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The Geographic Distribution of International Currencies and RMB internationalization

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Abstract

The paper investigates the determinants of geographical distribution of international currencies in global financial market transactions. We implement a gravity model, in which international currency distribution depends on the characteristics of the source and destination countries. We find that the source country's currency is more likely to be used in the financial market transactions of the destination country if the bilateral trade and capital flows are large or the destination country's economy is the larger of the two. We also find that the level of development of the destination country's financial market and whether the two countries use a common language are important determinants of the currency distribution. In addition, our model suggests that, to be a true international currency, the renminbi should be used more extensively in the financial markets of the US and UK.

JEL Classification: F33; F36; G15

Keywords: Currency Internationalization; Distribution of Currencies; Gravity Model

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1. Introduction

International use of different currencies is one of the key issues in international finance. Yet the reasons for using the currencies of different countries in financial transactions remain somewhat unclear. Since the collapse of Bretton Woods system in the early 1970s, the selection of international currencies has interested academics and policy makers. Kenen (1983) shows that to be an international currency the currency should be able to simultaneously play the roles of store of value, medium of exchange and unit of account. This means that there are several dimensions to consider when assessing the degree to which a currency has the characteristics needed to be used internationally.

The literature on international currencies has typically focused on the roles of invoicing currency for international trade and store of value. For example, Bachetta and Van Wincoop (2005) provide a theoretical analysis of the determinants of countries' currency invoicing share in international trade. Ito and Chinn (2013) empirically investigate the determinants of currency choice for trade invoicing in a cross-country context. Chinn and Frankel (2007, 2008) provide empirical evidence that GDP level, financial development and openness to the rest of the world are crucial for reserve-currency status. However, an international currency, as a vehicle currency, should be traded globally in foreign exchange markets as well. There are very few well-established results on the requirements for a currency to serve as a medium of financial market transactions.

To shed light on this issue, we implement a gravity model [1] to investigate the determinants of currency choice in international financial transactions. More specifically, we address the following two important issues: whether the international currencies differ geographically in their transactions across foreign exchange markets and what currency and country characteristics can explain the transaction pattern of the geographical distribution of international currencies.

Based on a set of data on cross-border foreign exchange transactions, we first provide evidence on the distribution of currencies in international financial transactions. The empirical results show that the gravity model performs well in explaining cross-border transactions of international currencies. We find that bilateral investment and trade between source and destination countries are important determinants of the use of an international currency. International currencies are traded disproportionately in the larger economies[2]. We also find that institutional and cultural factors, such as legal origins and common language, significantly affect the use of international currencies. The use of international currencies in the destination country increases significantly when the destination country implements common law or both the source and destination countries use a common language. Somewhat surprisingly, we find that international transactions with the world's major currencies are not influenced by geographical distance. This result suggests that truly international currencies are weightless, and less subject to the information asymmetry due to long distance.

We obtain similar results across a wide range of specification tests. Our results remain robust after controlling for the impact of capital account restrictions on the distribution of international currencies by including several measures of financial openness common in the international finance literature. In addition, we find that some country specific factors for currency transactions, e.g. the degree of insider trading and the sophistication of financial markets, are also important factors shaping the geographical distribution of

[1] The gravity model has been used extensively to explain trade and asset flows between countries.

[2] We use population and real per capita GDP to proxy economic mass.

international currency transactions.

We then use the predictions of the model to estimate the expected distribution of the Chinese renminbi (RMB) within the global foreign exchange market. The gap between the predicted and actual distribution of RMB offshore transactions is wide. Although Hong Kong is the leading RMB offshore market, and more than 50% of offshore RMB are traded in this market, our generated prediction is for the expected volume of RMB offshore transactions in the US to be larger than in Hong Kong. As the economic relationships between China and the UK and the EU are gaining in importance, a significant part of RMB transactions should be conducted in these areas. Hence, the establishment of offshore RMB markets in more western countries, including the US, UK and euro area, are important for increasing the international use of RMB.

The remainder of this paper is organized as follows. Section 2 presents a simple model and testable hypotheses. Research design is provided in Section 3. Section 4 describes the data we have collected and provides the summary statistics. Section 5 presents empirical results. In section 6, we provide an estimation of global distribution of RMB transactions and Section 7 concludes.

2. Theory and hypotheses

2.1 The Model

The international use of a currency occurs whenever a national currency performs the function of money outside of the issuing country. One important role of an international currency is to serve for asset denomination and international financial market transactions (Frankel, 2011). Whether and how faster a currency becomes internationally used depends on several key points (Ito and Chinn, 2013). The value of currency should be market-determined, so that investors can construct their own portfolio strategy accordingly. It also needs to be convenient in terms of both time and location for home investors to purchase or sell currency-denominated assets. In this sense, international currencies are actually assets bought by nonresidents, with the particular quantities of each currency depending upon their respective cost and return characteristics (Dowd and Greenaway, 1993). To investigate factors regarding demand on an international currency, we present a model for international trade in currency assets.

The model is a variant of the asset trade model of Martin and Rey (2004). Consider a two-period model with two countries (*A* and *B* respectively). Country *A* and country *B* are populated with l_A and l_B risk-averse immobile agents respectively. In the first period, agents in both countries are respectively endowed with n_A and n_B units of good (the numeraire), which they can use to consume or invest in risky assets[3]. Assets in country *A* and country *B* are denominated in their respective currencies. In the second period, there are L equally likely states of nature. The contingent asset return is d if state i occurs, and 0 otherwise. Asset returns are the only sources of consumption in the second period. Shares of assets are traded in both countries' stock markets. It implies that agents can directly develop (invest) a specific asset or buy shares of this asset through stock market.

In the first period, agents buy or sell shares of assets and construct their own portfolio strategy. When they trade assets internationally, they pay a transaction cost[4] τ. In this case, an agent g_A located in country *A* pays $(1+\tau)\, p_j s^j_{g_A}$ to buy a foreign currency asset, where p_j is the price of foreign currency asset and $s^j_{g_A}$ is the demand of agent g_A for this foreign currency asset. If the asset return is d in second period, the agent g_A receives only

[3] The assets can be risky projects that agents directly develop or other financial assets.

[4] International transactions on assets occur a variety of costs, such as exchange-rate transaction costs, bank and security commission, and other information costs.

$d(1-\tau)$ per share[5]. Hence, the budget constraint for an agent g_A in **country *A* is:**

$$c_{1,g_A} + f(z_{g_A}) + \sum_{\substack{i\in M_A \\ i\notin Z_{g_A}}} p_i s^i_{g_A} + \sum_{j\in M_B} (1+\tau) p_j s^j_{g_A} = n_A + \sum_{k\in Z_{g_A}} p^k_{g_A} \alpha^k_{g_A} \tag{1}$$

Where $c_{1,gA}$ is consumption of agent g_A in period 1; $f(z_{gA})$ is the investment cost of assets; *i* and *k* denote home currency assets and *j* denotes foreign ones. The two last terms on the left side are demands for home and foreign currency assets. M_A and M_B denote sets of risky assets developed in country *A* and country *B* respectively. Z_{g_A} denotes the set of home currency assets developed by agent g_A. (We denote by m_A, m_B and z_{gA} the corresponding number of currency assets). Agent g_A only buys assets that are developed by other agents. Hence, there are $(m_A - z_{gA})$ home currency assets and m_B foreign currency assets that agent g_A can choose. $s^i_{g_A}$ is agent g_A's demand for home currency assets. p_i is the price for home currency assets. On the right-hand side (revenue side), in addition to the endowment n_A, agent g_A can keep a proportion $(1-\alpha {g_A}^k)$ of each asset $k \in Z_{g_A}$ that he has developed and sell the rest on the market. $p^k_{g_A}$ is the relative asset price of risky assets developed by agent g_A. The budget constraint for an agent g_B in country *B* is defined in a symmetric way. The consumption of agent g_A in the second period ($c_{2,}g_A$) depends on returns of his assets.

$c_{2,g_A} = ds^i_{g_A}$ if state $i \in M_A, i \notin Z_{g_A}$ occurs;

$c_{2,g_A} = d(1-\tau)s^j_{g_A}$ if state $j \in M_B$ occurs;

$c_{2,g_A} = d(1-\alpha^k_{g_A})$ if state $k \in Z_{g_A}$ occurs; $c_{2,g_A} = 0$ otherwise.

Following Martin and Rey (2004), we adopt a linear utility function so that the utility of an agent g_A in country A is as follows:

$$EU_{g_A} = c_{1,g_A}^{1-1/\sigma} + \beta E\left(\frac{c_{2,g_A}^{1-1/\sigma}}{1-1/\sigma}\right) \tag{2}$$

where β is the discount rate and σ is the inverse of the degree of risk aversion($\sigma > 1$). Give above description of asset returns, the expected utility of agent g_A is:

$$EU_{g_A} = c_{1,g_A} + \frac{D}{1-1/\sigma}\left(\sum_{\substack{i\in M_A \\ i\notin Z_{g_A}}} {s^i_{g_A}}^{1-1/\sigma}\right) + \frac{D(1-\tau)^{1-1/\sigma}}{1-1/\sigma}\left(\sum_{j\in M_B} {s^j_{g_A}}^{1-1/\sigma}\right) + \frac{D}{1-1/\sigma}\left(\sum_{k\in Z_{g_A}} (1-\alpha^k_{g_A})^{1-1/\sigma}\right) \tag{3}$$

where $D = \beta d^{1-1/\sigma} / L$

Agent g_A maximizes his expected utility by choosing c_{1,g_A}, $\alpha^k_{g_A}$, $s^i_{g_A}$ and $s^j_{g_A}$ under budget constraints (Equation 1). The first order condition for agent g_A's demand for home currency assets and demand for foreign currency assets are:

$$s^i_{g_A} = p_i^{-\sigma} D^\sigma \quad i \in M_A - \left\{Z_{g_A}\right\} \tag{4}$$

$$s^j_{g_A} = p_j^{-\sigma} D^\sigma \frac{\phi}{1+\tau} \quad j \in M_B \tag{5}$$

Where $\phi = \left(\frac{1-\tau}{1+\tau}\right)^{\sigma-1}$ is a transformation of transaction costs and is less than 1 ($\sigma > 1$)[6].

[5] The transaction costs for an agent g_B in country B is similar.

We omit the notations of the identity of the agents (assets)[7]. Thus, agents (their assets) are identified only by their nationality *A* or *B*. The subscript denotes the nationality of purchaser and the superscript denotes the origin of the asset. For example, z_A and z_B are the number of assets developed by each agent in country *A* and *B*. The corresponding prices of assets are p_A and p_B respectively. s_A^B is the demand[8] of an agent in country *A* for a currency asset of country *B*, which equals $p_B^{-\sigma} D^{\sigma} \frac{\phi}{1+\tau}$.

As the aggregate value of currency assets in country B is $p_B l_B z_B$ and the total demand of agents in country *A* for a currency asset of country *B* is $l_A s_A^B$, the bilateral flows in currency assets (the currency assets of country *B* bought by agents in country *A* with transaction costs) is $TC_A^B = p_B l_B z_B l_A s_A^B (1+\tau)$. With the equilibrium condition (the equation for s_A^B), the log of transactions in currency assets from country B to country A is given by following expression.

$$\log(TC_A^B) = \log(p_B l_B z_B) + \log l_A + \log \phi + \sigma \log \frac{d}{p_B L} + \log \frac{\beta^{\sigma}}{d} \tag{6}$$

The first two terms are measures of economic masses of country A and county B (here financial wealth and population). The third term represents transaction cost. The fourth term presents the effects of financial depth (here expected asset returns) and the last term is the constant.

2.2 Testable Hypotheses

Givens the idea outlined above, we present several testable hypotheses. First, equation (6) shows that economic masses in both countries are positively related with the cross-border currency transactions. The literature on international currencies also suggests that the size of an economy is positively related to the volume of circulation of its currency. Krugman (1984) argued that the relative economic size of trading partners is crucial for the choice of transactions currencies. We expect that the economic size in both source and destination countries positively influence the use of source country's currency in the destination country.

Next, equation (6) implies that lower international transaction costs lead to higher ϕ and larger bilateral flows in currency assets. Hence, we state some hypotheses about the relationship between transaction costs and international trade in currencies. Tavlas (1997) suggests that transaction costs, such as switching costs and information asymmetries (information costs), are primary considerations for a nonresident to use an international currency. Switching costs from one country to another are reduced when the scale of circulation is large enough (Dowd and Greenaway, 1993). Rey (2001) confirms this hypothesis and finds that international trade increases the circulation of a given domestic currency in destination countries. We expect that the extent of foreign trade of source countries will lead to a greater use of their currencies in the destination countries.

The finance literature has documented that information available to market participants can differ substantially. Gehrig (1993) shows that asymmetric information between domestic and foreign investors can explain home bias in asset holdings. When domestic investors hold assets denominated in foreign currencies, they are usually less

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[6] Martin and Rey (2004) show that this parameter measure the extent of market segmentation. Higher transaction cost leads to higher market segmentation and lower ϕ.

[7] As all agents (assets) in the same country are identical (symmetric), agents of the same nationality are symmetric in the demand for the assets of a given country. The prices of assets of a given country are also identical.

[8] Thus, the total demand of agents in country *A* for a currency asset of country *B* is $l_A s_A^B$.

informed than the investors in the source country of the currency.

Information asymmetries may be due to some type of "familiarity" effect. Tesar and Werner (1999) suggest that the cost of obtaining information about foreign assets increases with linguistic, institutional and cultural differences. Ghosh and Wolf (2000) find evidence that capital is less likely to flow into Africa and less developed countries in the Western Hemisphere, as these regions are at a large "economic distance" from developed countries. Flandreau and Jobst (2009) show that geographical distance is positively associated with the transaction costs of using the pound. Hattari and Rajan (2011) underline the importance of language and culture for equity flows between countries. We expect that the use of a source country's currency in the destination country increases with similarity of culture and language and decreases with bilateral distance.

Recent literature in information asymmetries has addressed the importance of informal barriers constituted by politics, institutional standards and practices. Bekaert (1995) show that poor information or information frictions, such as political risks, poor accounting standards and poor investor protections are indirect barriers to foreign investors, preventing capital flows into emerging markets. Bergsten (1997) provides further evidence that social and political stability are important for evaluating assets, as investors can access more relevant information. Flandreau and Jobst (2009) find that democracy, parliamentary control of the executive and rule of law influence the international use of domestic currencies. Based on the above discussion, we expect that the distribution of international currencies in destination countries is positively related to the political stability and legal systems of both the source and destination countries. Finally, the theory suggests that the bilateral flows in currency assets increase in financial depth (see Equation 6). An open and well-developed financial market can efficiently funnel large amounts of capital from savers to borrowers. Furthermore, deep and liquid markets can help to reduce uncertainties due to exchange rate fluctuations and reduce the currency-exchange transaction costs. Empirical results suggest that financial market development and openness of the capital market are crucial for the international use of a country's currency (Chinn and Ito, 2006). Chen and Khan (1997) find that countries with higher capital returns attract the largest flows of capital; hence international currencies are more likely to be traded in such countries. Prasad et al. (2006) show that currencies follow capital movements and thus that the latter influence the patterns of currencies in international transactions. Papaioannou (2009) finds that deep and developed financial markets in destination countries lead to low transaction costs. Along the same lines, Ito and Chinn (2013) suggest that underdeveloped financial markets reduce the desirability of a currency in international transactions. Based on discussion above, we expect that the use of an international currency in destination country increases with bilateral capital flows and with the development of financial markets in destination countries.

3. Research design

Equation (6) is very similar to a "gravity" equation in international trade. Thus, we use an empirical specification similar to those of Rose and Spiegel (2007) and Goldberg and Tille (2008)[9]. We also introduce some other variables that have been suggested to influence the geographic use of international currencies. More specifically, the basic estimating equation takes the following form:

[9] The gravity model explains economic behaviors between two countries as a function of economic mass and distance. Variants of gravity models have been used in the international finance literature, such as Ports and Rey (2005) and Rose and Spiegel (2007).

$$Share_{ij} = \beta_0 + \beta_1 X + \beta_2 C + \beta_3 D + \varepsilon_{ij} \quad (7)$$

As we focus on the distribution of currencies in international financial transactions, the dependent variable $Share_{ij}$ is measured as the ratio of financial transactions invoiced in currency *i* in country *j* to global financial transactions invoiced in currency *i*[10]. The vector *X* includes a series of economic and financial factors of country *i* and country *j* that suggested by the theory. Variable $trade_i$ ($trade_j$) is the percentage of bilateral trade between country *i* and country *j* in total trade of country *i* (country *j*)[11]. This variable can serve as a proxy for the reliance of a country on bilateral trade with the other country. Using their currencies for transactions or settlements can reduce the transaction costs substantially. $lninvestment_{ij}$ is the natural logarithm of the sum of the cross-border portfolio investments between country *i* and country *j* (in millions of dollars)[12], which measures the degree of bilateral capital flows. As Rose and Spiegel (2007) suggest that a well-developed financial market is able to lower transaction costs, and facilitates shifting assets offshore, we include a dummy variable $center_j$, which equals one if country *j* has an offshore financial center and zero otherwise[13]. Traditional variables that proxy economic mass in a gravity model, e.g. GDP *per capita* and population, are also included.

Vector *C* includes political and institutional factors that affect the information costs of currency transactions. $civil_i$ ($civil_j$) is a dummy variable, which equals one if country *i* (country *j*) is a civil-law country and zero otherwise[14]. La porta et al. (2001) suggests that legal origins have an important impact on financial development and innovation. A civil-law system provides better investor protection. Hence, an international currency should be more extensively used in civil-law countries. Political stability is positively related to the extent of information disclosure, which relates to lower transaction costs. To measure the political stability of county *i* (ps_i) and country *j* (ps_j), we use the index developed by Governance Matters *III* from the World Bank database.[15]

The vector D_{it} includes cultural and distance factors. The literature of international trade and finance has suggested the important role of distance. Ghosh and Wolf (1999), studying cross-border asset holdings, provide empirical evidence that information asymmetries increase with distance. De Menil (1999) finds that distance can explain FDI flows among European countries. To capture this effect, we include the variable $lndist_{ij}$, which is the natural logarithm of distance between capitals of country *i* and country *j*. Language is directly related to the cost of obtaining information (Tesar and Werner, 1995). Hau (2001) finds that German traders perform better than foreign traders when they transact on the German stock market. Hence, we expect that a common language between source (country *i*) and destination (country *j*) can alleviate the problem of asymmetric information. $comlang_{ij}$ is a dummy variable that equals one if country *i* and country *j* use the same official language and zero otherwise. Detailed definitions of the variables are presented in the Appendix. Following Portes and Rey (2005), we include country fixed effects in our regression analysis to control for the unobserved time-invariant country factors that might influence the distribution of international currencies. Time dummies are included to control for the year fixed effects. Subsequently, we check

[10] Transactions of currency *i* in its home country are excluded.

[11] $trade_{it}$=(*TotalVolume betweeni and j / Total trade volume of i*)

[12] According to IMF CPIS data, portfolio investment is defined as cross-border transactions and positions involving debt or equity securities, other than those included in direct investment or reserve assets.

[13] The criterion for financial center is based on The Global Financial Centre Index. http://www.longfinance.net.

[14] For legal origins, we use the dataset from the well-known paper *The Economic Consequences of Legal Origins*, Laport et al. (2008).

[15] Detailed information is available at http://info.worldbank.org/governance/wgi/index.aspx.

for robustness by splitting samples and using various specifications. We also examine the impact of capital account restrictions and country specific factors for currency transactions on the distribution of international currencies by including several measures commonly used in the international finance literature. All the empirical results and robustness checks are presented in section 5.

4. Data and summary statistics

We begin by taking advantage of the Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity (hereafter, Triennial Survey). The Triennial Survey is conducted every 3 years and is available on the BIS website. There are 8 years of the panel, 1995-2013. In particular, we use Table 10, which provides a geographic breakdown of the transactions in world major currencies. Thus, we can determine the transaction volume of an international currency in each country's foreign exchange market. For instance, Table 10 reports that, at the end of 2013, the volume of Pound transactions in Germany was 15891 million dollars, while in US it was 134812 million dollars.

Our dataset on the geographic breakdown of transactions covers 26 countries, consistent with the sample size of Triennial Survey in 1995. Although BIS included more countries in the following Surveys, the transaction volume of 26 countries accounts for more than 89% of total transactions[16] in 2013. Following Chinn & Frankel (2008), we select 7 international currencies: US Dollar, British Pound, Euro[17], Japanese Yen, Swiss Franc, Canadian Dollar and Australian Dollar. Hence, our dataset includes 7 source (currency *i*) and 26 destination (country *j*) countries. The transaction variable we use in most specifications is the ratio of transactions in currency *i* (source) in country *j* (destination) to global transactions in currency *i*. As we focus on currency transactions outside of a given country, the transactions of currency *i* in country *i* are excluded.

[Insert Table 1 here]

Summary statistics for the geographic distribution of currency transactions are presented in Table 1. For each international currency, we report the mean geographic currency share across 26 countries or regions over the entire period (1995-2013). The transactions of world major currencies show similar patterns in their global transactions. Most international currencies are traded in countries or regions with global financial centers. e.g. United States, United Kingdom and Hong Kong. For instance, the currency shares of world major currencies traded in the United Kingdom ranges from 37.3% for the Canadian dollar to 50.61 % for the euro. However, currency shares differ substantially across countries and regions. For example, the shares of the British Pound traded in Commonwealth Nations such as Canada (2.4%), Singapore (9.92%) and Hong Kong SAR (7.99%), are much higher than other currencies. This suggests that culture and language may be important for the international use of a currency. We also find that 73% of transactions in Swiss Franc are conducted in the euro area, much higher than other currencies, which suggests that distance may influence the use of international currency.

Table 2 reports summary statistics on country characteristics of both source and destination countries. The mean of $Share_{ij}$ is 0.0433 and the standard deviation is 0.0937, which suggests an uneven distribution of international currencies among different

[16] To maintain a balanced panel, we restrict our sample size to cover 26 countries. To check the robustness, we also allow a varying extent of coverage. Our primary results remain quantitatively unchanged. For the sake of simplicity, these results are not reported, but available upon request.

[17] As the euro did not come into existence until 1999, we proxy euro transactions before 1999, by aggregating the transactions of currencies of euro members as well as the EMS (European Monetary System).

countries and regions. The variable $trade_i$ is the ratio of bilateral trade between country *i* and country *j* to the total trade volume of country *i* (bilateral trade between country *j* and country *i* to total trade volume of country *j*). These indicators reflect the trade concentration between the two countries (Massell, 1970). The higher the trade concentration between two countries, the higher the degree of economic integration. Therefore, it is natural to infer that high trade concentration between two countries is more likely to contribute to the use of country *i*'s (country *j*'s) currency if it is an international currency.

Results show that most destination countries have civil-law systems. The political stability of source countries is higher than that of destination countries. This suggests that a country's political stability may be positively related to the international use of its currency. Only a small proportion of countries have a common language. The average of the natural logarithm of distance is 8.14 (about 3484 kilometers), indicating that the bilateral geographic distance may not be an important determinant of the use of an international currency.

[Insert Table 2 here]

5. Empirical results

5.1.Basic results

Table 3 reports our baseline model for the determinants of geographic distribution of the international currencies. Following Portes and Rey (2005), we estimate this model with country or regional fixed effects. Dummy variables for year-specific fixed effect are also included. White corrected (heteroskedasticity-consistent) standard errors are reported in parentheses below the coefficient estimates.

Our first specification, which includes the conventional explanation variables of a gravity model, is tabulated in Column (1) of Table 3. The variables that proxy economic mass (bilateral investment, including the countries' foreign equity and debt securities) enter with the expected signs and with very well-determined coefficients.

The bilateral variables indicate that if the source country's (country *i*) proportion of bilateral trade with destination country (country *j*) increases by 1 percent, the use of currency *i* in country *j* might increase by 0.4 percent. Meanwhile, if the cross-border investment between country *i* in country *j* increases 1%, the use of currency *i* in country *j* increases 0.67%. It is natural that with an increase in bilateral trade and asset holding, transactions cost by using source country's currency is substantially reduced. This result is consistent with the argument of Prasad et al. (2006) that the currency indeed follows capital flow and other factors.

Other variables for economic mass matter as well. International currencies are more likely to be traded in countries with larger population and GDP per capita. This is natural, as a larger economic mass is associated with a higher demand for international currencies for international transactions and settlements. We include financial variables in the second column of Table 3. The coefficient of $center_j$ is positive and statistically significantly different from zero, indicating that international currencies are disproportionally traded in global financial centers. As global financial centers put few constraints on the cross-border capital flows, and provide various financial products for international investors, the transactions in international currencies naturally tend to be concentrated in global financial centers.

To examine institutional effects, we include legal origin and political and institutional variables in the third column of Table 3. Political stability apparently has no significant effect on the geographic use of international currencies. International currencies are more likely to be traded in the common law countries. As common law countries usually

impose few stringent regulations on financial activities, it is natural that the transactions of international currencies are concentrated in these countries.

Following the literature, we add geographical and cultural variables in the fourth column of Table 3. International trade literature has shown that the geographic distance can proxy for informational costs. Surprisingly, we do not find a significant effect of distance on the geographic distribution of international currencies. As international currencies are weightless, they are less subject to informational asymmetries due to long distance. Interestingly, we find that $comlang_{ij}$ is significantly positive. This indicates that if country *i* and country *j* have a common language, country *i*'s currency is more likely to be traded in country *j*. As having a common language in two countries indicates their "similarity", the transaction costs of country *i*'s currency in country *j* should be lower. For example, Hong Kong was a colony of the UK, hence, the percentage of British Pound transactions in Hong Kong is much higher than that of other currencies.

[Insert Table 3 here]

5.2. Robustness Checks

As euro was introduced to the world financial markets on Jan 1, 1999, transactions in that currency prior to 1999 are proxied by aggregating the transactions of the currencies of euro members as well as the EMS (European Monetary System). However, this aggregation may not be a good proxy for the euro's transaction volume. Moreover, different from other currencies, such as the British Pound and US dollar, the euro is a super-sovereignty currency, which certainly affects its use in global capital markets. We might ask whether our results hold if the euro is not included in our sample.

To check the robustness of our results, we re-estimate the basic specifications of Table 3 by excluding the euro. Results are reported in Table 4. They show that our primary results are robust to this exercise. As a result, it is reasonable to keep the euro transactions in our specifications

[Insert Table 4 here]

The literature on international trade usually uses a wide range of dummy variables related with economic exchange between two countries. We therefore introduce these dummy variables into our basic specifications. First, Rose et al (2007) show that countries or regions identified as money launderers are likely to be offshore financial centers. As countries with high tolerance or less strict regulation of money laundering are more likely to attract international capital, international currencies can be readily traded in these countries. We introduce a dummy variable *moneyl*[18], which equals one if these countries or regions are identified as money launderers, zero otherwise. Second, the entry barriers for trade and capital flows vis-a-vis island nations differ substantially from continental nations, which may influence the geographic use of international currencies. We therefore introduce a dummy variable *island*[19], which equals one if the country is an island nation, zero otherwise. This variable also serves as an alternative measure of geographical effects. Third, Portes and Rey (2005) show that geographical adjacency may influence the cross-border equity transactions. As adjacent countries are likely to have similar culture and language, and especially as transportation costs between adjacent countries are much lower, country *i*'s currency is disproportionately used in its adjacent countries. To catch this effect, we include a dummy variable *border*, which equals one if country *i* is adjacent to country *j*, and zero otherwise.

Results are reported in Table 5. The coefficients for our main explanatory variables remain qualitatively unchanged in all specifications. Interestingly, we find that the

[18] The data is available at: http://www1.oecd.org/fatf/pdf/AR2000_en.pdf.

[19] The data is available at https://www.cia.gov/library/publications/the-world-factbook/

coefficient of $moneyl_j$ is positive and statistically significant different from zero at the 1% confidence level. Consistent with our expectations, countries or regions identified as money launderers are more likely to be involved in international capital flows. We also find that the coefficient of $island_j$ is significantly positive, which suggests that international currencies are more likely to be traded in island nations. The coefficient of $border_{ij}$ is negative, but not significant in column (3). Consistent with our expectation, currencies are weightless, so that geographic factors are not important determinants of the use of international currencies.

[Insert Table 5 here]

Ports and Ray (2005) find that the currency block effect is important for the cross-border equity transactions. We include this regional bloc effect in our baseline specifications. More specifically, we construct a dummy variable *continent,* which takes the value of one if the source and destination countries are on the same continent and zero otherwise. Regional integration in Europe has probably affected goods trade and capital flows in this region. We include a dummy variable *euro,* which equals one if the destination country is a member of the euro area and zero otherwise. Most financial transactions are performed in the world's major financial centers. Cities like New York and London have the world's largest foreign exchange markets, and many international currencies are heavily traded in these regions (Mason and Warnock, 2001). We construct variable *fc* which is the rank of the destination country's global foreign exchange trading[20].

The results, reported in Table 6, show that the coefficients of our initial explanatory variables remain stable across all specifications. The coefficient of *continent* is negative, but statistically not different from zero, which suggests that the continent effect is negligible in the use of international currencies. As reported in Table 6, the coefficient of *euro* has the expected sign in the regression and is statistically significantly at conventional confidence levels. As countries in Europe tend to use the euro as the medium of exchange or the invoice money more than other international currencies, this reduces the use of other international currencies in the euro area. As expected, the coefficient of *fc* is significantly positive. The world's major financial centers have the largest foreign exchange markets. Hence, international currencies are disproportionately traded in these centers.

[Insert Table 6 here]

5.3 Financial openness

The literature has stressed the important role of capital account restrictions on international movements of capital. Chinn and Frankel (2007, 2008) show that a country's financial openness to the rest of world is a critical factor for international use of its currency. Restrictions on capital flows lead to misallocation of financial resources and limited use of those countries' currencies in international transactions (Fischer, 1998, 2003; Obstfeld, 1998; Rogoff, 1999; Summers, 2000)[21].

However, capital account liberalization may not increase the depth of the financial market, which is important for currency transactions. Klein and Oliver (2008) show that the openness of the capital account brings unequal benefits to countries. In particular, IMF (2012) suggests that adequate institutions and sound macroeconomic policies are important for full realization of the benefits of capital account liberalization.

[20] The rank of each destination country is estimated based on the amount of its annual foreign exchange trading. The data are available at http://www.bis.org/publ/rpfx13.htm .

[21] Many emerging market countries from Santiago to Seoul have implemented some form of capital account liberalization over the past 20 years.

To examine whether our results are robust to the inclusion of capital account liberalization, we use several measures of capital account openness in our model specifications. Quantity measures of capital controls (or financial openness) may be *de facto* or *de jure*. Edwards (1999) suggest that policy goals of capital control are usually unclear, and the private sector can circumvents capital account restrictions. Hence, a country's financial integration is often used as a *de facto* measure of capital transaction restrictions (Rajan, 2003). Following Lane & Milesi-Ferretti (2007), we use the ratio of the sum of total international assets and liabilities to GDP to measure financial integration. Many researchers use the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (*AREAER*)[22]. Chinn and Ito (2013) suggest that a drawback of *de facto* measures is that they depend on the normalization of the volumes of cross-border capital transactions. For instance, normalizing the sum of total assets and liabilities as a ratio to GDP would make the index appear unnecessarily low for large economies such as the US and very high for an international financial center such as Hong Kong. Chinn and Ito (2013) develop the KAOPEN index based on the AREAER tabulation using the extent and intensity of capital controls. Hence, we use this *de jure* measure of financial openness as an alternative measure of capital account openness. The results, reported in Table 7, show that the coefficients of the main variables remain stable in the presence measures of financial openness. We also find that neither measure of financial openness is statistically significantly different from zero.

[Insert Table 7 here]

5.4 Further analysis

So far our regression analysis has focused on the variables commonly adopted in the literature to explain bilateral trade and capital flows between countries. Although currency transaction is accordingly to serve for international trade and capital flows, some country specific factors for currency transactions themselves may be important determinants of international currency distribution. In this part, we further include a variety of variables that could directly influence the use of international currencies in transactions[23].

Following the literature of financial asset transaction (Portes and Rey, 2005), we consider the variables related with information cost and the efficiency of the transaction technology. To capture the information cost of currency transaction, we use the degree of overlap in trading hours $overlap_{ij}$, measured as number of trading hours overlap between major financial centers of country *i* and country *j*. As information cost may be positively related with the asymmetry between domestic and foreign investors, we also include a measure of the degree of insider trading (*insider*) in the stock market.

Portes and Ray (2005) use the index of sophistication of financial markets as a measure of transaction technology. We use the same method and construct a variable *soph*, indicating the extent of sophistication of financial markets. Coval and Moskowitz (2001) show that the efficiency of transaction technology depends on the development of financial market. Thus, we include several additional indices of financial market development such as the ratio of capital marketization over GDP (*mktcap*), the ratio of private credit over GDP (*credit*) and exchange-stability dummy variable (*exstability*)[24]. Detailed definitions and data sources of variables are presented in the Appendix.

We first include two information cost variables into our basic specification. The first

[22] AREAER provides the rules and regulations governing capital account transactions for most countries.
[23] These variables are actually alternative measures for transaction costs and financial depth (Equation 6).
[24] *exstability* is a dummy variable that equals one if the exchange rate between source and destination countries is fixed and zero otherwise.

column of Table 8 shows that the coefficient of $overlap_{ij}$ is negative but statistically insignificant different from zero. The extent of insider trading in destination country ($insider_j$) apparently has significantly negative effect on the transaction of international currencies. As information cost of transaction is higher in countries with heavier insider trading, the transaction volume in these countries should be lower. We next include variables related with the efficiency of the transaction technology. The sophistication of financial market variables enters with expected sign (Column 2 of Table 8): the greater the sophistication of financial market in destination country, the more likely international currencies trade in this country. In Column (3) of Table 8, we add several measures of financial development. The development of credit market and the exchange rate stability do not seem to have a significant influence on the use of international currencies. International currencies are disproportionately traded in countries with a developed capital market. We include all variables in Column 4 of Table 8, and similar results are obtained.

The empirical results, reported in Table 8, also show that the coefficients of our initial explanatory variables remain stable across all specifications. It suggests that our results are robust to the inclusion of country specific factors for currency transactions.

[Insert Table 8 here]

6. Implications for RMB

With China's rapid economic growth, the use of RMB in international markets has risen significantly in recent years. At the end of 2013, about 16% of China's trade was settled in RMB. According to the Society for Worldwide Interbank Financial Telecommunication (SWIFT), China's RMB has overtaken the euro to become the second most fused currency in international trade finance. The transactions share of RMB in global financial market has increased to 1.39%, to rank 7th in the world (BIS, 2014). Many countries have signed currency swap agreements with China.

As RMB is increasingly used in overseas markets, global financial centers are competing with each other for larger slices of RMB business. However, China still maintains restrictions on capital flows and limits the convertibility of RMB. Nevertheless, Chinese government has attempted to foster the use of RMB through the development of offshore markets in the Chinese Yuan[25]. Hong Kong has become the leading offshore RMB market since the Bank of China (Hong Kong) became a clearing bank. On July 6, 2012, China and Singapore signed an agreement to designate a Chinese bank to clear RMB deals in Singapore. Since then many international financial centers have gained the right to be RMB clearing and settlement hubs[26].

As China still has not liberalized its capital account, the early development of RMB offshore business has depended on policy support from the Chinese government. Location and timing of offshore establishments are still a major concern for the Chinese government.

BIS began to collect RMB transaction data in 2010. Based on observations from 2010 to 2013, we construct the actual global distribution of RMB transactions in foreign exchange markets. Figure 1 plots the transaction share of RMB in 6 countries or regions in 2010 and 2013. It shows that most of RMB trading takes place in Hong Kong. As Hong Kong has a similar culture, economic structure and a close relationship with mainland

[25] Offshore markets can help to increase the recognition and acceptance of currencies (He and McCauley, 2010). The success of US dollar internationalization is largely accredited to the euro-dollar market where approximately 80% of the US dollar trading takes place.

[26] The British and Chinese government agreed to establish a clearing bank in London for RMB (Reuters, 2013). Frankfurt was also chosen as an RMB clearing and settlement hub in 2014 and is starting to compete with other RMB offshore markets.

China, it is natural that Hong Kong would be the leading offshore RMB market. The figure shows that about 50 percent of RMB trading occurs in the Hong Kong offshore market. Singapore is the second largest RMB offshore market, and it has a close trade relationship with China as well as a large Chinese-speaking population. On the other hand, despite a high level of bilateral trade between China and Germany, few RMB transactions take place in the Germany.

[Insert Figure 1 here]

Figure 2 shows the predicted proportion of RMB in global foreign exchange market transactions. For simplicity, we only plot transaction shares for RMB in US, UK, Japan, Singapore, Germany and Hong Kong, from 1995 to 2013. The estimates are based on the results of our benchmark specification[27].

Overall, the actual distribution of RMB transactions is much more concentrated than the model estimates. For example, our model predicts that only 10 % of global RMB transactions are settled in Hong Kong whereas the actual share of RMB transactions in Hong Kong is more than 50%. The prediction also suggests that the largest offshore RMB market should be established in US instead of Hong Kong. As of 2013, the end of our sample period, the share of the RMB offshore transactions in Germany would be 6 % whereas the actual share was essentially non-existent.

[Insert Figure 2 about here]

To examine the model's ability to predict other features of international currency markets we illustrate the predicted and actual distributions of international currencies in the world's major financial centers. It appears that our predicted results are fairly well in line with reality for the other international currencies.

[Insert Figure 3 about here]

These models suggest that our predictions are reliable, and the gap between the predicted and actual distributions of RMB offshore transactions is large. The US has a much larger economic mass than Hong Kong. Bilateral economic activities between US and China have played an important role in international trade and finance. Therefore, RMB offshore transactions in US are expected be larger than in Hong Kong. Meanwhile, economic relationships between China and UK as well as China and EU are increasingly important. Bilateral trade between China and the UK surpassed $70bn (£43bn) in 2013. Bilateral trade between China and EU area was 729.97 billion USD in 2013. The EU remains China's biggest export market (17 per cent of its exports) and China is now the EU's second biggest export market (9 per cent). Bilateral investment flows have increased in the last ten years. However, various administrative measures continue to restrict RMB trading internationally. At the same time Hong Kong enjoys a preferred position here and therefore it is not surprising that the majority of RMB trading takes place there. To facilitate global use of RMB restrictions for other financial centers should be loosened.

7. Conclusion

Using a data set from seven international currencies' transactions across 26 countries and regions from 1995 through 2013, we implement a gravity model and investigate the determinants of the geographical distribution of international currencies. The empirical results show that bilateral trade and capital flows between source and destination countries are important determinants of geographic use of international currencies. International currencies are traded disproportionally in destination countries

[27] More specifically, our prediction is based on the estimation results in column (1) of Table 4. To check the robustness, we implemented various specifications. It turns out that our prediction remains unchanged.

with large economic mass, non-civil law systems, better-developed financial market and where the source and destination countries share a common language. However, the distance between source and destination countries plays no role on explaining the geographic use of international currencies. In this sense currencies are truly weightless. We then predict the distribution of RMB trading in the global foreign exchange markets. Most RMB transactions are concentrated in the Hong Kong financial market. In fact, trading in Hong Kong is much higher than predicted by our empirical model.

This can be explained by China's restrictions on capital movements and the preferred status of Hong Kong. To be widely internationally used, the RMB should be heavily traded in the US and UK This will not happen until restrictions on capital movements are relaxed to a significant degree. Even then, it is not certain that China's currency will be used in international transactions as much as China's economic size would suggest. The case of Japan shows that even a large country's currency may be relatively little used in global financial markets.

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Table 1

Distribution proportion of International Currencies in Destination Countries

Destination Countries	U.S Dollar	Euro	Japanese Yen	British Pound	Swiss Franc	Canadian Dollar	Australian Dollar
United States	-	22.54%	25.22%	38.33%	24.71%	35.54%	20.11%
United Kingdom	40.24%	50.61%	40.22%	-	40.53%	37.30%	37.40%
Austria	0.58%	-	0.42%	0.45%	1.39%	0.16%	0.10%
Belgium	1.32%	-	0.60%	2.71%	0.75%	1.27%	0.68%
Denmark	2.17%	2.07%	0.52%	1.70%	3.07%	0.39%	0.27%
France	4.02%	-	2.56%	6.44%	4.44%	2.43%	1.78%
Germany	4.96%	-	2.84%	7.91%	6.86%	1.32%	1.44%
Italy	1.25%	-	0.67%	1.58%	0.76%	0.22%	0.23%
Luxembourg	1.11%	-	0.65%	1.69%	1.18%	0.49%	1.13%
Netherlands	1.79%	-	0.92%	3.42%	2.40%	0.61%	0.54%
Norway	0.76%	0.65%	0.14%	0.54%	0.18%	0.12%	0.31%
Sweden	1.16%	1.67%	0.29%	1.18%	0.71%	0.39%	0.18%
Switzerland	5.93%	7.76%	3.51%	9.45%	-	3.17%	2.37%
Canada	2.73%	1.00%	1.06%	2.40%	1.28%	-	0.91%
Japan	10.66%	4.90%	-	7.48%	1.76%	3.98%	9.41%
Finland	0.23%	-	0.03%	0.22%	0.57%	0.09%	0.02%
Greece	0.18%	-	0.51%	0.17%	0.22%	0.04%	0.05%
Ireland	0.39%	0.70%	0.32%	2.09%	0.23%	0.41%	0.14%
Portugal	0.13%	-	0.08%	0.28%	0.11%	0.04%	0.02%
Spain	0.85%	-	0.23%	1.50%	0.26%	0.14%	0.09%
Australia	4.55%	2.47%	3.49%	5.08%	1.52%	2.50%	-
New Zealand	0.43%	0.08%	0.19%	0.26%	0.05%	0.08%	2.06%
South Africa	0.59%	0.17%	0.11%	0.49%	0.07%	0.03%	0.05%
Bahrain	0.17%	0.13%	0.14%	0.33%	0.15%	0.04%	0.02%
Hong Kong SAR	6.36%	1.66%	6.96%	7.68%	1.94%	2.61%	8.98%
Singapore	8.33%	4.43%	9.20%	9.92%	4.86%	6.63%	12.66%

Note： This table summarizes the average distribution proportion of 7 international currencies in 26 countries and regions, from 1995 to 2013.

" – " means that currency transactions in their home countries are excluded.

$$Distribution\ proportion\ in\ country\ i = \frac{Trading\ volumn\ in\ country\ i}{Total\ trading\ volumn\ (home\ country\ excludecd)}$$

Data Source: BIS Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity (1995, 1998, 2001, 2004, 2007, 2010, 2013)

Table 2

Summary statistics

Variables	Mean	Standard Deviation	Minimum	Maximum	Median
$share_{ij}$	0.0433	0.0937	0.0000	0.5536	0.0080
$lninvesetment_{ij}$	9.8342	2.3857	0.0000	14.9060	10.0517
$trade_i$	0.0246	0.0510	0.0000	0.6825	0.0079
$trade_j$	0.0590	0.0940	0.0004	0.6890	0.0259
$lnpop_i$	17.9409	1.3031	15.7605	19.6174	17.9026
$lnpop_j$	16.5309	1.3507	13.1834	19.5646	16.1719
$lngdp_i$	10.8060	0.8935	9.8044	13.1835	10.5588
$lngdp_j$	10.2408	0.5922	8.0130	11.5850	10.2876
$center_j$	0.4723	0.4994	0	1	0
$civil_i$	0.4286	0.4951	0	1	0
$civil_j$	0.6571	0.4749	0	1	1.
ps_i	0.9397	0.3123	0.0496	1.4915	1.0021
ps_j	0.8700	0.5459	-1.2169	1.6681	1.0132
$lndist_{ij}$	8.1562	1.0451	5.2883	9.3599	8.5265
$comlang_{ij}$	0.2866	0.4524	0	1	0

Note: *i* and *j* are country indices. $Share_{ij}$ is is the ratio of transactions in currency *i* (source) in country *j* (destination) to global transactions in currency *i*. $lninvesetment_{ij}$ is the natural logarithm of the sum of the cross-border portfolio investments between country *i* and country *j* (in millions of dollars). $trade_i$ ($trade_j$) is the percentage of bilateral trade between country *i* and country *j* in total trade of country *i* (country *j*). *lnpop* is the natural logarithm of population. *lngdp* is the natural logarithm of population. *civil* is a dummy variable, which equals one if a country is a civil-law country and zero otherwise. *ps* is an index of political stability. $comlang_{ij}$ is a dummy variable that equals one if country *i* and country *j* use the same official language and zero otherwise. $lndist_{ij}$ is the natural logarithm of distance between capitals of country *i* and country *j*. The detailed information of variables are given in the Appendix.

Table 3
Determinants of International Currencies Distribution

	(1)	(2)	(3)	(4)
$lninvestment_{ij}$	0.0067***	0.0058***	0.0064***	0.0048***
	(0.0025)	(0.0022)	(0.0022)	(0.0018)
$trade_i$	0.4040***	0.3395***	0.3308***	0.2933***
	(0.0579)	(0.0587)	(0.0619)	(0.0702)
$trade_j$	0.0306	0.0263	0.0259	0.0251
	(0.0247)	(0.0223)	(0.0221)	(0.0215)
$lnpop_i$	0.0010	0.0011	0.0024	0.0040
	(0.0038)	(0.0034)	(0.0037)	(0.0043)
$lnpop_j$	0.0126**	0.0093*	0.0106**	0.0110***
	(0.0057)	(0.0048)	(0.0049)	(0.0041)
$lngdp_i$	0.0064	0.0025	0.0021	0.0057
	(0.0151)	(0.0146)	(0.0179)	(0.0164)
$lngdp_j$	0.0109**	0.0072	0.0088	0.0098*
	(0.0050)	(0.0051)	(0.0056)	(0.0055)
$center_j$		0.0378***	0.0328***	0.0323***
		(0.0156)	(0.0162)	(0.0146)
$civil_i$			0.0059	0.0183
			(0.0103)	(0.0115)
$civil_j$			-0.0181***	-0.0180***
			(0.0063)	(0.0062)
ps_i			0.0101	0.0100
			(0.0105)	(0.0124)
ps_j			0.0033	0.0031
			(0.0034)	(0.0030)
$lndist_{ij}$				-0.0034
				(0.0052)
$comlang_{ij}$				0.0305**
				(0.0129)
Constant	-0.4470**	-0.3204*	-0.3763*	-0.3082*
	(0.2044)	(0.1884)	(0.2080)	(0.1830)
Observation	923	894	827	800
R-squared	0.3524	0.4603	0.4575	0.4563

Note: This table shows the OLS regression results for basic specification. Dependent variable $Share_{ij}$, which is measured as the ratio of transactions in currency *i* (source) in country *j* (destination) to global transactions in currency *i*. The definition of all other variables are given in the Appendix. Country and time fixed effects are included but not reported. Heteroskedasticity robust standard errors are reported in parentheses. ***, ** and * indicate marginal significance at 1%, 5% and 10% levels.

Table 4
Robustness tests: Excluding Euro

	(1)	(2)	(3)	(4)
$lninvestment_{ij}$	0.0058**	0.0048**	0.0055***	0.0046***
	(0.0023)	(0.0019)	(0.0020)	(0.0017)
$trade_i$	0.3948***	0.3273***	0.3187***	0.3071***
	(0.0569)	(0.0612)	(0.0662)	(0.0722)
$trade_j$	0.0225	0.0180	0.0185	0.0181
	(0.0207)	(0.0179)	(0.0181)	(0.0180)
$lnpop_i$	0.0020	0.0025	0.0033	0.0041
	(0.0039)	(0.0034)	(0.0035)	(0.0044)
$lnpop_j$	0.0127**	0.0099**	0.0111**	0.0100**
	(0.0060)	(0.0049)	(0.0051)	(0.0041)
$lngdp_i$	0.0011	0.0052	-0.0023	0.0058
	(0.0120)	(0.0114)	(0.0201)	(0.0164)
$lngdp_j$	0.0127***	0.0097**	0.0109**	0.0121**
	(0.0048)	(0.0047)	(0.0051)	(0.0050)
$center_j$		0.0357***	0.0309***	0.0293***
		(0.0163)	(0.0169)	(0.0146)
$civil_i$			0.0072	0.0155
			(0.0121)	(0.0117)
$civil_j$			-0.0150**	-0.0139**
			(0.0058)	(0.0054)
ps_i			0.0081	0.0088
			(0.0082)	(0.0095)
ps_j			-0.0025	-0.0019
			(0.0035)	(0.0030)
$lndist_{ij}$				0.0010
				(0.0036)
$comlang_{ij}$				0.0258*
				(0.0134)
Constant	-0.4163**	-0.3973**	-0.3670*	-0.4706**
	(0.2065)	(0.1845)	(0.1913)	(0.2140)
Observation	876	847	784	757
R-squared	0.4951	0.5997	0.5945	0.6089

Note: This table displays the results of subsample OLS regressions (excluding euro). Dependent variable $Share_{ij}$, which is measured as the ratio of transactions in currency *i* (source) in country *j* (destination) to global transactions in currency *i*. The definition of all other variables are given in the Appendix. Country and time fixed effects are included but not reported. Heteroskedasticity robust standard errors are reported in parentheses. ***, ** and * indicate marginal significance at 1%, 5% and 10% levels.

Table 5

Robustness tests: Including more dummy variables

	(1)	(2)	(3)
$lninvestment_{ij}$	0.0055***	0.0045**	0.0053***
	(0.0020)	（0.0018）	(0.0020)
$trade_i$	0.3190***	0.3239***	0.4041***
	(0.0624)	（0.0608）	(0.0690)
$trade_j$	0.0238	0.0231	0.0242
	(0.0210)	（0.0186）	(0.0212)
$lnpop_i$	0.0028	0.0011	0.0012
	(0.0038)	（0.0038）	(0.0035)
$lnpop_j$	0.0106**	0.0140**	0.0096**
	(0.0047)	(0.0056)	(0.0047)
$lngdp_i$	-0.0050	0.0006	0.0055
	(0.0149)	(0.0147)	(0.0152)
$lngdp_j$	0.0078	0.0146**	0.0090
	(0.0056)	(0.0059)	(0.0058)
$center_j$	0.0369***	0.0268***	0.0355***
	(0.0143)	(0.0111)	(0.0142)
$moneyl_i$	-0.0141*		
	(0.0076)		
$moneyl_j$	0.0116***		
	(0.0038)		
$island_i$		0.0062	
		(0.0101)	
$island_j$		0.0392**	
		(0.0154)	
$border_{ij}$			-0.0581
			-0.0372
$comlang_{ij}$	0.0291***	0.0233**	0.0310***
	(0.0103)	(0.0097)	(0.0106)
Constant	-0.2967	-0.4544**	-0.3768*
	(0.1821)	(0.2177)	(0.1948)
Observation	878	878	884
R-squared	0.4921	0.5048	0.4968

Note: This table shows the OLS regression results by including more dummy variables. Dependent variable Shareij, which is measured as the ratio of transactions in currency *i* (source) in country *j* (destination) to global transactions in currency *i*. The definition of all other variables are given in the Appendix. Country and time fixed effects are included but not reported. Heteroskedasticity robust standard errors are reported in parentheses. ***, ** and * indicate marginal significance at 1%, 5% and 10% levels.

Table 6

Robustness tests: Other control variables

	(1)	(2)	(3)	(4)
$lninvestment_{ij}$	0.0040***	0.0051***	0.0061***	0.0042***
	(0.0014)	(0.0019)	(0.0021)	(0.0016)
$trade_i$	0.3094***	0.2923***	0.4324***	0.3788***
	(0.0999)	(0.0672)	(0.0774)	(0.0972)
$trade_j$	0.0295	0.0254	0.0252	0.0270
	(0.0229)	(0.0209)	(0.0216)	(0.0209)
$lnpop_i$	0.0050	0.0029	0.0033	0.0048
	(0.0039)	(0.0037)	(0.0043)	(0.0033)
$lnpop_j$	0.0089**	0.0229***	0.0151**	0.0137***
	(0.0039)	(0.0067)	(0.0059)	(0.0051)
$lngdp_i$	-0.0032	-0.0033	0.0014	0.0021
	(0.0171)	(0.0192)	(0.0207)	(0.0215)
$lngdp_j$	0.0037*	0.0213***	0.0172**	0.0097*
	(0.0021)	(0.0068)	(0.0068)	(0.0063)
$civil_i$	0.0119	0.0111	0.0157	0.0080
	(0.0118)	(0.011)	(0.0134)	(0.0112)
$civil_j$	-0.0118*	-0.0321***	-0.0258***	-0.0161**
	(0.0063)	(0.0083)	(0.0079)	(0.0063)
ps_i	0.0045	0.0035	0.0079	0.0059
	(0.0123)	(0.0109)	(0.0113)	(0.0113)
ps_j	0.0077**	0.0087**	0.0077**	0.0085**
	(0.0034)	(0.0035)	(0.0036)	(0.0034)
fc	-0.0023***			-0.0018***
	(0.0008)			(0.0006)
euro		-0.0421***		-0.0324***
		(0.011)		(0.0097)
continent			-0.0677	-0.0544
			(0.0481)	(0.0376)
$comlang_{ij}$	0.0317**	0.0266**	0.0500***	0.0293**
	(0.0136)	(0.0118)	(0.0154)	(0.0132)
Constant	-0.2146	-0.5982**	-0.5322**	-0.4058*
	(0.1839)	(0.2284)	(0.2232)	(0.2332)
Observation	816	822	846	805
R-squared	0.3612	0.4389	0.4020	0.3926

Note: This table shows the OLS regression results by including other control variables. Dependent variable Shareij, which is measured as the ratio of transactions in currency *i* (source) in country *j* (destination) to global transactions in currency *i*. The definition of all other variables are given in the Appendix. Country and time fixed effects are included but not reported. Heteroskedasticity robust standard errors are reported in parentheses. ***, ** and * indicate marginal significance at 1%, 5% and 10% levels.

Table 7

Effect of financial openness on the distribution of international currencies

	(1)	(2)	(3)	(4)
$lninvestment_{ij}$	0.00672***	0.0066***	0.0086***	0.0012**
	(0.008)	(0.0022)	(0.007)	(0.0006)
$trade_i$	0.404***	0.3348***	0.398***	0.34***
	(0.000)	(0.0728)	(0.000)	(0.0691)
$trade_j$	0.0306	0.0274	0.0300	0.0272
	(0.219)	(0.0231)	(0.221)	（0.0226）
$lnpop_i$	0.00105	0.0138	0.0001	0.0005
	(0.786)	(0.1001)	(0.981)	（0.0046）
$lnpop_j$	0.0126**	0.0138***	0.0117*	0.0134**
	(0.034)	(0.0048)	(0.054)	(0.0049)
$lngdp_i$	0.0064	0.0012	0.0058	-0.0021
	(0.673)	(0.0232)	(0.704)	(0.0024)
$lngdp_j$	0.0109*	0.0153	0.0058	0.0066
	(0.034)	(0.0064)	(0.525)	(0.0093)
$civil_i$		0.3724		0.0176
		(0.3916)		(0.0132)
$civil_j$		-0.0255***		-0.0243***
		(0.0080)		(0.0074)
ps_i		0.0026		0.0077
		(0.0085)		(0.0126)
ps_j		-0.0066		-0.0061
		(0.0031)		(0.0032)
$lndist_{ij}$		-0.0009		-0.0031
		(0.0076)		(0.0053)
$comlang_{ij}$		0.0383***		0.3881**
		(0.0164)		(0.1679)
integration	-0.0001	-0.0001		
	(0.958)	(0.0001)		
kaopenj			0.00389	0.0075
			(0.535)	(0.0068)
Constant	-0.447**	-0.3204	-0.380*	-0.3763*
	(0.030)	(0.1884)	(0.052)	(0.2080)
Observation	923	799	811	799
R-squared	0.362	0.4603	0.363	0.4575

Note: This table reports the effect of financial openness on the distribution of international currencies. Dependent variable $Share_{ij}$, which is measured as the ratio of transactions in currency *i* (source) in country *j* (destination) to global transactions in currency *i*. Variable *integration* is measured as the ratio of the sum of total international assets and liabilities over GDP. *Kaopen* is a measure of financial openness constructed by Chinn and Ito (2013). The definition of all other variables are given in the Appendix. Country and time fixed effects are included but not

reported. Heteroskedasticity robust standard errors are reported in parentheses. ***, ** and * indicate marginal significance at 1%, 5% and 10% levels.

Table 8

Country specific factors for currency transactions

	(1)	(2)	(3)	(4)
$lninvestment_{ij}$	0.0061***	0.0054**	0.0061***	0.0045**
	(0.0021)	(0.0021)	(0.0021)	(0.0019)
$trade_i$	0.3887***	0.3458***	0.3470***	0.3365***
	(0.0584)	(0.0662)	(0.0658)	(0.0659)
$trade_j$	0.0281	0.0280	0.0284	0.0274
	(0.0232)	(0.0227)	(0.0234)	(0.0215)
$lnpop_i$	-0.0004	0.0025	0.0017	0.0048
	(0.0046)	(0.0069)	(0.0063)	(0.0072)
$lnpop_j$	0.0090**	0.0060*	0.0113***	0.0075**
	(0.0038)	(0.0031)	(0.0042)	(0.0031)
$lngdp_i$	0.0067	0.0033	0.0032	0.0005
	(0.0138)	(0.0134)	(0.0147)	(0.0125)
$lngdp_j$	-0.0020	0.0126***	0.0125**	-0.0142
	(0.0075)	(0.0047)	(0.0051)	(0.0132)
$comlang_{ij}$	0.0263*	0.0249*	0.0253*	0.0103*
	(0.0138)	(0.0146)	(0.0144)	(0.0006)
$lndist_{ij}$	-0.0022	-0.0002	-0.0015	-0.0076
	(0.0066)	(0.0060)	(0.0057)	(0.0084)
$overlap_{ij}$	-0.0021			-0.0016
	(0.0023)			(0.0025)
$insider_j$	-0.0187**			-0.0298**
	(0.0075)			(0.0120)
$soph_i$		-0.0016		-0.0022
		(0.0038)		(0.0046)
$soph_j$		0.0129**		0.0109**
		(0.0051)		(0.0048)
$exstability_{ij}$			-0.0040	-0.0006
			(0.0131)	(0.0137)
$credit_i$			-0.0001	-0.0001
			(0.0001)	(0.0001)
$credit_j$			0.0001	-0.0000
			(0.0001)	(0.0001)
$mktcap_i$			0.0000	0.0000
			(0.0001)	(0.0001)
$mktcap_j$			0.0001***	0.0002***
			(0.0000)	(0.0000)
Constant	-0.1511	-0.4047**	-0.4141***	0.0135
	(0.1808)	(0.1806)	(0.1347)	(0.1868)
Observation	891	860	856	826
R-squared	0.3943	0.3987	0.3908	0.4309

Note: This table shows the OLS regression results by including country specific factors for currency transactions. Dependent variable $Share_{ij}$, which is measured as the ratio of transactions in currency *i* (source) in country *j* (destination) to global transactions in currency *i*. The definition of all other variables are given in the Appendix. Country and time fixed effects are included but not reported. Heteroskedasticity robust standard errors are reported in parentheses. ***, ** and * indicate marginal significance at 1%, 5% and 10% levels.

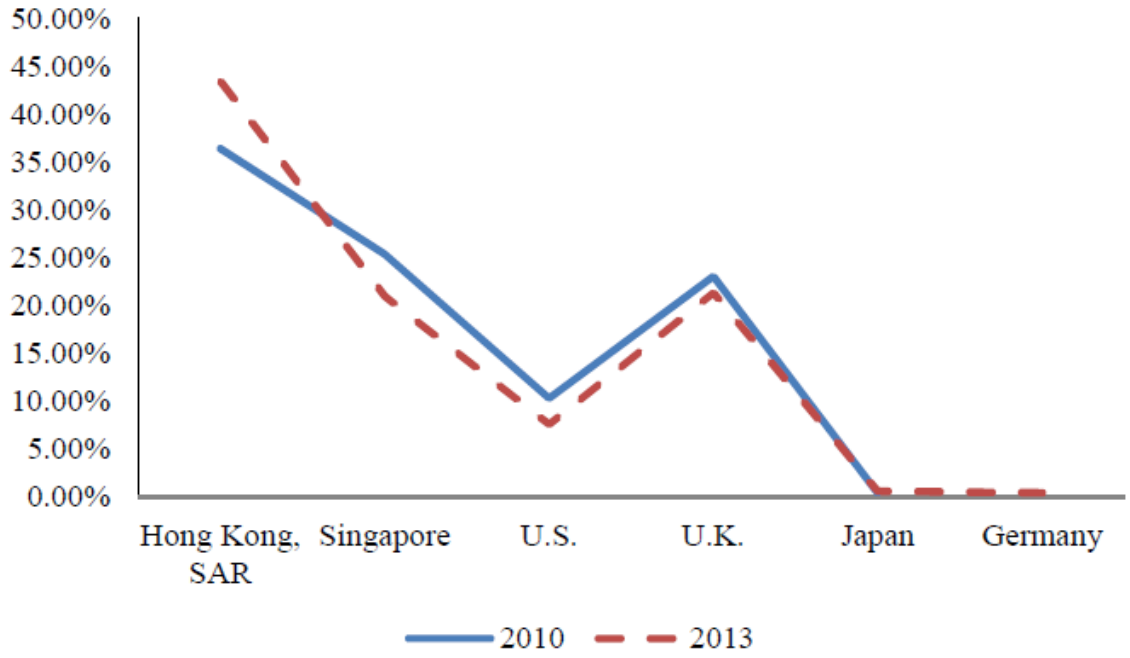

Figure 1 RMB transactions in global major financial centers.

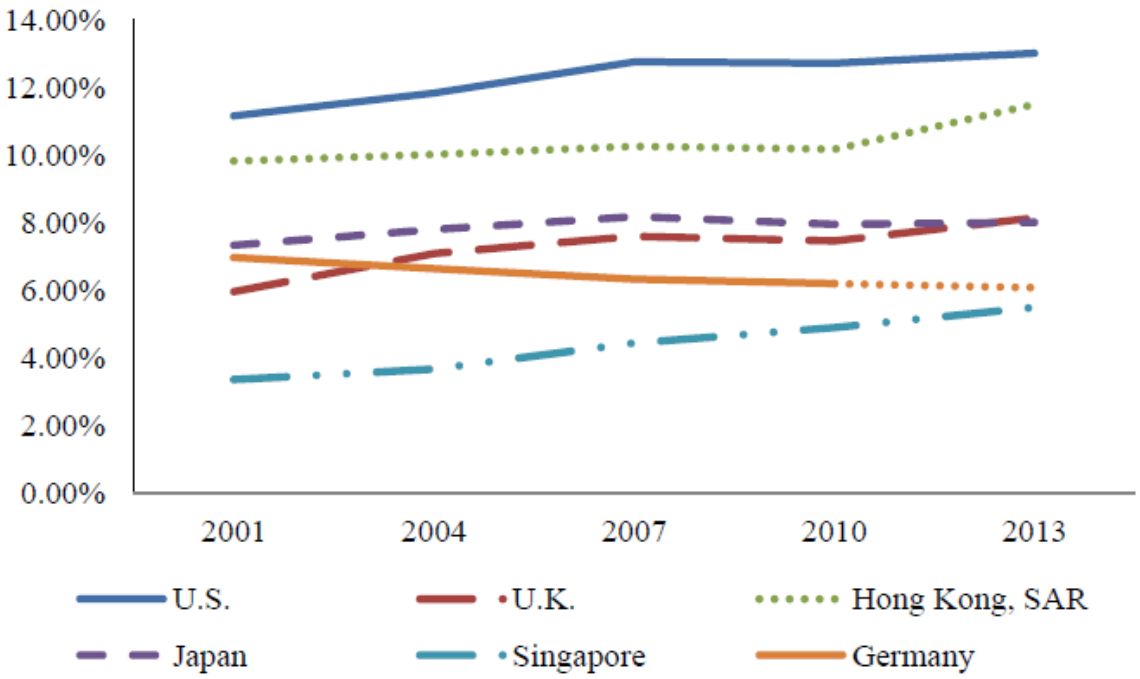

Figure 2 Predicted RMB transactions in global major financial centers

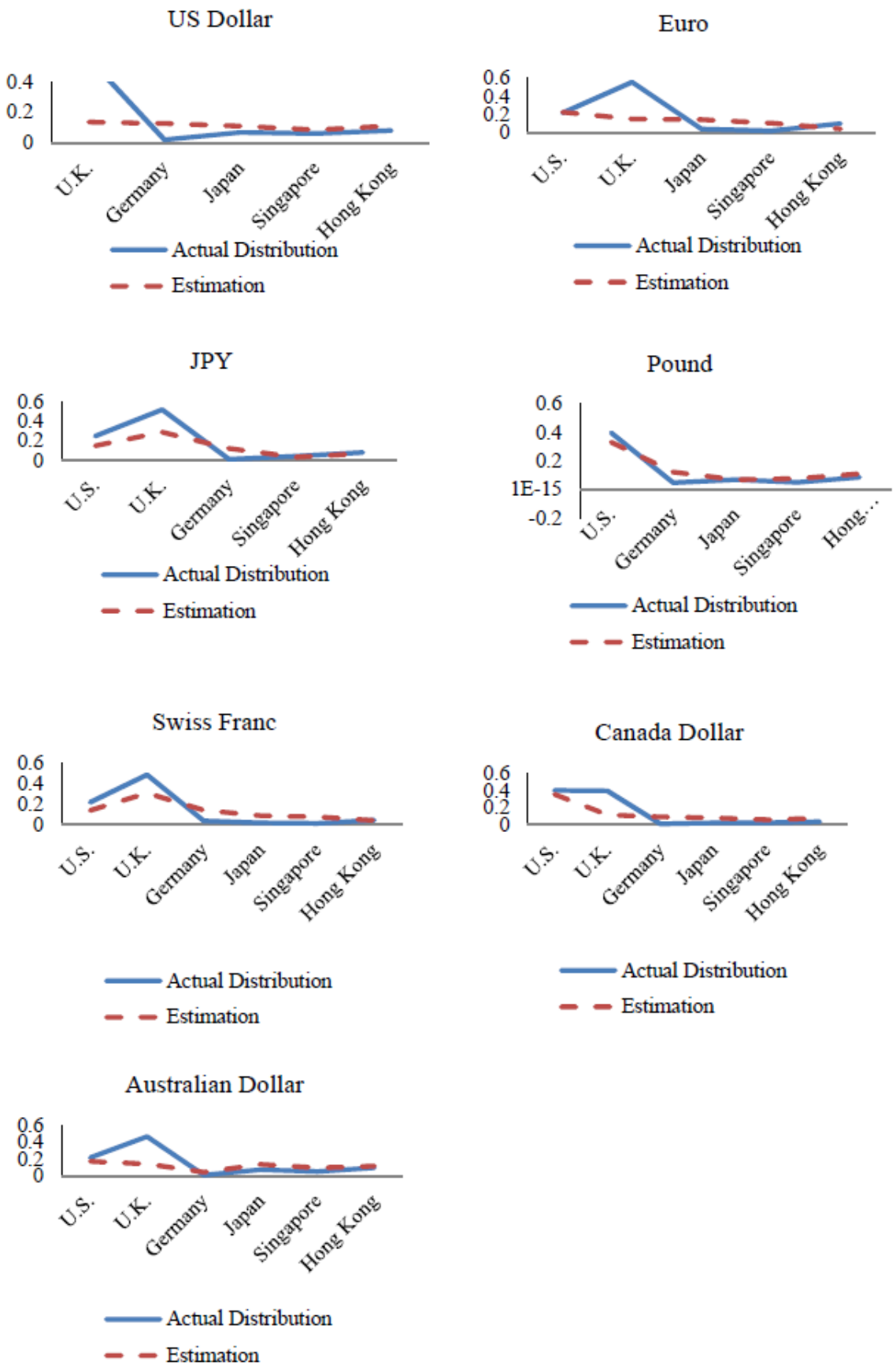

Figure 3 Transactions in international currencies in global major financial centers

Appendix: Variable definition and data source

Variable	Definition	Data source
$Share_{i,j}$	The distribution proportion of currency *i* in country *j*, measured as the ratio of financial transactions invoiced in currency *i* in country *j* to global financial transactions invoiced in currency *i*	The BIS Triennial Central Bank Survey https://www.bis.org/publ/rpfx13.htm
$lninvestment_{i,j}$	The natural logarithm of the sum of the cross-border portfolio investments between country *i* and country *j* (in millions of dollars)	Coordinated Portfolio Investment Survey (CPIS) from the IMF http://cpis.imf.org/
$trade_i$	The ratio of bilateral trade between country *i* and country *j* to total trade volume in country *i*	IMF-Direction of Trade Statistics (DOTS) www.elibrary-data.imf.org
$trade_j$	The ratio of bilateral trade between country *i* and country *j* to total trade volume in country *j*	IMF-Direction of Trade Statistics (DOTS) www.elibrary-data.imf.org
$lndist_{i,j}$	The natural logarithm of distance between capitals of country *i* and country *j*.	http://www.worldatlas.com/travelaids/flight_distance.htm
$comlang_{i,j}$	A dummy variable that equals one if country *i* and country *j* use the same official language and zero otherwise	https://www.cia.gov/library/publications/the-world-factbook/
$border_{i,j}$	A dummy variable that equals one if country *i* is adjacent to country *j* and zero otherwise.	https://www.cia.gov/library/publications/the-world-factbook/
lnpop	The natural logarithm of population	World Development Indicators - The World Bank www. data.worldbank.org
island	A dummy variable that equals one if a country is an island nation and zero otherwise	Rose dataset http://faculty.haas.berkeley.edu/arose/StabData.zip .
lngdp	The natural logarithm of annual real GDP per capita in dollars	World Development Indicators - The World Bank www. data.worldbank.org
center	A dummy variable that equals one if a country has an offshore financial center and zero otherwise	http://www.longfinance.net.
civil	A dummy variable that equals	The Economic Consequences of Legal

	one for a country is a civil-law country and zero otherwise	Origins, La port et al. (2008)
ps	Index of political stability	"Governance Matters VIII" World Bank Policy Research Working Paper, Kaufmann et al(2009). http://info.worldbank.org/governance/ wgi/index.aspx
moneyl	A dummy variable that equals one if a country is identified as money launderer nation and zero otherwise	http:// www1.oecd.org/fatf/pdf/AR2000_en.pdf
fc	The rank of a country's annual foreign exchange transaction value. The greater the foreign exchange transaction value of a country, the higher its ranking.	http://www.bis.org/publ/rpfx13.htm
euro	A dummy variable that equals one if destination country is in euro area and zero otherwise.	http://www.ecb.europa.eu/stats/html/ index.en.html .
continent	A dummy variable that equals one if source country and destination country are in the same continent and zero otherwise.	https://www.cia.gov/library/publications/ the-world-factbook/
integration	The ratio of the sum of total international assets and liabilities over GDP	New External Wealth of Nations Mark II (EWN II) http://www.philiplane.org/EWN.html
kaopen	A measure of financial openness constructed by Chinn and Ito (2013).	http://web.pdx.edu/~io/ Chinn-Ito_websie.htm
overlap	Number of trading hours overlap between source and destination country	Portes and Rey(2005)
insider	Index of insider trading.	World Competitiveness Report, http://www.imd.org/business-school/wcc/ the-global-competitiveness-report.html
soph	Index of sophistication of financial markets	World Competitiveness Report, http://www.imd.org/business-school/wcc/ the-global-competitiveness-report.html
mktcap	The ratio of equity market value over GDP	World Development Indicators -www. data.worldbank.org

credit	The ratio of private credit over GDP	World Development Indicators - www.data.worldbank.org
exstability	A dummy variable that equals one if the exchange rate between source and destination countries is fixed and zero otherwise	Portes and Rey(2005)

Note: *i* and *j* are country indices.