructed with the assistance of a spatial weights matrix using an average of values from neighboring regions.

4.1 A spatial-lag gravity model for banking foreign claims

The spatial lag model may be described as:

$$y = \rho W y + X\beta + \varepsilon$$

$$y = \left(I_n - \rho W\right)^{-1} X\beta + \left(I_n - \rho W\right)^{-1} \varepsilon$$

$$\varepsilon \sim N\left(0, \sigma^2 I_n\right)$$

[4] Spatial error models (spatial dependency is hypothesized to reside in the error term) in a context of spatial interaction data have been used in Bolduc et al (1992), in Abreau and Melendez (2006), and in Fischer and Griffith (2008).

The main attraction of the spatial autoregressive model is that it offers itself for the analysis of spatial spillovers and hence financial spillovers. The data generating process of the SAR model can be written as (LeSage and Pace, 2009, p. 18)

$$y = \sum_{k=1}^{h} S_k(W)X_k + (I_n - \rho W)^{-1}\varepsilon$$

where *k* denotes explanatory variable *k*.

The dependent variable's expectation is given by $E(y) = \sum_{k=1}^{h} S_k(W)X_k$, where $S_k(W) = (I_n - \rho W)^{-1}\beta_k$

For two distinct observations *l* and *m* $\frac{\partial E(y_l)}{\partial X_{mk}} = S_k(W)_{lm}$, where $S_k(W)_{lm}$ represents the lmth element of the $S_k(W)$ matrix. In the case of the SAR model the usual interpretation of the regression coefficients such as $\hat{\beta}_k = \partial y / \partial X_k$ is not valid. For the SAR model the impact of a change in an explanatory variable varies over different locations and partial derivatives become of interest: $\partial y_l / \partial X_{lk}$ (own partial derivative) and the cross-derivative $\partial y_l / \partial X_{mk}$ $(l \neq m)$ that measures the impact on y_l from changes in the observation *m* of the explanatory variable *k*.

LeSage and Pace (2009, pp. 36-39) offer definitions and formulas for the calculation of direct, total and indirect effects:

a) the own derivative $\frac{\partial y_l}{\partial X_{lk}} = S_k(W)_{ll}$ measures the impact on the dependent variable observation l from a change in X_{lk}. As noted by LeSage and Pace, this impact also includes feedback loops where observation l affects observation m which in turn affects back observation l. The average of these impacts, called *average direct impact*, is given by $\frac{1}{n}tr(S_k(W))$ and represents the average response of the dependent variable to a change in the *kth* independent variable over the sample observations;

b) Average Total Impact on an observation: this is essentially the lth row sum of $S_k(W)$ and represents the total impact on the dependent variable observation y_l of changing all observations of the *kth* independent variable by the same amount. If $c_k = S_k(W)\iota_n$ is the column vector of the n such row sums then the average of these total impacts is $\frac{1}{n}\iota'_n c_k$ and ι_n is a n by one vector of ones;

c) average total impact from an observation: this is essentially the sum of the mth column of $S_k(W)$ and represents the total impact *over all* y_l resulting from changing the mth observation of the *kth* explanatory variable. If $r_k = \iota'_n S_k(W)$ is the row vector of n of such sums then an average of these total impacts is $\frac{1}{n} r_k \iota_n$. Note, however that these average total impacts are equal since $\frac{1}{n}\iota'_n c_k = \frac{1}{n}\iota'_n S_k(W)\iota_n = \frac{1}{n} r_k \iota_n$.

From the above the average direct and average total impacts may be summarized as follows:

$$\bar{I}(k)_{direct} = \frac{1}{n} tr(S_k(W))$$

$$\bar{I}(k)_{total} = \frac{1}{n}\iota'_n S_k(W)\iota_n$$

At this point it is worth noting that the estimated coefficient may be different from the average direct impact if feedback effects, as previously described, are present. The difference might be positive, indicating a positive feedback loop, or negative indicating a negative feedback loop (see LeSage and Pace, 2009 p. 71).

The difference between the average total and average direct impacts produces the average indirect impact:

$$\bar{I}(k)_{indirect} = \bar{I}(k)_{total} - \bar{I}(k)_{direct}$$

The above is of special interest since it summarizes the impact due to cross-derivative effects previously described. The average indirect impact is a measure of spatial spillovers--in our case spatial financial spillovers.

The SAR model log-likelihood function is:

$$\ln L = -(n/2)\ln(\pi\sigma^2) + \ln|I_n - \rho W| - \frac{e'e}{2\sigma^2}$$

$e = y - \rho W y - X\beta$, $\rho \in \left(\min(\phi)^{-1}, \max(\phi)^{-1}\right)$, where ϕ_n is the eigenvalue vector of W. The application of general first order conditions for the above log-likelihood yields the following estimator for β (Anselin 1988 p. 181): $b = (X'X)^{-1}X'(I - \rho W)y$, or alternatively $b = (X'X)^{-1}X'y - \rho(X'X)^{-1}X'Wy = b_O - \rho b_L$.

Substituting for β by $b_O - \rho b_L$ in $e'e = (y - \rho Wy - X\beta)'(y - \rho Wy - X\beta)$ yields that $e'e = (y - Xb_O - \rho Wy + \rho Xb_L)'(y - Xb_O - \rho Wy + \rho Xb_L) = (e_O - \rho e_L)'(e_O - \rho e_L)$.

The latter term may be written as:

$(e_O - \rho e_L)'(e_O - \rho e_L) = e_O{}'e_O - 2\rho e_L{}'e_O + \rho^2 e_L{}'e_L$. where $e_O = y - Xb_O$ and $e_L = Wy - Xb_L$.

Anselin (1988, p. 181) suggests that an estimator of the error variance for the SAR model is $\sigma^2 = (1/n)(e_O - \rho e_L)'(e_O - \rho e_L)$ and Pace and Barry (1997)) propose the following method of concentrating the log likelihood with respect to β and σ^2:

$$\ln L(\rho) = C - (n/2)\ln\left(e_O{}'e_O - 2\rho e_L{}'e_O + \rho^2 e_L{}'e_L\right) + \ln|I_n - \rho W|,$$

where C is a constant that does not depend on ρ.

Following Pace and Barry (1997), the concentrated log-likelihood is evaluated using an $m \times 1$ vector of values of $\rho \in [\rho_{\min}, \rho_{\max}]$ to determine the value of ρ that maximizes the log-likelihood function.

$$\begin{pmatrix} \ln L(\rho_1) \\ \ln L(\rho_{21}) \\ \vdots \\ \ln L(\rho_m) \end{pmatrix} = -(n/2)\begin{pmatrix} \ln\left(e_O{}'e_O - 2\rho_1 e_L{}'e_O + \rho_1{}^2 e_L{}'e_L\right) \\ \ln\left(e_O{}'e_O - 2\rho_2 e_L{}'e_O + \rho_2{}^2 e_L{}'e_L\right) \\ \vdots \\ \ln\left(e_O{}'e_O - 2\rho_m e_L{}'e_O + \rho_m{}^2 e_L{}'e_L\right) \end{pmatrix} + \begin{pmatrix} \ln|I_n - \rho_1 W| \\ \ln|I_n - \rho_2 W| \\ \vdots \\ \ln|I_n - \rho_m W| \end{pmatrix}$$

Once the value of $\hat{\rho}$ that maximizes the log-likelihood has been found, the following can be calculated: $\hat{\beta} = b_O - \hat{\rho} b_L$, $\hat{\sigma}^2 = (1/n)(e_O - \hat{\rho} e_L)'(e_O - \hat{\rho} e_L)$.

Due to the large sample size the log-determinant calculations were approximated using the faster to direct calculation Monte Carlo procedure suggested by Barry and Pace (1999), whereas the Hessian calculations used for inference on the estimated coefficients follow the "mixed analytical-numerical" procedure suggested by LeSage and Pace (2009, pp. 56-59).

Our econometric exploration of the determinants of foreign claims uses BIS data for the year 2006[5] and employs a gravity model that closely resembles that used by Buch (2005) and to a lesser extent that used by Papaioannou (2009) while at the same time differs considerably from that used in Neugerbauer (2010):

$$\ln(fc) = \beta_0 + \beta_1 \ln(GDP\_origin) + \beta_2 \ln(GDP\_destination) + \beta_3 \ln(dis\tan ce)$$
$$+\beta_4 growth\_correlation + \beta_5 Common\_language + \beta_6 volatility + \sum_{i=1}^{3} \beta_{6+i} Risk\_factor_i + \varepsilon$$

The logarithmic transformation of the dependent variable in the presence of zero values was made possible by adding the value of one to all observations before taking logs. The variables of GDP for both the origin (reporting) and destination (recipient) countries as well as the distance between them are standard gravity type variables. The GDP data used here come from the IMF IFS database whereas distance and common language come from CEPII databases. The *growth_correlation* refers to the GDP growth

[5] Restricting the analysis to a single year estimation may seem to be a limitation. However, at this stage, this research has been concerned with accounting for possible bias arising from the extent of zero valued observations of the dependent variable. This is dealt with in a spatially autoregressive Tobit model (see Section 3.3.). This would not have been feasible in a panel data setting. Please also note that Aviat and Coeurdacier (2007, p.30) refrain to explore the time series dimension of their BIS data on the grounds that "there is too much variation in the reporting conventions" and restrict their analysis to 2001.

correlation between the origin and destination countries more than a decade prior to 2006. For GDP growth correlation, the data used hail from the latest version of Penn World Tables (PTW). The same source of data was used for the calculation of the exchange rate volatility of bilateral exchange rate between the origin and destination countries. As highlighted by Buch (2005), if bank activities are motivated by portfolio considerations then both growth rate correlation and exchange rate volatility should have a negative impact on foreign claims.

The vector of risk factors contains three country risk measurements provided by PRS Group in the International Country Risk Guide (ICRG) for the recipient countries in each pair. Namely, these risk measurements pertain to political, economic and financial risk.

The *Political Risk* variable is essentially a composite variable that takes into account factors such as: government stability, socioeconomic stability, investment profile, internal conflict, external conflict, corruption, military involvement in politics, religion involvement in politics, law and order, ethnic tensions, democratic accountability, and bureaucratic quality. It is worth noting that the larger the value of this index, the lower a country's political risk.

The *Economic Risk* variable is composed of GDP per capita, real GDP growth, annual inflation rates, budget balance as a percentage of GDP, and current account balance as a percentage of GDP. Together, these fundamental economic components are thought to reflect a country's overall economic strength. The larger the extent that a country's economic strength outweighs its weaknesses, the larger the composite index and the lower a country's economic risk.

The *Financial Risk* composite variable assesses the ability of a country to finance its official, commercial, and trade debt obligations. This variable is composed by foreign debt as a percentage of the country's GDP, foreign debt service as a percentage of exports of goods and services, current account as a percentage of exports of goods and services, net international liquidity as the months of import cover, and exchange rate stability. The higher this index, the lower a country's financial risk.

The results of the maximum likelihood estimation of the spatial autoregressive model for the year 2006 are presented in Table 2 below. All variables of interest are statistically significant as it can be established by using the corresponding t-ratios provided in parentheses.

_________________________Table 2 about here____________________

The standard gravity variables (GDP of origin and destination countries and distance) have the anticipated signs and they are all statistically significant. Thus both the economic size of the countries in the pairs considered and the distance that separates them are significant determinants of international banking. These results are in par with earlier results in the relative literature. In Neugerbauer (2010), accounting for the effect of bilateral trade reduces the effect of distance which remains however statistically significant and larger in absolute magnitude than the one reposted in the present study. The positive effect of growth rate correlation has also been found in Buch (2005) and Portes and Rey (2001). This suggests that banks expand in countries with in-phase business cycles, thus implying that portfolio considerations might not be that important. On the other hand, exchange rate volatility appears to be a significant impediment to international banking. In contrast, cultural similarity—as captured by the same official language—appears to be an important positive influence on international banking. These variables behave similarly in both samples. Data availability allows the use of risk related variables only for a smaller set of countries (135).

The results for the risk-related variables suggest that, while international banking seeks better institutional quality and political stability (lower political risk), it additionally opts for higher economic and, more importantly, financial risk. This may depict a situation where banks seeking higher returns (associated with higher financial risk) ignore, to a large extent, economic fundamentals (as summarized by the economic risk variable). This may not be an inaccurate description of bank behaviour in the estimation year (2006) ex-post evaluated.

What is, however, more important here and distinguishes the present study from previous ones, is that the spatial lag coefficient is positive, sizeable (ranging from 0.49 to

0.53) and statistically significant. This suggests that the effect of geography on international banking is a multidirectional one and that spatial financial spillovers are present. The spatial lag coefficients reported by Neugerbauer (2010) are in the range of 0.54 to 0.60 depending on the specification.

4.2 Spatial gradation of impacts

Following LeSage and Pace (2009, pp. 114-115), the calculation of direct, total and indirect effects and their spatial gradation for each variable interest may be based on a matrix power series approximation of $S_k(W)$[6].

That is, $S_k(W) = (I_n - \rho W)^{-1}\beta_k = I_n\beta_k + \rho W\beta_k + \rho^2 W^2\beta_k + \rho^3 W^3\beta_k + \dots$

Let the following be defined:

$TR = [1 \quad 0 \quad n^{-1}tr(W^2) \quad n^{-1}tr(W^2) \quad \dots \quad n^{-1}tr(W^\nu)]$, an augmented vector of traces;

$r = [1 \quad \rho \quad \rho^2 \quad \rho^3 \quad \dots \quad \rho^\nu]$ a vector of powers of the spatial autocorrelation coefficient;

$R_{\nu+1\times\nu+1} = diag(r)$ a diagonal matrix;

$\beta = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_k \end{bmatrix}$ a vector of the coefficients of the variables of interest (save for the constant term);

$\alpha = \iota_{\nu+1}$ a vector of ones

Then the direct, total and indirect effects of all variables of interest may be calculated as:

$$\bar{I}_{direct} = \beta \cdot TR \cdot R \cdot \alpha$$

$$\bar{I}_{total} = \beta \cdot r \cdot \alpha$$

[6] Neugerbauer's (2010) research does not contain such analyses.

$$\bar{I}_{indirect} = \bar{I}_{total} - \bar{I}_{direct}$$

Inference on direct effects, indirect and total effects is possible by simulating parameters using the maximum likelihood multivariate normal distribution and a mixed analytical Hessian (see LeSage and Pace 2009, pp. 56-59).

Note that α sums the effects over the "spatial grades" that correspond to the various powers of *W* and ρ. If α is omitted from the above expressions, then the effects are calculated for any of $0,\ldots,\nu$ powers of *W*.

The total, direct and indirect effects associated with the estimated coefficients of model (3) in Table 2 are given in Table 3. For the calculation of these effects the order (ν) of *W* and ρ used was 101.

_________________________Table 3 about here________________

Indirect effects account for more than 90 percent of the direct effects (this percentage exceeds 99% in the case of model variant (3) in Table 2) and more than 48% (50% in case of model (3) in Table 2) of the total effects suggesting that international banking spillovers are sizeable. In addition, the direct effect is slightly larger in absolute value than the corresponding estimated coefficient reflecting some positive feedbacks. Consequently, spatial financial spillovers are as sizeable as the estimated SAR coefficients. All impacts are statistically significant.

The magnitude of the indirect effects suggest that changing the value of an explanatory variable that corresponds to a country-pair affects the values of the dependent variable corresponding to other country-pairs through the operation of the spatial-lag. This further elaborates on the third- country effects already evidenced by the statistically significant spatial-lag coefficient (ρ) and suggests that one should consider the impact of changes in economic fundamentals in other related countries beyond the countries directly involved in bilateral international banking activities.

The "spatial gradation" of these total, direct and indirect effects is given in Table 4. The approximation up to the ninth power of *W* is very close accounting for more than 99% of the corresponding cumulative totals as they are reported in Table 3.

________________________**Table 4 about here** ____________________

It becomes evident that direct effects decay more rapidly than the indirect effects. It reaches approximately the fifth power of W to get a cumulative figure of indirect effect to be comparable to "own" (W^0) direct impact[7]. This suggests that the indirect effects represent smaller impacts spread though over much more countries.

4.3. The zero claims problem: a spatially autoregressive Tobit Model.

One of the possible drawbacks of the previous models in the present application context is that they ignore the consequences that the fraction of zero claims (almost 34% in the smaller sample) may have on estimated model coefficients (downward bias)[8]. On somewhat theoretical grounds, zero foreign claims between countries may also result from international banking costs exceeding some threshold value.

A latent variable presentation of the Spatial Autoregressive Tobit model is given below assuming that censoring occurs at zero (n_1 censored observations) and y_2 denotes a $n_2 \times 1$ vector of non-censored observations.

$$y^* = (I_n - \rho W)^{-1} X\beta + (I_n - \rho W)^{-1} \varepsilon$$

$$y^* = \begin{cases} y_1^* \text{ if } y^* \leq 0 \\ y_2 \text{ otherwise} \end{cases}$$

For the estimation of the spatially autoregressive spatial Tobit model, the Bayesian Markov Chain Monte Carlo (MCMC) methods detailed in LeSage and Pace (2009, pp. 299-302) were used.[9]

The relevant model vectors and matrices can be partitioned as follows:

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[7] The corresponding figure for model (4) of Table 2 is much higher. These results are available but are not presented here in order to economize in space. The model that includes Financial Risk as opposed to Economic Risk is characterized with more immediate spatial spillovers.
[8] Neugerbauer's (2010) sample contains only 15 countries and no zero values problem for her dependent variable (bilateral bank assets) is reported.
[9] The implementation of these methods was facilitated by the use of LeSage's Spatial Econometrics Toolbox in Matlab.

$$y^* = \begin{pmatrix} y_1^* \\ y_2 \end{pmatrix},\ W = \begin{pmatrix} W_{11} & W_{12} \\ W_{21} & W_{22} \end{pmatrix},\ X = \begin{pmatrix} X_1 \\ X_2 \end{pmatrix}$$

where subscripts $(1,1),(2,2),(2,1),(2,1)$ denote matrix dimensions of $(n_1 \times n_1),(n_2 \times n_2),(n_1 \times n_2),(n_2 \times n_1)$ respectively. The conditional posterior distribution of n_1 censored observation is assumed to follow a truncated multivariate normal distribution (TMVN), $y_1^* \sim TMVN(\mu_1^*, \Psi_{1,1}^*)$ with mean and variance-covariance

$$\mu_1^* = E(y_1^* | y_2, X, W, \beta, \rho, \sigma_\varepsilon^2) = \mu_1 - \Sigma_{1,1}^{-1}\Sigma_{1,2}(y_2 - \mu_2)$$

$$\Psi_{1,1}^* = \text{var} - \text{cov}(y_1^* | y_2, X, W, \beta, \rho, \sigma_\varepsilon^2) = \Psi_{1,1} + (\Sigma_{1,1})^{-1}\Sigma_{1,2}\Psi_{2,1}$$

where

$$\Psi_{1,1} = \sigma_\varepsilon^2 \left[(I_n - \rho W)' (I_n - \rho W) \right]^{-1}$$

$$\Sigma = \Psi^{-1}$$

$$\mu_1 = (I_n - \rho W)_{1,1}^{\ -1} X_1 \beta$$

$$\mu_2 = (I_n - \rho W)_{2,2}^{\ -1} X_2 \beta$$

The use of MCMC requires sequential sampling from the conditional distribution of model parameters β, ρ, σ^2 as well as the conditional distribution for the zero-valued observations (the latter being essentially treated as additional estimable parameters). Further details on the practical issues regarding the implementation of MCMC Bayesian estimation of spatial Tobit can be found in LeSage and Pace (2009, pp. 299-305). Table 5 presents the results of the estimation of the spatial Tobit based on 10,000 draws. All coefficients, apart from that of the constant in the first model variant, are highly statistically significant according to a probability level computation based on the proportion of draws>0 or draws<0 depending on the sign of the estimated coefficient.

______________________Table 5 about here________________________

The results of the Spatial Tobit closely replicate those of the maximum likelihood estimated of the corresponding SAR models. Once again the results suggest positive and significant spatial dependence, sizeable financial spillovers (as suggested by the magnitude of the indirect effects), and positive feedback as the direct effect is larger in absolute value than the corresponding model coefficient.

5. Conclusions

This study provides evidence of considerable “third-country” effects in international banking activities. These results accord with those found in recent studies on FDI (see Baltagi et al 2007; Blonigen et al 2007). Understanding these third-country effects would not only allow for an improved prediction of bilateral international banking activity but also for a better understanding of the ways financial crises spread.

Geography is important and its role operates beyond a one-dimensional effect of bilateral distance, the latter being a negative and significant determinant of international banking activity. Confirming the results of earlier studies, the "economic mass" of origin and destination countries, cultural similarity, and in-phase business cycles all positively affect international banking. In contrast, international banking is hindered by the distance between countries and exchange rate volatility.

As far as the risk variables are concerned, international banking appears to be attracted by both lower political risk--implying better institutional quality and political stability--as well as higher financial risk, possibly seeking higher returns and disregarding economic fundamentals, thus perhaps reflecting some of the reasons behind the current financial crisis.

As for the indirect effects for all, these variables are almost as large as the direct effects, this could urge future research *looking beyond changes in the variables corresponding to countries directly involved in bilateral cross-border banking activities*.

Appendix

Table A1. BIS reporting countries

Australia	Denmark	Italy
Austria	Spain	Japan
Belgium	France	Luxembourg
Brazil	United Kingdom	Netherlands
Canada	Greece	Panama
Switzerland	Hong Kong SAR	Portugal
Chile	India	Sweden
Germany	Ireland	Turkey
		Taiwan Province of China
		United States

Table A2. Large sample countries

Afghanistan, Rep. of.	Gambia*	Niger*
Albania*	Georgia	Nigeria*
Algeria*	Germany*	Norway*
Angola*	Ghana*	Oman*
Argentina*	Greece*	Pakistan*
Armenia*	Grenada	Panama*
Australia*	Guatemala*	Papua New Guinea*
Austria*	Guinea*	Paraguay*
Azerbaijan*	Guinea-Bissau*	Peru*
Bahamas*	Guyana*	Philippines*
Bahrain*	Haiti*	Poland*
Bangladesh*	Honduras*	Portugal*
Barbados	Hong Kong SAR*	Qatar*
Belarus*	Hungary*	Romania*
Belgium*	Iceland*	Russia*
Belize	India*	Rwanda
Benin	Indonesia*	Samoa
Bhutan	Iran, Islamic Republic of*	Sγo Tomι and Prνncipe
Bolivia*	Iraq*	Saudi Arabia*
Bosnia and Herzegovina	Ireland*	Senegal*
Botswana*	Israel*	Seychelles
Brazil*	Italy*	Sierra Leone*
Brunei Darussalam	Jamaica*	Singapore*
Bulgaria*	Japan*	Slovak Republic*

Table A2: continued

Burkina Faso*	Jordan	Slovenia*
Burundi	Kazakhstan*	Solomon Islands
Cambodia	Kenya*	South Africa*
Cameroon*	Kiribati	Spain*
Canada*	Korea*	Sri Lanka
Cape Verde	Kuwait*	St. Lucia
Central African Republic	Kyrgyz Republic	St. Vincent and the Grenadines
Chad	Lao People's Democratic Republic	Sudan*
Chile*	Latvia*	Suriname*
China*	Lebanon*	Swaziland
Colombia*	Lesotho	Sweden*
Comoros	Liberia*	Switzerland*
Congo, Democratic Republic of*	Libya*	Syrian Arab Republic*
Congo, Republic of*	Lithuania*	Taiwan Province of China*
Costa Rica*	Luxembourg*	Tajikistan
Cτte d'Ivoire*	Macedonia, Former Yugoslav Republic of	Tanzania*
Croatia*	Madagascar	Thailand*
Cyprus*	Malaysia*	Togo*
Czech Republic*	Maldives	Tonga
Denmark*	Mali*	Trinidad and Tobago*
Djibouti	Malta*	Tunisia*
Dominica	Mauritania	Turkey*
Dominican Republic*	Mauritius	Turkmenistan
Ecuado*r	Mexico*	Uganda*
Egypt*	Moldova*	Ukraine*
El Salvador*	Mongolia*	United Arab Emirates*
Equatorial Guinea	Morocco*	United Kingdom*
Eritrea	Mozambique*	United States*
Estonia*	Myanmar*	Uruguay*
Ethiopia*	Namibia*	Uzbekistan
Fiji	Nepal	Vanuatu
Finland*	Netherlands*	Venezuela*
France*	New Zealand*	Vietnam*
Gabon*	Nicaragua*	Yemen, Republic of*
		Serbia*
		Zambia*
		Zimbabwe*

*Country also included in the "small sample"

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Table 1: Spatial Autocorrelation in International Banking: Moran's I

		Foreign Claims		Spatial Weights Matrix		Number of Countries
year	Moran's I	$fc_{ij} \Big/ \sum_j fc_{ij}$	$fc_{ij} \Big/ \sum_i fc_{ij}$	W_o	W_d	
2004	0.5415***	√		√		178
2006	0.4897***	√		√		178
2008	0.4431***	√		√		178
2004	0.4088***		√		√	178
2006	0.3589***		√		√	178
2008	0.3748***		√		√	178
2004	0.1019***	√			√	178
2006	0.0952***	√			√	178
2008	0.1056***	√			√	178
2004	0.5357***	√		√		135
2006	0.4837***	√		√		135
2008	0.4355***	√		√		135
2004	0.4394***		√		√	135
2006	0.4237***		√		√	135
2008	0.4045***		√		√	135
2004	0.0965***	√			√	135
2006	0.0908***	√			√	135
2008	0.1017***	√			√	135
*** significant at 1% based on pseudo p-values (see Cliff and Ord, 1981, pp. 63-65) using 1000 permutations						

Table 2. Maximum likelihood estimation of Spatial Autoregressive Model

	(1)	(2)	(3)	(4)
Variable	**Coefficient (t-statistic)**	**Coefficient (t-statistic)**	**Coefficient (t-statistic)**	**Coefficient (t-statistic)**
Constant	-0.1811 (-0.4427)	-5.4113 (-7.6054)	-0.8289 (-1.0415)	-3.9039 (-4.7206)
GDP_origin	0.4739 (20.0421)	0.5682 (21.2606)	0.5327 (20.4379)	0.5577 (20.9347)
GDP_destination	0.9984 (58.7637)	0.9313 (41.6424)	1.0248 (43.6325)	0.9584 (40.1656)
Distance	-0.5646 (-13.4890)	-0.6093 (-13.6395)	-0.5512 (-12.6427)	-0.5874 (-13.1786)
Growth Correlation	0.3511 (3.3257)	0.5532 (5.2807)	0.4445 (4.3358)	0.5348 (5.1155)
Common Language	1.1296 (11.4136)	1.1096 (9.5250)	1.0331 (9.0791)	1.0946 (9.4198)
Volatility	-0.5333 (-8.6578)	-0.2488 (-2.8810)	-0.2892 (-3.4244)	-0.2760 (-3.1838)
Political Risk (inverse notion of)	_	1.6629 (9.2938)	2.0895 (11.6974)	1.7782 (9.7891)
Financial Risk (inverse notion of)	_	_	-3.0855 (-12.3514)	_
Economic Risk (inverse notion of)	_	_	_	-0.9807 (-3.6670)
$\boldsymbol{\rho}$	0.5090 (320.2834)	0.4940 (283.1658)	0.5280 (298.8556)	0.5040 (287.1683)
Number of observations	4602	3484	3484	3484
Log-Likelihood	-8797	-6609	-6536	-6602
$\mathbf{R^2}$	0.6068	0.6132	0.6178	0.6095

Table 3: Cumulative direct, indirect and total effects corresponding to SAR estimated coefficients (see Table 2)

	(1)			(2)			(3)			(4)		
Variable	**Direct**	**Indirect**	**Total**	**Direct**	**Indirect**	**Total**	**Direct**	**Indirect**	**Total**	**Direct**	**Indirect**	**Total**
	(t-stat)	(t-stat)	(t-stat)	(t-stat)	(t-stat)	(t-stat)	(t-stat)	(t-stat)	(t-stat)	(t-stat)	(t-stat)	(t-stat)
GDP_origin	0.499	0.466	0.966	0.597	0.526	1.123	0.563	0.562	1.125	0.588	0.538	1.126
	(20.016)	(9.673)	(19.884)	(21.420)	(20.956)	(21.250)	(20.965)	(20.486)	(20.768)	(20.698)	(20.190)	(20.497)
GDP_destination	1.051	0.982	2.034	0.977	0.860	1.838	1.087	1.086	2.173	1.009	0.923	1.932
	(58.598)	(54.519)	(57.340)	(42.934)	(41.084)	(42.442)	(44.084)	41.466	43.127	39.702	38.088	39.223
Distance	-0.595	-0.556	-1.151	-0.639	-0.563	-1.202	-0.585	-0.584	-1.169	-0.619	-0.566	-1.184
	(-13.370)	(-13.248)	(-13.321)	(-13.344)	(-13.149)	(-13.264)	(-12.374)	(-12.355)	(-12.375)	(-12.991)	(-12.912)	(-12.965)
Growth correlation	0.373	0.348	0.721	0.588	0.518	1.105	0.467	0.467	0.934	0.564	0.516	1.079
	(3.349)	(3.345)	(3.347)	(5.325)	(5.324)	(5.325)	(4.324)	(4.323)	(4.324)	(4.983)	(4.972)	(4.978)
Common Language	1.193	1.115	2.308	1.165	1.026	2.191	1.093	1.092	2.185	1.150	1.052	2.202
	(11.247)	(11.210)	(11.236)	(9.513)	(9.506)	(9.514)	(9.042)	(9.047)	(9.048)	(9.555)	(9.546)	(9.556)
Volatility	-0.566	-0.529	-1.096	-0.259	-0.228	-0.487	-0.304	-0.303	-0.607	-0.289	-0.265	-0.554
	(-8.469)	(-8.448)	(-8.461)	(-2.895)	(-2.891)	(-2.893)	(-3.376)	(-3.373)	(-3.375)	(-3.203)	(-3.201)	(-3.203)
Political Risk				1.757	1.547	3.305	2.207	2.204	4.411	1.871	1.711	3.582
				(9.433)	(9.398)	(9.421)	(11.628)	(11.577)	(11.610)	(9.992)	(9.977)	(9.990)
Financial Risk							-3.266	-3.262	-6.527			
							(-12.435)	(-12.402)	(-12.428)			
Economic Risk										-1.019	-0.932	-1.950
										(-3.541)	(-3.543)	(-3.542)

Table 4: Spatial Gradation of total, direct and indirect effects corresponding to (3) in Table 2

W-order	GDP_origin			GDP_destination			Distance			Growth correlation		
	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect
W^0	0.5313	0.5313	0.0000	1.0258	1.0258	0.0000	-0.5518	-0.5518	0.0000	0.4409	0.4409	0.0000
W^1	0.2805	0.0000	0.2805	0.5415	0.0000	0.5415	-0.2913	0.0000	-0.2913	0.2327	0.0000	0.2327
W^2	0.1481	0.0240	0.1240	0.2858	0.0464	0.2394	-0.1537	-0.0250	-0.1288	0.1228	0.0199	0.1029
W^3	0.0782	0.0024	0.0757	0.1509	0.0047	0.1462	-0.0812	-0.0025	-0.0786	0.0648	0.0020	0.0628
W^4	0.0413	0.0035	0.0377	0.0797	0.0068	0.0728	-0.0428	-0.0037	-0.0392	0.0342	0.0029	0.0313
W^5	0.0218	0.0006	0.0212	0.0421	0.0012	0.0408	-0.0226	-0.0007	-0.0220	0.0181	0.0005	0.0176
W^6	0.0115	0.0007	0.0108	0.0222	0.0013	0.0209	-0.0119	-0.0007	-0.0112	0.0095	0.0006	0.0090
W^7	0.0061	0.0002	0.0059	0.0117	0.0003	0.0114	-0.0063	-0.0002	-0.0061	0.0050	0.0001	0.0049
W^8	0.0032	0.0002	0.0030	0.0062	0.0003	0.0059	-0.0033	-0.0002	-0.0032	0.0027	0.0001	0.0025
W^9	0.0017	0.0000	0.0017	0.0033	0.0001	0.0032	-0.0018	0.0000	-0.0017	0.0014	0.0000	0.0014
	Common Language			**Volatility**			**Political Risk**			**Financial Risk**		
	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect
W^0	1.0316	1.0316	0.0000	-0.2867	-0.2867	0.0000	2.0826	2.0826	0.0000	-3.0816	-3.0816	0.0000
W^1	0.5445	0.0000	0.5445	-0.1513	0.0000	-0.1513	1.0993	0.0000	1.0993	-1.6267	0.0000	-1.6267
W^2	0.2874	0.0467	0.2408	-0.0799	-0.0130	-0.0669	0.5803	0.0942	0.4861	-0.8587	-0.1394	-0.7193
W^3	0.1517	0.0047	0.1470	-0.0422	-0.0013	-0.0409	0.3063	0.0095	0.2969	-0.4533	-0.0140	-0.4393
W^4	0.0801	0.0069	0.0732	-0.0223	-0.0019	-0.0204	0.1617	0.0138	0.1479	-0.2393	-0.0205	-0.2188
W^5	0.0423	0.0012	0.0411	-0.0118	-0.0003	-0.0114	0.0854	0.0025	0.0829	-0.1263	-0.0036	-0.1227
W^6	0.0223	0.0014	0.0210	-0.0062	-0.0004	-0.0058	0.0451	0.0027	0.0423	-0.0667	-0.0040	-0.0626
W^7	0.0118	0.0003	0.0115	-0.0033	-0.0001	-0.0032	0.0238	0.0006	0.0232	-0.0352	-0.0009	-0.0343
W^8	0.0062	0.0003	0.0059	-0.0017	-0.0001	-0.0016	0.0126	0.0006	0.0120	-0.0186	-0.0009	-0.0177
W^9	0.0033	0.0001	0.0032	-0.0009	0.0000	-0.0009	0.0066	0.0001	0.0065	-0.0098	-0.0002	-0.0096

Table 5. Bayesian Estimation of Spatial Autoregressive Tobit Model

Variable	Coefficient (std. deviation)	Total	Direct	Indirect	Coefficient (std. deviation)	Total	Direct	Indirect
Constant	-0.8274 (0.8012)				-3.9186 (0.8344)			
GDP_origin	0.5388 (0.0311)	1.1298	0.5705	0.5593	0.5573 (0.0317)	1.1262	0.5874	0.5388
GDP_destination	1.0270 (0.0243)	2.1535	1.0874	1.0660	0.9584 (0.0248)	1.9367	1.0101	0.9266
Distance	-0.5588 (0.0497)	-1.1718	-0.5918	-0.5801	-0.5856 (0.0508)	-1.1834	-0.6172	-0.5662
Growth correlation	0.4452 (0.1029)	0.9335	0.4714	0.4621	0.5344 (0.1048)	1.0798	0.5632	0.5166
Common language	1.0332 (0.1143)	2.1663	1.0940	1.0723	1.0941 (0.1167)	2.2105	1.1530	1.0575
Volatility	-0.2939 (0.0857)	-0.6166	-0.3114	-0.3052	-0.2752 (0.0879)	-0.5564	-0.2902	-0.2662
Political Risk (inverse notion of)	2.0960 (0.1799)	4.3945	2.2190	2.1755	1.7802 (0.1831)	3.5966	1.8758	1.7208
Financial Risk (inverse notion of)	-3.0782 (0.2499)	-6.4549	-3.2595	-3.1954	–	–	–	–
Economic Risk (inverse notion of)	–	–	–	–	-0.9832 (0.2671)	-1.9870	-1.0364	-0.9506
ρ	0.5226 (0.0153)				0.5046 (0.0156)			
No. Obs	3484				3484			
No. of censored obs.	1171				1171			

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