From:
OECD Journal: Economic Studies

Access the journal at:
http://dx.doi.org/10.1787/19952856

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Please cite this article as:

Ahrend, Rudiger and Cyrille Schwellnus (2013), "Do investors disproportionately shed assets of distant countries during global financial crises?: The role of increased uncertainty", *OECD Journal: Economic Studies*, Vol. 2012/1.
http://dx.doi.org/10.1787/eco_studies-2012-5k4dpmw9hphc

OECD Journal: Economic Studies
Volume 2012

Do investors disproportionately shed assets of distant countries during global financial crises? The role of increased uncertainty

by
Rudiger Ahrend *and* Cyrille Schwellnus*

The global crisis of 2008-09 went hand in hand with sharp fluctuations in capital flows. To some extent, these fluctuations may have been attributable to uncertainty-averse investors indiscriminately selling assets about which they had poor information, including those in geographically distant locations. Using a gravity equation setup, this article shows that the impact of distance increases with investors' uncertainty aversion. Consistent with a sudden increase in uncertainty, the negative impact of distance on foreign holdings increased during the global financial crisis of 2008-09. Host-country structural policies enhancing the quality of information available to foreign investors, such as strict disclosure requirements and prudential bank regulation, tended to mitigate withdrawals.

JEL classification: F21, G11, G18

Keywords: Capital flows, gravity model, uncertainty, crisis, financial regulation

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1. Main results

The global financial and economic crisis of 2008-09 highlights that financial stress is often associated with sudden reversals in international capital flows. Such fluctuations may partly reflect that, in times of financial turmoil, information becomes more important for asset allocation decisions as uncertainty-averse investors liquidate assets about which they have poor knowledge (Krishnamurty, 2010; Uhlig, 2010; Milesi-Ferretti and Tille, 2011). From the perspective of recipient countries, this implies that policy measures which improve the availability of information to foreign investors and improve confidence in the soundness of the financial system should result in more stable capital flows.

Even though theoretical models and less formal studies of globalisation often assume frictionless international capital markets, the empirical evidence shows that information frictions, *i.e.* the cost of collecting information, matter for the geographical allocation of financial assets. It is a well-established fact that a simple gravity model which includes countries' economic size and the distance between them predicts bilateral capital flows at least as well as international trade flows (Portes *et al.*, 2001; Portes and Rey, 2005).[1] This paper follows the standard view in the international capital flows literature that the negative effect of geographical distance on capital flows partly reflects information frictions (Portes *et al.*, 2001; Daude and Fratzscher, 2008; Lane and Milesi-Ferretti, 2008). Even though advances in information and communication technologies have greatly improved formal access to financial information, the empirical evidence suggests that local investors have better access to informal information channels (Hau, 2001; Malloy, 2005; Bae *et al.*, 2008). For instance, local investors may talk to firm representatives, employees, customers and competitors more frequently, or they may form part of a social network of local investors (Hong *et al.*, 2005).[2]

Financial turmoil may increase the impact of information frictions, thereby triggering disproportionate reductions in investments from geographically distant investors. Financial or macroeconomic shocks can create doubts about the probability distribution of asset returns (*i.e.* increase Knightian uncertainty), inducing investors to turn to assets about which they have better information (Caballero and Krishnamurty, 2008; Krishnamurty, 2010; Uhlig, 2010). Attracting capital inflows from geographically distant investors who face higher costs of acquiring information may reduce the stability of investments in times of global crises. This paper uses the "natural experiment" of the global financial crisis of 2008-09 to test whether investors from more distant locations indeed reduced their financial asset holdings more than investors from geographically closer areas.

Taking the global financial crisis of 2008-09 as an external shock, the paper further examines structural policy settings that may improve the stability of financial investments from geographically more distant investors. For instance, financial market transparency and stability may moderate the increased impact of geographical distance in times of financial crisis. Similarly, regulatory controls on capital movements could limit the amount

of financial assets foreign investors may repatriate during episodes of financial stress. More generally, financial market regulation may enhance the stability of financial flows.

The paper explores these issues, adding to the existing literature along several dimensions. First, it analyses how geographical distance and national uncertainty aversion interact in shaping foreign investment positions (portfolio equity and debt; FDI; bank loans and deposits). For this purpose, the paper sets up a gravity model including origin- and destination-country fixed effects that appropriately deals with possible omitted variable bias arising in simple cross-section specifications that do not include country fixed effects (Okawa and van Wincoop, 2012). The country-level measure of uncertainty aversion – which has been used in studies on trade (Huang, 2007) and economic development (Huang, 2008) – is based on a value survey of employees holding similar positions across different countries in a large multinational company (Hofstede, 1980, 2001). A second contribution of the paper is to analyse how the distance effect varied during the global financial crisis of 2008-09 as compared with the years immediately preceding it. Analysing how the distance effect varies over time is common in the literature on trade in goods (Disdier and Head, 2008) and services (Head *et al.*, 2009), but no such analysis exists for international investment. An increase in the distance effect during the global financial crisis of 2008-09 could be interpreted as evidence for uncertainty-driven capital outflows. The third and final contribution of the paper is to examine whether structural policy settings that improve the availability of information to foreign investors and improve confidence in the soundness of the financial system influenced the extent of asset withdrawals during the crisis.

The main results of the paper are the following:

- Distance matters for international portfolio allocation.
- The distance effect increases with investing-country uncertainty aversion.
- The distance effect increased significantly during the financial crisis of 2008-09, consistent with the view that uncertainty aversion played a major role.
- There is a clear ranking of the increase in the distance effect across asset classes. Debt securities and bank loans and deposits were more affected than portfolio equity and FDI. This may reflect that portfolio equity and FDI are relatively illiquid investments or that more accurate information on these types of assets is available to investors.
- Accurately measuring the degree and quality of regulation in the financial sector is fraught with difficulties. Nonetheless, indicators of prudential banking regulation, in particular relatively stringent capital adequacy rules and strict information disclosure requirements, appear to have limited the increase in the distance effect during the 2008-09 crisis. By contrast, no such evidence is found regarding other structural features such as financial market development or capital controls.[3]

The remainder of the paper is organised in the following way. The next section describes the data and outlines the empirical methodology. The empirical results are discussed in Section 3. Section 4 presents robustness and sensitivity checks, and Section 5 concludes with a short discussion of policy implications.

2. Methodology and data

2.1. Methodology

Over the past decade gravity models which have traditionally been used to explain international trade patterns have increasingly been applied to international finance. Essentially, these models explain bilateral capital flows or holdings by the sizes of the two countries and the geographical distance between them. Whereas early contributions estimated *ad-hoc* specifications (Portes *et al.*, 2001; Portes and Rey, 2005), more recent papers have tried to provide theoretical foundations for estimated gravity equations (Martin and Rey, 2004; Okawa and van Wincoop, 2012). These papers model the demand and supply of assets in a general equilibrium framework, with asset trade arising from specific assumptions on asset production and consumer preferences. When trading assets across borders, investors are assumed to incur bilateral trading costs ("financial frictions"), which can be proxied by bilateral variables such as geographical distance or common language and include the cost of acquiring information about foreign assets.

The estimation strategy adopted in this paper is closest in spirit to Okawa and van Wincoop (2012), with this gravity equation taking the following form:

$$X_{od} = \frac{H_o S_d}{H} \frac{P_o \Pi_d}{\tau_{od}} \tag{1}$$

Bilateral asset holdings X_{od} of country o (origin) in country d (destination) are a function of two terms: the first term on the right-hand side of equation (1) ($H_o S_d/H$) is a measure of a country pair's financial market size, with H_o measuring the total asset holdings of country o, S_d the total supply of assets in country d and H the world holdings of assets. The second term ($P_o \Pi_d/\tau_{od}$) is a measure of relative financial frictions between countries o and d, with τ_{od} measuring the bilateral financial friction, P_o the multilateral or average friction of country o as an origin country, and Π_d the multilateral friction of country d as a destination country.

The intuition for the relative friction term in equation (1) is that bilateral asset holdings depend not only on bilateral financial frictions between partner countries but also on both countries' frictions with the rest of the world. At a given bilateral friction, a country pair that is financially remote from the rest of the world (high P_o and high Π_d) would be expected to have higher bilateral asset holdings than a less remote country pair. In Okawa and van Wincoop (2012), financially remote countries offer higher risk-adjusted returns in equilibrium, which at a given bilateral friction generates larger bilateral investment.

The empirical counterpart to equation (1) for a panel of bilateral financial asset holdings takes the following form:

$$\ln(X_{odt}) = \sum_{m=1}^{M} \beta_m Z_{od}^m + \gamma_{ot} + \gamma_{dt} + \varepsilon_{odt} \tag{2}$$

Z_{od}^m are observable proxies for time-invariant bilateral financial frictions, such as the logarithm of geographical distance or a dummy variable for membership in the same currency union. γ_{ot} and γ_{dt} are time-varying origin and destination country fixed effects that account for the unobservable and time-varying multilateral frictions terms in equation (1). In the theoretical model of Okawa and van Wincoop (2012) the multilateral frictions terms are functions of the bilateral frictions terms and are thus likely to be correlated empirically. Omitting the multilateral frictions terms in a "naive" gravity-

equation setup without origin and destination fixed effects may therefore result in a serious omitted-variable bias. Moreover, the time-varying origin and destination country fixed effects capture the variation in investment related to all observable or non-observable fixed and time-varying country characteristics such as country size or the growth outlook. These variables can therefore be omitted from the estimated equation without biasing the coefficients of the included explanatory variables.

Equation (3) modifies the baseline gravity model in equation (2) to test the hypothesis that the effect of distance on bilateral asset positions varies with uncertainty aversion in the investing country:

$$\ln(X_{odt}) = \sum_{m=1}^{M} \beta_m Z_{od}^m + \beta_U dist_{od} \cdot UAI_o + \gamma_{ot} + \gamma_{dt} + \varepsilon_{odt} \quad (3)$$

As in equation (2), observed bilateral financial frictions are captured by the Z_{od}^m. $dist_{od}$ denotes the logarithm of the geographical distance between countries *o* and *d*, and UAI_o denotes an uncertainty aversion index in country *o*. The coefficient of interest, β_u, measures here how the distance effect, which can be interpreted as a measure of information frictions, varies with the uncertainty aversion index in the investing country UAI_o.

Equation (4) examines whether the distance effect increased during the global financial crisis of 2008-09:

$$\ln(X_{odt}) = \beta_c dist_{od} \cdot crisis_t + \gamma_{od} + \gamma_{ot} + \gamma_{dt} + \varepsilon_{odt} \quad (4)$$

$Crisis_t$ is a dummy that takes value 1 in the years 2008-09 and 0 otherwise. The coefficient β_c measures here the extent to which the distance effect changed during the global financial crisis of 2008-09. In this specification the recipient-country-year fixed effects fully account for domestic valuation changes in the recipient country, *e.g.* for fluctuations in the recipient-country's stock market index. Moreover, as asset holdings are expressed in US dollars, the recipient-country-year fixed effects also capture exchange-rate-induced valuation changes. As a result, the coefficient β should capture only foreign investors' *active* portfolio reallocation strategies.

Finally, the paper investigates how structural policy settings shaped the increase in the distance effect during the global financial crisis of 2008-09, using the following specification:

$$\ln(X_{odt}) = \beta_k dist_{od} \cdot crisis_t \cdot pol_d^k + \beta_c dist_{od} \cdot crisis_t + \gamma_{od} + \gamma_{ot} + \gamma_{dt} + \varepsilon_{odt} \quad (5)$$

The coefficient of interest in this specification is β_k, which measures how the increase in the distance effect during the global financial crisis of 2008-09 varied with structural policy setting pol_d^k in the destination country. The term $dist_{od}$. $crisis_t$ denotes the simple interaction between geographical distance and the crisis dummy already featured in equation (4) above.

2.2. Data

This paper constructs a comprehensive database of *stocks* of the four asset categories constituting the financial account, namely portfolio equity and debt, FDI, as well as bank loans and deposits. For portfolio investments the IMF's Consolidated Portfolio Investment Survey (CPIS) is used, which reports bilateral portfolio equity and debt investments for

74 reporting countries and 231 partner countries for the years 2001-2009.[4] Information on bilateral FDI stocks is taken from the *OECD International Direct Investment Database*, which covers 34 reporting countries and 217 partner countries. For bilateral bank loans and deposits BIS Locational Banking Statistics (ILB) are used, which are available for 25 reporting countries and 205 partner countries.

Financial centres are excluded from the regressions reported in the main part of the paper.[5] The rationale is that financial centres act as pure intermediaries that are neither the true source nor the true destination of foreign investments. Several checks on the sensitivity of the results to the precise list of excluded financial centres are conducted in Section 4.

The data contain a substantial number of observations equal to zero.[6] In the baseline specifications these observations are dropped as the dependent variable is specified as the logarithm of the bilateral investment position. The rationale is to focus on how the magnitude of positive bilateral investment positions varies with changes in the explanatory variables rather than on changes from zero to positive holdings. To assess whether the logarithmic transformation of the gravity equation biases the estimated coefficients, including because zero reported trade flows are dropped, several robustness checks are conducted in Section 4.

The estimation covers two periods, namely the years 2005-06 and 2008-09. For the results reported in the main text the pre-crisis distance effect is estimated using the end-of-year asset positions in 2005-06 and the distance effect during the crisis using the asset positions in 2008-09. While it is possible to use only one year for each period, using two years has the advantage of limiting measurement error in bilateral capital stocks. The sensitivity to using only one year for each period is assessed in Section 4.

The country-level measure of uncertainty aversion used in this paper is taken from Hofstede (1970, 2001). It is based on a survey that asks around 90 000 employees of a large multinational company in 50 countries, holding similar positions in marketing and customer service, several questions to assess their attitudes toward uncertainty and ambiguity. Recent studies on international trade (Huang, 2007) and economic development (Huang, 2008) have used the Hofstede measure of uncertainty avoidance as an explanatory variable, showing that uncertainty avoidance has a significant impact on the geographical structure of exports and the industrial composition of growth.[7]

Further explanatory variables include the bilateral Z_{od}^{m} variables in equation (2) which measure geographical and cultural proximity (geographical distance, common language, common border) and are taken from CEPII's distance database. The pol_{d}^{k} in equation (5) measure structural policies and other destination country characteristics. They include income per capita from the World Bank World Development Indicators and financial development indicators (private credit to GDP and liquid liabilities to GDP) from Beck and Demirgüç-Kunt (2009). They further include measures of banking regulations in different areas, including capital adequacy and information disclosure requirements, obtained by extending the database of Ahrend *et al.* (2009) to non-OECD countries; indicators of capital flow restrictions taken from Schindler (2009), Brune (2006) and Quinn and Toyoda (2008); and the measures of overall institutional quality provided by *The World Bank Governance Indicators Database*.

3. Empirical results

3.1. Baseline

The results for the baseline specification (1) estimated for the years 2005-06 are reported in Table 1.[8] As all regressions control for investing-country-year and recipient-country-year fixed effects, the effect of GDP as a proxy for countries' economic sizes is not separately identifiable. Distance, common language, common border, colonial relationship in the past and membership in the euro area vary along both the investing- and recipient-country dimensions.

Table 1. **Baseline specification**

Equation (2)
2005-06

Dependent variable	(1) Total portfolio	(2) Portfolio equity	(3) Portfolio debt	(4) FDI	(5) Loans and deposits
Distance	-0.425***	-0.522***	-0.513***	-1.096***	-1.262***
	(0.083)	(0.097)	(0.104)	(0.103)	(0.131)
Common language	0.413***	0.160	0.664***	0.273	-0.156
	(0.136)	(0.143)	(0.176)	(0.185)	(0.193)
Common border	0.297*	0.438***	0.131	0.111	0.085
	(0.166)	(0.168)	(0.218)	(0.202)	(0.273)
Colony	0.192	0.424**	0.062	1.100***	1.251***
	(0.169)	(0.188)	(0.214)	(0.230)	(0.229)
Euro area	1.198***	0.664***	1.392***	0.117	0.413*
	(0.139)	(0.142)	(0.194)	(0.196)	(0.229)
Observations	1 353	1 353	1 353	1 353	1 353
R-squared	0.91	0.91	0.86	0.79	0.80

* Significant at 10%; ** significant at 5%, *** significant at 1%.
Notes: Includes investor-year and recipient-year fixed effects. Robust standard errors clustered at the country pair level in parentheses.

Together, the country fixed effects and the proxies for bilateral frictions explain 80-90% of the variation in bilateral asset holdings. In line with results by Daude and Fratzscher (2008), the estimated distance elasticity is around -0.5 for portfolio holdings and around -1 for FDI and loans and deposits. One reason may be that, for the latter, information frictions play a more important role in asset allocation decisions.[9] The fact that, controlling for other dimensions of distance such as common language, common border or colonial relationship, geographical distance comes out strongly significant for all asset types may suggest that distance by itself is a significant component of bilateral information frictions.[10]

Assuming that geographical distance partly measures information frictions for each class of assets, the distance effect should increase with uncertainty aversion. As the cost of information acquisition increases with distance, uncertainty-averse investors should invest mainly at home or in geographically proximate locations. Kasa (2000), for instance, illustrates how the interaction of information frictions with uncertainty-averse investors may explain the negative correlation between distance and foreign asset holdings (Portes *et al.*, 2001). Based on the country-level measure of uncertainty aversion of Hofstede (1980, 2001), it is possible to conduct a formal test of this hypothesis by estimating equation (3) above, which augments the baseline gravity equation with the interaction between distance and Hofstede's (1980, 2001) uncertainty-avoidance index (UAI).[11] Table 2 reports the coefficients of this interaction term for four different asset classes.[12]

Table 2. **The distance effect increases with uncertainty aversion**

Specification: Equation (3)
2005-06

Dependent variable	(1) Total portfolio	(2) Portfolio equity	(3) Portfolio debt	(5) Loans and deposits	(6) Total portfolio
Distance	-0.508***	-0.585***	-0.575***	-1.239***	-2.046***
	(0.090)	(0.108)	(0.107)	(0.132)	(0.495)
Common language	0.387***	0.140	0.646***	-0.149	0.433***
	(0.136)	(0.143)	(0.174)	(0.191)	(0.133)
Common border	0.206	0.368**	0.063	0.110	0.179
	(0.168)	(0.169)	(0.217)	(0.272)	(0.166)
Colony	0.206	0.434**	0.072	1.247***	0.256
	(0.170)	(0.190)	(0.212)	(0.225)	(0.162)
Euro area	0.980***	0.498***	1.230***	0.473*	0.892***
	(0.142)	(0.149)	(0.204)	(0.243)	(0.144)
Distance * UAI	-0.366***	-0.279***	-0.271**	0.100	-0.177*
	(0.090)	(0.089)	(0.122)	(0.121)	(0.101)
Distance * Income per capita					0.600***
Observations	1 353	1 353	1 353	1 353	1 353
R-squared	0.89	0.89	0.84	0.73	0.81

* Significant at 10%; ** significant at 5%, *** significant at 1%.

Notes: The reported distance coefficient relates to the country with mean log UAI (and mean log income per capita in column 6). Includes investor-year and recipient-year fixed effects. Robust standard errors clustered at the country pair level in parentheses.

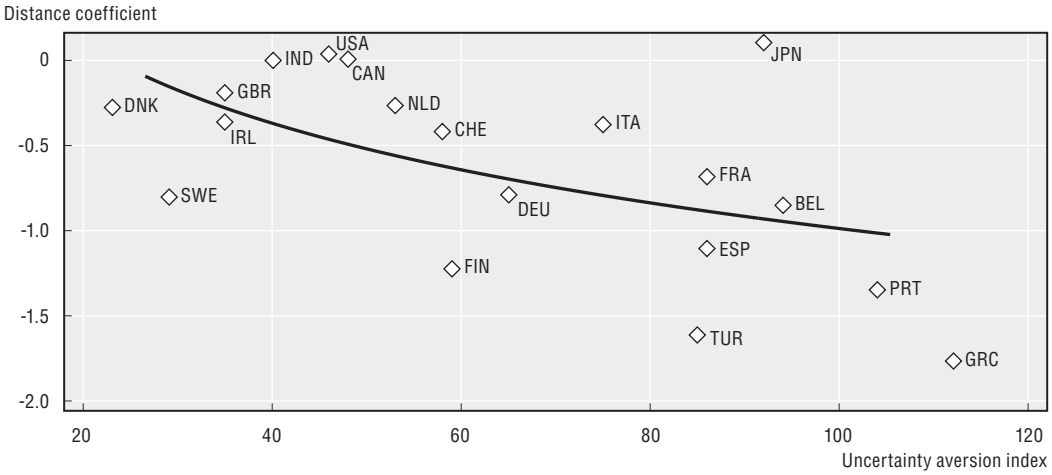
Generally, a higher degree of uncertainty aversion as measured by the UAI is associated with a larger distance effect (a more negative impact of distance on bilateral asset holdings).[13] As the UAI enters the interaction with distance in logarithmic form, the coefficients can be interpreted as the increase in the absolute distance elasticity resulting from doubling the UAI in the investing country. For instance, the absolute distance elasticity of total portfolio investments would be increased by around 0.4 if the UAI in the investing country was doubled (Table 2, Column 1).[14] However, given the negative correlation between the UAI and income per capita, an increase in the distance effect may not necessarily be attributable to higher uncertainty aversion but might instead reflect lower income per capita. To test this hypothesis, the analysis additionally controls for the interaction between distance and income per capita in the total portfolio equation (Column 6). While the size of the estimated coefficient on the interaction between the UAI and distance decreases, the coefficient remains negative and statistically significant at the 10% level, confirming the robustness of the result. Figure 1 provides a graphical illustration of the relationship between the UAI and the estimated distance coefficient for the countries in the sample.

3.2. Did the distance effect increase during the global financial crisis of 2008-09?

Asset liquidations by uncertainty-averse investors were at the heart of the financial crisis of 2008-09. Investors liquidated complex debt securities which had become difficult to value and moved into assets with less uncertain valuations, such as government bonds. Theoretical models by Caballero and Krishnamurty (2008), Krishnamurty (2010) and Uhlig (2010), among others, are based on such a "flight to quality". If distance at least partly measures information frictions, as suggested by the empirical evidence on the performance of local investors (Hau, 2001; Malloy, 2005; Bae *et al.*, 2008), in the gravity model estimated here asset liquidations by uncertainty-averse investors should be

Figure 1. **The distance effect increases with uncertainty aversion**

2005-06



Note: Estimated distance effect for total portfolio holdings.
Source: OECD calculations based on Hofstede (1970, 2001).

reflected in an increase in the distance effect. Investors would be expected to reduce their asset holdings in geographically more distant markets by more than in nearby locations when uncertainty suddenly rises. Table 3 reports the results from estimating equation (4) above, which is a formal test of whether, during the crisis, the distance effect differed significantly from that in the pre-crisis period.

Table 3. **The distance effect increased during the crisis**

Specification: Equation (4)
2005-06, 2008-09

Dependent variable	(1) Total portfolio	(2) Portfolio equity	(3) Portfolio debt	(4) Long portfolio debt	(5) Short portfolio debt	(6) FDI	(7) Loans and dep.
Distance * Crisis	-0.127***	0.008	-0.101***	-0.093**	-0.239**	0.049	-0.084**
	(0.031)	(0.042)	(0.036)	(0.038)	(0.108)	(0.046)	(0.042)
Observations	7 368	5 224	5 880	5 560	1 304	3 788	6 900
R-squared (within)	0.36	0.45	0.32	0.34	0.42	0.45	0.31

* Denotes statistically significant at 10%; ** significant at 5%, *** significant at 1%. The within R-squared denotes the variance within country pairs explained by the change in the distance effect over time and the investor-year and recipient-year fixed effects.
Notes: Includes investor-year and recipient-year fixed effects. Robust standard errors clustered at the country pair level in parentheses.

The distance effect indeed increased – the coefficient of distance became more negative – during the global financial crisis of 2008-09.[15] There was a large and statistically significant increase for portfolio investments, which appears to be driven mainly by portfolio debt securities. Given that for total portfolio investments the estimated coefficient (*i.e.* the distance elasticity) was around -0.4 before the crisis (see Table 1, Column 1), a -0.13 change (Table 3, Column 1) corresponds approximately to a 30% increase in the distance effect. Put differently, the financial crisis of 2008-09 had similar effects on bilateral asset holdings as increasing the distance between countries by 30%. The increase in uncertainty aversion during the crisis also appears to have affected the geographical

pattern of international loans and deposits but not portfolio equity and FDI. This may reflect that portfolio equity and FDI are relatively illiquid investments in the sense that they cannot be rapidly withdrawn during a crisis without incurring large capital losses. Alternatively, equity investors, in particular those engaging in FDI, may have collected more accurate information about their investments than holders of portfolio debt securities or banks about their debtors. While the coefficients in Table 3 are not directly comparable across asset classes because of differing sample sizes, additional evidence presented in Section 4 supports the view that the increase in the distance effect was indeed particularly large for portfolio debt and for bank loans and deposits.

The collapse in global trade that coincided with the financial crisis of 2008-09 does not change the interpretation of the results in Table 3. The increase in the distance effect for international asset holdings may, to some extent, reflect the trade collapse of 2008-09 if the latter was disproportionately large for geographically-distant trading partners and if there are complementarities between goods and asset trade. However, this would not change the interpretation of the results in Table 3. Changes in transport costs cannot plausibly account for the possible increase in the distance effect in international trade. Instead, any increase in the distance effect in international trade would likely reflect a similar interaction between information frictions and higher uncertainty during the financial crisis of 2008-09 as described above.[16]

The increase in the distance effect during the financial crisis of 2008-09 was mainly driven by withdrawals of investors from particularly uncertainty-averse countries. Splitting the sample into reporting countries with below- and above-median indexes of uncertainty aversion shows that the increase in the distance effect for total portfolio holdings and loan and deposit holdings was large and statistically highly significant for investing countries with above-median indexes of uncertainty aversion (Table 4).[17] By contrast, the increase in the distance effect was small and statistically less significant for countries with low indexes of uncertainty aversion. This suggests that the overall increase in the distance effect can, to a large extent, be attributed to investors from particularly uncertainty-averse countries.

Table 4. **The increase in the distance effect during the crisis was mainly driven by countries with above-median uncertainty aversion**

Specification: Equation (4)
2005-06, 2008-09

Dependent variable	(1) Total PF	(7) Loans and deposits
Distance * Crisis * (Below-median UAI)	-0.065*	-0.050
	(0.038)	(0.048)
Distance * Crisis * (Above-median UAI)	-0.126***	-0.115**
	(0.039)	(0.053)
Observations	7 368	6 900
R-squared (within)	0.36	0.31

* Denotes statistically significant at 10%; ** significant at 5%, *** significant at 1%. The within R-squared denotes the variance within country pairs explained by the change in the distance effect over time and the investor-year and recipient-year fixed effects.
Notes: Includes investor-year, recipient-year and pair-fixed effects. Robust standard errors clustered at the country pair level in parentheses.

Summing up, these results are consistent with the view that increases in perceived uncertainty were at the core of the 2008-09 crisis. Investors, especially those who were particularly uncertainty averse, disproportionately reduced the holdings of assets in geographically more distant locations, possibly because they had less information about them.

3.3. Which structural policy settings mitigated the crisis-related increase in the distance effect?

Some structural policies may mitigate the increase in the distance effect in times of crisis. For instance, financial market transparency may reassure investors as it facilitates the assessment of the health of the financial system. Regulations that increase financial market transparency could thereby limit the extent to which distant investors may wish to reduce their holdings in the event of global financial turmoil. Consistent with this hypothesis, Gelos and Wei (2005) find that mutual funds tend to disproportionately exit non-transparent countries during financial crises. Similarly, stricter prudential banking regulation may induce investors to retain a higher share of their holdings in a given country, in particular if they are located in geographically-distant countries with less information on the destination country. Finally, restrictions on capital outflows – which may limit the amount of capital investors can repatriate during financial crises – could primarily be a constraint on geographically-distant investors. This could arise, for example, when geographically more distant investors desire to reduce their holdings by more, in which case tighter capital account restrictions should limit the increase in the distance effect during crises.[18] These hypotheses are tested by estimating several variations of equation (5).

Only structural policy variables relating to domestic banking regulation appear to have limited the increase in the distance effect during the global financial crisis of 2008-09 (Table 5). Neither the overall quality of institutions nor capital outflow restrictions were found to be effective, but the absence of statistically-significant results for the latter variables could also reflect inherent difficulties in measuring them.[19] By contrast, stricter capital adequacy requirements were found to have limited the increase in the distance effect both for total portfolio investments and bank loans. Resilience and reduced leverage of the banking system may also have raised foreign investors' confidence in its stability, possibly resulting in a particularly large stabilising effect on capital flows from more distant investors during the crisis. Similarly, more extensive external auditing and disclosure requirements for banks appear to have limited the increase in the distance effect for loans and deposits during the crisis, presumably as better access to information helped reassure investors about the safety of their investments.

4. Robustness checks

This section assesses the robustness of the previous analysis, with a particular focus on the central result that the effect of distance increased during the financial crisis of 2008-09.[20] It is found that this result is robust to changes in the sample, alternative estimation methods or using a different proxy for bilateral frictions. Moreover, the robustness checks presented below strengthen the view that there was a clear ranking of the increase in the distance effect across asset classes, with debt securities as well as bank loans and deposits more affected than portfolio equity and FDI.

Table 5. **Some structural policy setting were associated with smaller increases in the distance effect during the global financial crisis of 2008-09**

Equation (5): Coefficients of interaction terms between distance, crisis and structural policies
2005-06, 2008-09

Dependent variable	Total portfolio investment				
Institutional quality	-0.009				
	(0.031)				
Liquid liabilities to GDP		0.021			
		(0.079)			
Bank capital adequacy rules			0.071**		
			(0.030)		
Bank information disclosure rules				0.048	
				(0.043)	
Capital outflow restrictions					0.142
					(0.100)
Observations	7 232	6 564	6 884	6 884	6 180
R-squared (within)	0.36	0.35	0.35	0.35	0.37
Dependent variable	Total loans and deposits				
Institutional quality	0.049				
	(0.040)				
Liquid liabilities to GDP		-0.006			
		(0.129)			
Bank capital adequacy rules			0.082*		
			(0.046)		
Bank information disclosure rules				0.148**	
				(0.070)	
Capital outflow restrictions					-0.139
					(0.104)
Observations	6 836	5 952	5 756	5 756	4 820
R-squared (within)	0.31	0.30	0.30	0.30	0.30

* Denotes statistically significant at 10%; ** significant at 5%, *** significant at 1%. Reported coefficients denote the triple interactions between distance, the crisis dummy and the structural policy in the first column. The interactions between distance and the crisis dummy are included but not reported. The capital outflow restrictions relate to the recipient country and the specific type of flow. Source: Schindler (2009). The within R-squared denotes the variance within country pairs explained by the change in the distance effect over time and the investor-year and recipient-year fixed effects.

Notes: Includes investor-year, recipient-year and pair-fixed effects. Robust standard errors clustered at the country pair level in parentheses.

4.1. Sample period

The estimations in the main text use, respectively, end-of-year data from the 2005-06 and 2008-09 periods to estimate the distance effects prior to and during the crisis. Using two years in each period improves estimation efficiency by reducing the impact of measurement error on the precision of the estimated coefficients. Strictly speaking, however, the geographical pattern of asset withdrawals during the crisis should be inferred from comparing capital stocks at the end of the pre-crisis period with those at the end of the crisis. Arguably, end-of-2006 data should be used for the end of the boom period, as capital flows started to reverse during 2007. Similarly, end-of-2009 data can be seen as marking the end of the most acute phase of the global financial crisis, as capital flows to emerging countries recovered in 2010. Table 6 therefore reports the results from estimating equation (3) for the years 2006 and 2009. The estimated coefficients are almost identical to those in Table 3. Unsurprisingly, the standard errors are somewhat higher than in the

Table 6. **The distance effect increased during the crisis**

Specification: Equation (4)
2006, 2009

Dependent variable	(1) Total portfolio	(2) Portfoliol	(3) Portfolio debt	(4) Long portfolio debt	(5) Short portfolio debt	(6) FDI	(7) Loans and dep.
Distance * Crisis	-0.153***	0.051	-0.157***	-0.120***	-0.202*	-0.031	-0.077*
	(0.035)	(0.040)	(0.043)	(0.046)	(0.120)	(0.047)	(0.047)
Observations	4 342	3 146	3 510	3 374	892	2 374	3 704
R-squared (within)	0.29	0.35	0.28	0.30	0.43	0.39	0.24

* Denotes statistically significant at 10%; ** significant at 5%, *** significant at 1%. The within R-squared denotes the variance within country pairs explained by the change in the distance effect over time and the investor-year and recipient-year fixed effects.
Notes: Includes investor-year, recipient-year and pair-fixed effects. Robust standard errors clustered at the country pair level in parentheses.

baseline estimations, reflecting the loss in estimation efficiency when using two years instead of four.

4.2. Reported zero positions

Both in the CPIS and BIS data there is a substantial number of reported zero positions, which reflect either small holdings or "true" zero positions. It has been argued in the international trade literature that the logarithmic transformation of the gravity equation may bias the estimated coefficients, including because zero reported trade flows are dropped (Santos and Tenreyro, 2006). However, non-linear estimators addressing this issue may fail to converge in models with large numbers of fixed effects (Santos and Tenreyro, 2011). Studies on the determinants of foreign asset positions generally exclude zero positions from the analysis or transform the dependent variable before taking logarithms (Lane and Milesi-Ferretti, 2008).[21] In the current context, asset positions with a reported value of zero both at the end of the boom period and the end of the of the crisis period do not contribute to the understanding of the geographical pattern of asset reallocations during the crisis. Therefore, it makes economic sense to exclude them from the sample. By contrast, assets positions with positive reported values in one period and zero values in the other may be relevant. For instance, if investors fully unwind positions (*i.e.* bring asset holdings to zero) mainly in geographically distant countries, this would contribute to an increase in the distance effect.[22] Hence, these observations should be included in the estimation sample. Table 7 reports the results from estimating equation (3) when observations with zero reported values in either the pre-crisis or crisis periods are retained. This is achieved by adding ε=1 (equal to USD 1 000) to the dependent variable before taking logarithms.[23]

Sample size increases by around 50% for total portfolio holdings and aggregate equity and debt portfolio holdings, and by around 20% for loans and deposits. These sample changes notwithstanding, the estimated coefficients are similar to those in the baseline estimates in Table 3. A noticeable difference is that in Table 6 the largest increase in the distance effect is for loans and deposits, while the increase for short-term portfolio debt becomes statistically insignificant.

4.3. Inclusion of financial centres

International financial centres (IFCs) cannot be viewed as the true source or destination of investment flows, as they frequently act as pure intermediaries. In the

Table 7. **The distance effect increased during the crisis (2005-06, 2008-09)**

Specification: Equation (4)
Including zero values

Dependent variable	(1) Total portfolio	(2) Portfolio equity	(3) Portfolio debt	(4) Long portfolio debt	(5) Short portfolio debt	(6) FDI	(7) Loans and dep.
Distance * Crisis	-0.133***	0.014	-0.084**	-0.092***	-0.112	-0.037	-0.214***
	(0.033)	(0.037)	(0.035)	(0.035)	(0.107)	(0.044)	(0.053)
Observations	10 852	6 968	8 120	7 496	2 636	4 248	8 312
R-squared (within)	0.34	0.39	0.27	0.30	0.29	0.42	0.26

* Denotes statistically significant at 10%; ** significant at 5%, *** significant at 1%. The within R-squared denotes the variance within country pairs explained by the change in the distance effect over time and the investor-year and recipient-year fixed effects.
Notes: Includes investor-year, recipient-year and pair-fixed effects. Robust standard errors clustered at the country pair level in parentheses.

baseline estimation IFCs are therefore excluded from the sample. The results from estimating the baseline model including IFCs are reported in Table 8. While the sample size increases by up to 50% with respect to the baseline specification excluding IFCs, the results remain qualitatively the same. The distance effect increased during the crisis for portfolio holdings and loans and deposits, with the increase for portfolio holdings being driven by debt holdings.

Table 8. **Including IFCs does not alter the results**

2005-06, 2008-09

Dependent variable	(1) Total portfolio	(2) Portfolio equity	(3) Portfolio debt	(4) Long portfolio debt	(5) Short portfolio debt	(6) FDI	(7) Loans and dep.
Distance * Crisis	-0.078***	0.007	-0.120***	-0.132***	-0.220***	0.055	-0.067*
	(0.026)	(0.033)	(0.028)	(0.028)	(0.072)	(0.043)	(0.039)
Observations	11 308	7 900	8 976	8 472	2 276	4 252	8 572
R-squared (within)	0.30	0.37	0.27	0.29	0.38	0.46	0.29

* Denotes statistically significant at 10%; ** significant at 5%, *** significant at 1%. The within R-squared denotes the variance within country pairs explained by the change in the distance effect over time and the investor-year and recipient-year fixed effects.
Notes: Includes investor-year, recipient-year and pair-fixed effects. Robust standard errors clustered at the country pair level in parentheses.

4.4. "Closeness" instead of geographical distance

Besides geographical distance, some of the bilateral explanatory variables included in the baseline gravity equation in Table 2 may also measure information frictions. A common language, for instance, facilitates communication and reduces the cost of information acquisition. Similarly, it may be less costly to obtain information about neighbouring countries or former colonies. To test whether asset reallocations during the financial crisis of 2008-09 were indeed related to this broader set of potential proxies for information frictions, the first standardised principal component of common language, common border, former colonial relationship, bilateral newspaper trade and inverse distance is interacted with the crisis dummy in equation (4). The estimation results, reported in Table 9, are qualitatively similar to those in the baseline specification which focuses on geographical distance alone. During the financial crisis of 2008-09 investors

Table 9. **Fund withdrawals were smaller in geographically and culturally "close" countries**

(2005-06, 2008-09)

Dependent variable	(1) Total portfolio	(2) Portfolio equity	(3) Portfolio debt	(4) Long portfolio debt	(5) Short portfolio debt	(6) FDI	(7) Loans and dep.
Closeness * Crisis	0.050***	0.003	0.041**	0.039**	0.077**	-0.023	0.024*
	(0.013)	(0.017)	(0.016)	(0.017)	(0.037)	(0.018)	(0.014)
Observations	7 368	5 224	5 880	5 560	1 304	3 788	6 900
R-squared (within)	0.36	0.45	0.32	0.34	0.42	0.45	0.31

* Denotes statistically significant at 10%; ** significant at 5%, *** significant at 1%. The within R-squared denotes the variance within country pairs explained by the change in the distance effect over time and the investor-year and recipient-year fixed effects.

Notes: Includes investor-year, recipient-year and pair-fixed effects. Robust standard errors clustered at the country pair level in parentheses.

reallocated their asset holdings toward countries that were geographically and culturally "closer" to their home country. This effect appears to be largest for portfolio debt holdings and in particular for short-term debt holdings.

4.5. *Sample balanced both within and across asset classes*

As already mentioned in Section 3, the estimated increase in the distance effect during the crisis is not directly comparable across asset classes because of differing sample sizes. While balancing the sample both within asset classes over time and across asset classes is impossible due to the sharp reduction in sample size this would entail, it is possible to balance the sample pair-wise across the relevant asset classes.[24] Table 10 reports the results from the following pair-wise balanced panels: Total portfolio securities and FDI; bank loans and deposits and FDI; and equity portfolio and debt portfolio securities. The results are similar to those in the unbalanced panel. There is a statistically-significant increase in the distance effect for portfolio debt and bank loans and deposits, whereas the increase in the distance effect is statistically insignificant for FDI and portfolio equity.

Table 10. **The distance effect increased during the crisis**

Balanced panel within and across asset classes (2005-06, 2008-09)

Dependent variable	(1) Total portfolio	(2) FDI	(3) Loans and dep.	(4) FDI	(5) Portfolio equity	(6) Portfolio debt
Distance * Crisis	-0.076*	0.027	-0.219***	-0.035	0.035	-0.267***
	(0.041)	(0.039)	(0.064)	(0.039)	(0.042)	(0.074)
Observations	5 560	5 560	2 928	2 928	3 768	3 768
R-squared (within)	0.29	0.41	0.43	0.53	0.42	0.35

* Denotes statistically significant at 10%; ** significant at 5%, *** significant at 1%. The within R-squared denotes the variance within country pairs explained by the change in the distance effect over time and the investor-year and recipient-year fixed effects.

Notes: Includes investor-year, recipient-year and pair-fixed effects. Robust standard errors clustered at the country pair level in parentheses.

4.6. *Further recipient-country characteristics*

Country characteristics other than the specific regulatory setups identified in Section 3 do not appear to be associated with the increase in the distance effect during the global financial crisis of 2008-09. Columns (1) and (2) of Table 11 show that when the Brune

Table 11. **Other recipient-country characteristics were not related to the increase in the distance effect during the crisis**

Equation (5): Coefficients of interaction terms between distance, crisis and structural policies
2005-06, 2008-09

Dependent variable	Total portfolio investment				
Capital outflow restrictions (Brune, 2006)	-0.018				
	(0.059)				
Capital outflow restrictions (Quinn and Toyoda, 2008)		-0.002			
		(0.002)			
GDP per capita			-0.014		
			(0.028)		
Product market regulation (OECD)				0.034	
				(0.066)	
Quality of regulation (World Bank WGI)					-0.059
					(0.040)
Observations	7 104	5 496	7 087	4 736	7 222
R-squared (within)	0.36	0.36	0.36	0.35	0.36
Dependent variable	Total loans and deposits				
Capital outflow restrictions (Brune, 2006)	0.046				
	(0.080)				
Capital outflow restrictions (Quinn and Toyoda, 2008)		0.000			
		(0.003)			
GDP per capita			0.003		
			(0.033)		
Product market regulation (OECD)				-0.097	
				(0.102)	
Quality of regulation (World Bank WGI)					0.038
					(0.051)
Observations	6 732	3 908	6 663	2 692	6 808
R-squared (within)	0.31	0.26	0.30	0.30	0.31

* Denotes statistically significant at 10%; ** significant at 5%, *** significant at 1%. Reported coefficients denote the triple interactions between distance, the crisis dummy and the structural policy in the first column. The interactions between distance and the crisis dummy are included but not reported. The capital outflow restrictions relate to the recipient country and the specific type of flow. The within R-squared denotes the variance within country pairs explained by the change in the distance effect over time and the investor-year and recipient-year fixed effects.
Notes: Includes investor-year, recipient-year and pair-fixed effects. Robust standard errors clustered at the country pair level in parentheses.

(2006) or Quinn and Toyoda (2008) measures of capital outflow restrictions are used instead of Schindler (2009), the coefficient on the interaction of these indicators with distance and the crisis dummy remains statistically non-significant. Moreover, GDP per capita in the recipient country appears to be unrelated to the increase in the distance effect (Column 3), providing further evidence that the structural policy indicators relating to banking sector regulation identified in Section 3 do not merely pick up broad economic development. Finally, the overall regulatory setup as measured by the OECD Product Market Regulation (PMR) indicator or the World Bank Quality of Regulation indicator do not display a robust relationship with the increase in the distance effect during the global financial crisis of 2008-09.

5. Conclusion

This paper uses a large dataset of bilateral investment positions covering portfolio assets, FDI, as well as loans and deposits, to assess the role of uncertainty aversion in

international asset allocation. One view of the global financial and economic crisis of 2008-09 attributes the associated sharp fluctuations in capital flows to indiscriminate selling by uncertainty-averse investors (Caballero and Krishnamurty, 2008; Krishnamurty, 2010; Uhlig, 2011). According to this view, the financial dislocations of 2008-09 increased uncertainty, inducing investors to consider worst-case scenarios and replace risky financial claims with better-known and safer assets. This paper provides empirical support for this view. Using a survey-based measure of country-level uncertainty aversion, this paper first shows that uncertainty-averse investors have a stronger preference for geographically-proximate locations than investors who are less uncertainty averse. It further shows that the preference for geographically-proximate locations generally went up during the 2008-09 global crisis as investors shed disproportionately the assets of geographically-distant countries, possibly because information frictions for these countries were larger. The results of this paper also suggest that structural policies can alleviate the destabilising effects of increases in global uncertainty. Regulatory policies enhancing information disclosure and capital buffers in the banking system are found to mitigate particularly strong capital withdrawals from more distant investors in times of global financial-market stress.

Notes

1. See Anderson (2011) and Bergstrand and Egger (2011) for recent reviews of the gravity model in international trade and, *inter alia*, Baldwin and Taglioni (2007), Bussière *et al.* (2008), and Bussière and Schnatz (2009) for recent empirical applications.
2. This said, distance may to some extent also capture trade linkages or familiarity effects unrelated to information frictions. In particular, the behavioural finance literature has documented that, even in the absence of superior information, employees tend to overinvest in own-company stock or investors tend to be overconfident in forecasting domestic as opposed to foreign asset returns, which suggests behavioural biases toward familiar assets (Foad, 2010).
3. The absence of statistically-significant results for the latter variables could also reflect difficulties in measuring them.
4. A pilot survey was conducted for 29 reporting countries in 1997. However, some major investing countries, including Germany, did not participate.
5. Both small international financial centres (as defined by Lane and Milesi-Ferretti, 2010) and the more important international financial centres Cyprus, Hong Kong S.A.R. of China, Luxembourg and Singapore are excluded from the analysis.
6. Observations with a value of zero in the database relate either to "true" 0 bilateral asset positions or to bilateral asset positions below a given threshold (USD 0.5 million in the IMF CPIS data).
7. Although the survey was carried out around 1970 and the foreign investment positions used in this paper span the period 2001-09, the measurement error in this variable is unlikely to be high. Uncertainty aversion can be considered as an element of a country's culture which only changes very slowly over time (Williamson, 2000). For instance, Huang (2007) finds that the UAI is highly correlated with religion: the share of the population that is protestant displays a correlation of -0.5 with the UAI, while the population share of Catholics displays a positive correlation of 0.5.
8. To ensure comparability of coefficients the sample has been balanced across asset classes. The results for the unbalanced sample are qualitatively and quantitatively similar (available upon request).
9. Note that the coefficients for the total portfolio equation are not necessarily within the interval given by the portfolio equity and portfolio debt equations. The reason is that in the CPIS data for some country pairs, reported total portfolio assets differ from the sum of reported portfolio equity and reported portfolio debt.

10. The estimated coefficient of the euro area dummy is highly significant with the expected positive sign for all types of flows under consideration. Common language, common border and colonial relationship also come out broadly as expected, although not always statistically significant.

11. Huang (2007) analyses whether the distance effect in international trade varies with the UAI in the exporting country. He finds that the distance effect (the negative impact of distance on exports) increases significantly with the UAI.

12. To ensure comparability of coefficients the sample has been balanced across asset classes. The results for the unbalanced sample are qualitatively and quantitatively similar (available upon request).

13. The coefficient for the total portfolio equation is not within the interval given by the portfolio equity and portfolio debt equations, because in the CPIS data for some country pairs, reported total portfolio assets differ from the sum of reported portfolio equity and reported portfolio debt. The estimation results for FDI are not reported as one motive for choosing FDI over the other investment modes is precisely to reduce monitoring costs and thus limit uncertainty. As expected, in unreported regressions, the coefficient on the interaction between the UAI and distance turns out statistically insignificant (available upon request).

14. As the average distance elasticity for the countries in the sample is negative, a negative estimated coefficient on the interaction between distance and the UAI implies a larger distance elasticity in absolute terms.

15. Note that the sample is balanced within asset classes over time to ensure the estimated distance coefficient is not contaminated by composition effects. Further note that the simultaneous inclusion of investor-year, recipient-year and pair-fixed effects increases the overall fit of the empirical model. In contrast to the preceding section which attempted to explain the geographical pattern of portfolio holdings, this section attempts to explain the *change* in portfolio holdings over time. Instead of the overall R-squared this section therefore reports the within R-squared, which measures the proportion of the variance within country pairs that is explained by the time-varying distance effect and the investor-year and recipient-year fixed effects.

16. Moreover, depending on the direction of causality between asset and goods trade, the possible increase in the distance effect for international goods trade may itself reflect developments in international asset holdings. For instance, restrictions in the availability of trade credit were a major factor behind the trade collapse of 2008-09 (Amiti and Weinstein, 2009).

17. Samples that are balanced within asset classes over time for disaggregated portfolio and FDI holdings include an insufficient number of investing countries to allow splitting the change in the distance effect across investing countries with below- and above-median indexes of uncertainty aversion.

18. By contrast, there may be no such relation if distant investors anticipate the effect of capital outflow restrictions during crises and therefore do not invest in countries with restrictions on capital outflows in the first place.

19. Overall institutional quality is measured as the first standardised principal component of the following World Bank Governance indicators: Government effectiveness, political stability, voice, rule of law, control of corruption and regulatory quality.

20. The results on the correlation between the structural policy settings in the recipient country and the increase in the distance effect are generally robust to the changes in sample and definitions discussed below. For presentational ease, these tables are not reported but are available from the authors upon request.

21. A common transformation of the dependent variable is $\ln(y+\varepsilon)$, where y denotes the dependent variable and ε an arbitrary small number.

22. Similarly, if investors mainly build up new positions in geographically proximate countries during the crisis, this would also contribute to an increase in the distance effect.

23. Additionally retaining observations with zero reported holdings in both the boom and crisis periods gives qualitatively and quantitatively similar results.

24. As a large part of the reduction in sample size when balancing the sample across asset classes reflects country pairs with zero holdings for one or both asset classes, observations with zero reported values in either the pre-crisis or crisis periods, but not both, are retained for this robustness check.

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