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# The Geography of Cross Border Portfolio Investment and Information Accessibility : The relationship between ICT and FPI

국가간 금융자산거래에 정보 접근성이 미치는 영향

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# The Geography of Cross Border Portfolio Investment and Information Accessibility : The relationship between ICT and FPI

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**Abstract**

On the backdrop of increasing international capital mobility, a large volume of research was devoted to dissecting the factors that facilitate the observed international investment patterns. While many studies focused on the role of distance to examine the significance of information frictions in financial asset trades, little work has considered various factors that may shape information asymmetries between countries, such as the diffusion of the information and communications technology (ICT).

The main purpose of this study is, therefore, to explore how the ease and efficiency of information transmission, namely the "information accessibility" facilitated by the diffusion of the ICT, may affect the cross-border financial asset trades between countries. The product of the ICT diffusion indices of two countries in a pair is used as a proxy for the degree of information accessibility between the two, i.e. a high value of the product implies lower information barrier and higher information transmission between the two countries. Under the gravity model specification, a panel dataset of 67 source countries and 173 host countries from 2001 to 2013 is used to grasp the relationship between the information accessibility and foreign portfolio investments (FPI). Major finding of this paper is that the information accessibility is playing a significant role in determining the geography of FPI alongside conventional factors such as language, bilateral distance and economic size. As it turns out, higher information accessibility positively influences FPI, while the magnitude of the effect may increase as the level of FPI holdings approach zero, indicating that information barrier is a stronger deterrence at the near-zero level of asset trades.

*Keywords:* ICT, Gravity Model, Information Asymmetries, Cross-border Asset Trades, FPI

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# 1. Introduction

To shed light on the so-called 'home bias puzzle'[1], numerous researches focus on the determinants of cross-border investments. Some authors try to find the answer in trading costs on the goods market (Obstfeld and Rogoff, 2001), while others hail information asymmetries and/or 'familiarity' effects[2] as the key determinant of the financial trades between countries. Especially in finance literature, information asymmetries and/or 'familiarity' effects on the portfolio investment holdings are closely studied by many researches, notably French and Poterba (1991), Coval and Moskowitz (1999), Tesar and Werner (1995) and Gordon and Bovenberg (1996). However, there is a still no unanimous conclusion as to which factor drives such international portfolio holdings.

In the effort to understand the lack of international diversification, many studies were devoted to dissecting the factors that may affect the international investment patterns. Notably, Portes and Rey (2005), under the gravity model specification, argue for the importance of information costs, captured by the bilateral distance between two countries, in shaping the geography of foreign portfolio holdings. While the key contributions of related researches do vary, many explicitly or implicitly admit the significant role of information costs in determining the cross-border financial asset trades. In almost all of the specifications examined, the negative sign of the coefficient of the bilateral distance, a proxy for information frictions between two countries, was consistently shown.

Whereas many researchers ground their work on the importance of information barrier, they seldom focus on the factors that shape the information asymmetries or costs

[1] French and Poterba (1991), Cooper and Kaplanis(1994), Tesar and Werner(1995), and Lewis(1999) are the early papers that formally document the home-bias puzzle, where the authors argue that the lack of international diversification is hardly explained by the explicit barrier and/or transaction costs.

[2] Two notable examples that explore familiarity effects are Heath and Tversky(1991) and Huberman(2000). Heath and Tversky(1991) ,after a series of experiments, conclude that people are willing to pay extra premium for their belief and prefer "betting on their judgments over an equi-probable chance event". Huberman (2000) defines "familiarity as information ranges from the investor actually possessing superior information, to the investor thinking that he currently has superior information, to the investor thinking that he will have superior information at some important point in the future". It is often hard to identify 'pure' information asymmetries from 'familiarity' effects.

between countries. Especially, the studies that focus on the role of time-invariant bilateral distance to analyze the effects of information frictions are certainly overlooking the fact that information barrier between two countries may change due to many possible factors. One notable factor in the 21st century is the digital divide- unequal access to, use of, or knowledge of information and communication technologies (ICTs). To some countries, the diffusion of ICT has increased the information accessibility- the ease and efficiency of information transmission- thereby lowering the information barrier between two countries; in contrast, other countries that lag behind this technological diffusion may face lower information accessibility, leading to higher information frictions between the countries. Observing the lacking consideration of the underlying causes that shape the information barrier, this paper tries to include that very factor into the analysis.

On this paper, one of the important driving forces of the alleviation of information barrier between countries is considered to be the ICT diffusion. Unanimously, the advent of internet is hailed as one of the most influential inventions and has sparked many other technological advancements, ranging from e-mail to smart phones. The diffusion of internet has led to an ease and efficiency of cross-border communication, lowering information barrier between countries. The increase in information accessibility facilitated by the ICT diffusion may enrich the picture of the role of information asymmetries in shaping the geography of cross-border portfolio investments. It is especially more of significance, when the key objective of the paper is to dissect the effect of information, which this paper is in line with.

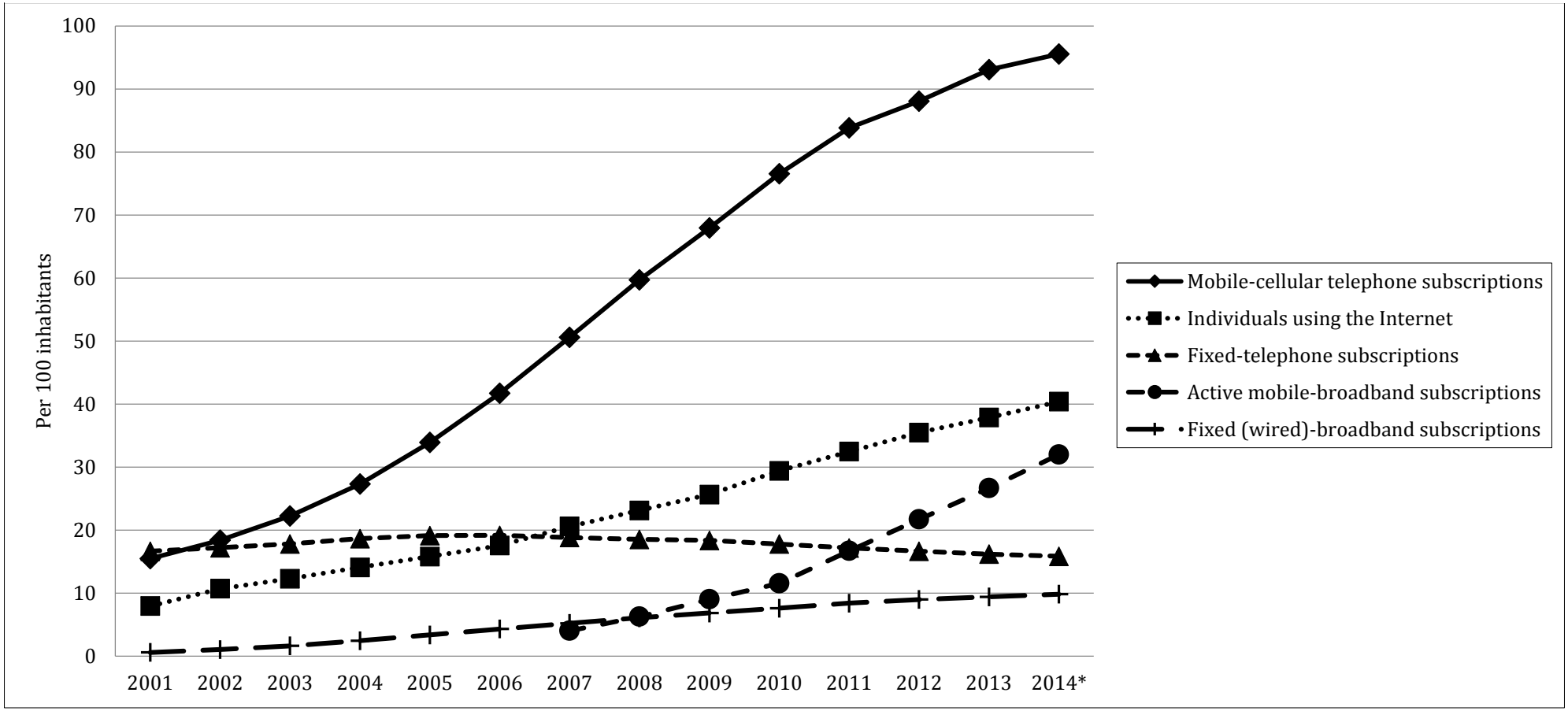
Figure 1 shows the global ICT diffusion indices from 2001 to 2014, including mobile-cellular telephone subscriptions, individuals using the Internet, fixed-telephone subscriptions, active mobile-broadband subscriptions and fixed (wired)-broadband subscriptions. As evident from the graph, the number of internet users globally has quadrupled. The major medium of communication in 21st century is mainly utilizing Internet, especially when considering the cross-border information transmission. In contrast, the fixed telephone subscriptions are almost constant over the time horizon examined and has been decreasing after mid-2000s. The two different ICT diffusion indices, therefore, may indicate the varying degree of the reduction in the information barrier, and they may also have different implications in terms of the overall level of ICT infrastructure

development. Therefore, while the paper focuses on the number of individuals using the Internet (per 100 inhabitants) to reflect the variant information accessibility across countries, it also compares the results of two different ICT indices.

The paper, therefore, empirically analyzes how ICT diffusion may influence foreign portfolio investment (FPI). In many countries, ICT diffusion has been rapid in 21st century and lowered the information barrier between countries significantly. To truly gauge the significance of information asymmetries and 'familiarity effects' as a determining factor of FPI patterns, ICT diffusion should be taken into consideration. Using the panel data of 67 source countries and 173 destination countries over a period between 2001 and 2013, this paper follows the gravity model specification, as in Portes and Rey (2005), to analyze the geography of cross-border portfolio investments. A comparison between the two different ICT indices - one of the number of individuals using the Internet and the other of fixed-telephone subscriptions- is made to clearly grasp their differential effects on the bilateral FPI holdings. Moreover, *FPI holdings by all sectors* and *FPI holdings by financial organizations* are separately analyzed to see if lowering information barrier has a contrasting influence on FPI as to who holds the securities. Furthermore, two different periods are separately examined to see how early and later phrases of the two ICT diffusion indices have heterogeneous effects on FPI. The contrasting effects of internet diffusion at different quantiles of FPI holdings are also examined.

The rest of the paper is organized as follows. Section 2 reviews the information asymmetries and 'familiarity effects' in the finance literature and moreover examines the relevant empirical studies using gravity model. Section 3 presents the baseline model, the data used for the analysis and the summary statistics. Section 4 then summarizes the estimates from the baseline model without ICT indices and with ICT indices separately using pooled OLS and 'between' estimators. The estimation results for FPI holdings by all sectors and FPI holdings by financial organizations are reported separately. The analyses were further taken to consider the differential effects across time and across quantiles of FPI holdings of country pairs. Section 5 presents the results of the robustness check, using source country fixed effects and Tobit estimation for the baseline model with the ICT index of the number of internet users per 100 inhabitants. Concluding remarks follow in Section 6.

**Figure 1** Global ICT Diffusion, 2001-2014




Note: * Estimate

Source: ITU World Telecommunication/ICT indicators database

# 2. Literature Review

## 2.1. Home Bias and Information Asymmetries

Under a close examination of the data, several papers point out the discrepancy between the portfolio theory and the observed allocation of investments, i.e. the so-called 'home-bias puzzle'. Lewis (1999) offers a thorough analysis of home-bias but abstains from arguing for one definite cause of the phenomenon. Tesar and Werner (1995) maintain that transaction costs cannot adequately explain the lack of international diversification. Moreover, Cooper and Kaplanis (1994) test theoretically whether inflation hedging and observable costs of international investments are possible explanations to the home-bias, and conclude that it is not probable. Tesar and Werner (1995) and Cooper and Kaplanis (1995) both argue that explicit barriers are unlikely to be the reason.

While no direct costs explain such observed pattern of international investments, information asymmetries and/or 'familiarity effect' are offered as one of the explanations of the home-bias puzzle. Theoretically, Gehrig (1993) and Gordon and Bovenberg (1996) derive the home-bias from the model with the asymmetric information between domestic and foreign investors. Empirically, French and Poterba (1991) find that investors are optimistic about the domestic returns, due to 'familiarity' effects, and Coval and Moskowitz (1999) and Tesar and Werner (1995) contend that the geographical proximity is playing an important role in determining the international investment holdings.

In fact, numerous researches in the finance literature find the presence of information asymmetries (where the market participants have unequal information availability) and/or familiarity effect. Coval and Moskowitz (2001) analyze the US mutual managers' investment patterns and find that the geographical distance of headquarters is an important factor in determining the investment holdings.[3] Grinblatt and Keloharju (2001) analyze the 97 publicly traded companies of Finland and find that investors have a

[3] On this paper, the authors find that fund managers, who make investments more in the geographically close firms, tend to yield higher returns, reflecting that they may indeed have some information advantage in investing locally.

strong inclination towards "the proximate and for same-language and same-culture firms". Similarly, with the German Security Exchange data of the equity trades of 756 traders located in 23 different cities, Hau (2001) finds that traders located outside Germany in non-German speaking cities underperform while the geographical proximity of traders to corporate headquarters shows a strong information advantage. Moreover, Huberman (2001) examines the shareholders of a Regional Bell Operating Company and finds that shareholders tend to live where the company is located and the employees hold their employers' stocks. A strong evidence of so-called 'familiarity' and information asymmetries is pronounced in various researches.

## 2.2. Gravity Specification in Cross-Border Asset Trades

The gravity model[4] has a long history in the analysis of trade flows between countries. For instance, Rose(2000) used the gravity model to examine the role of currency union in trade patterns. It is relatively recent for international finance literature to adopt the gravity model for the analysis of the international investment patterns. Martin and Rey(2004) theoretically show that the gravity model is applicable to the analysis of cross-border investments. A notable example of an earlier empirical work is Portes and Rey(2005), where the authors show that the gravity model works for international transactions in financial assets as well as for trade in goods and services.

Analyzing cross-border asset trades under the gravity specification, some of the papers focus on the complementarity of trade in goods and trade in assets (Rose and Spiegel, 2002; Shin and Yang, 2006; Aviat and Coeurdacier, 2007; Lane and Ferretti, 2008), the cultural factors in the cross-border investments (Aggarwal et al, 2012), and the regional integration in East Asia (Kim, Lee and Shin, 2005; Garcia-Herrero, Wooldridge, Yang, 2009). Others mainly focus on the significance of distance - a proxy of information costs- as a key determinant of cross-border investments. Portes and Rey (2005) examine the equity flows between countries and accentuate the role of information asymmetries as a key driver in the geography of equity flows. Hattari and Rajan (2008) study the cross-border foreign direct investment flows and accentuate the role of distance and time zones, while Hattari

[4] The gravity model was first used by Jan Tinbergen in 1962 to explain the bilateral trade flows by the economic sizes and the bilateral distance between the two units.

and Rajan (2011) examine the heterogeneous effects of distance to the ratio of FDI/FPI, M&A/FDI and M&A/FPI[5].

Examining a few researches on the pattern of FPI holdings which this study focuses on, Lane and Ferretti(2008) use the CPIS data[6] of 67 source countries in 2001 to examine the effects of trade and information proxy variables, such as distance, tax treaty, colony, currency union, common language and common legal origin, on the FPI. The main finding of this paper is a strong correlation between the portfolio equity investments and trade flows; moreover, information links such as distance and common language play significant roles in determining the international investment patterns. Similarly, Aviat and Coeurdacier (2007) accentuate the role of bilateral trade in alleviating the information asymmetries in the cross-border equity flows. In their analysis of equity flows, the authors show that when controlling for trade, the influence of distance is smaller; however, even after considering the complementarity of trade in goods and trade in assets, the effect of distance on the foreign equity flows still remain unanswered. On the other hand, focusing on the effects of the introduction of euro, Coeurdacier and Martin(2009) analyze cross-sectionally the factors that affect FPI of equity and bond holdings, and bank claims[7]. The implications of currency union are closely dissected and examined.

## 2.3. Information Costs and Asset Trades under Gravity Model

Among the papers examining the factors that affect the cross-border asset trades, not many papers have examined the role of information asymmetries as a determinant of cross-border investments. The lack of researches on this area may ascribe to the data limitation.

Portes and Rey (2005), based on the modelling of asset markets (Martin and Rey, 2003), analyze the cross-border equity flows of 14 countries in 1989-1996. The bilateral telephone call traffic, the degree of overlap in trading hours and multinational bank branches are used to reflect the information transmission between countries and an index of degree of insider trading is included to directly represent the information asymmetries

[5] FDI, M&A and FPI stand for foreign direct investment, merge and acquisition and foreign portfolio investment, respectively.
[6] Refer to the IMF website at http://www.imf.org/external/np/sta/pi/cpis.htm for details.
[7] Refer to BIS website at http://www.bis.org/statistics/histstats10.htm for details

between domestic and foreign investors. The paper estimates the coefficients of the information variables using the 'between' estimator to focus on the cross-sectional variations. The authors argue that the geography of information is of importance in explaining the cross-border equity flows.

Faruqee et al. (2004) use IMF international portfolio holdings survey data of 1997[8] to dissect the factors that affect the FPI and asserts that market size, transaction costs, and information asymmetries are major determinants of cross-border portfolio investments. The number of main phone lines in use per 1000 inhabitants and the per-minute international phone costs to call from one country to the other during business hours are used to analyze the effects of information asymmetries/costs on the FPI. The authors conclude that there is a strong evidence that the product of the number of phone lines of the two countries in pair has a positive and the per-minute international phone costs have a negative impact on the FPI holdings. Moreover, Loungani, Mody and Razin (2002) estimate the impact of information barrier to trade and FDI flows, employing the bilateral distance and the telephone traffic data. 12 source countries and 45 host countries of FDI flow data are used for the analysis. For possible endogeneity issue of using traffic data, telephone densities are used for instrument variable estimation.

Very few papers examine the effect of internet on the cross-border asset trades. Choi (2003) using bilateral FDI flow data in 1995 from 14 source countries and 53 host countries, estimates the impact of the Internet- the number of internet hosts and users of the hosting country as proxies – on the FDI flows. The author argues that the FDI flows between the two countries is positively related to the internet development in the host country due to the lower search costs and entry barrier, and higher productivity. The estimated results support the idea where the number of internet hosts in a host country increased by 10% and consequently FDI inflows increased by more than 2%.

Bae (2011) examines the effect of internet infrastructure on the FPI holdings. The fixed-line internet broadband subscriptions are used as a proxy for internet infrastructure, and the analysis is restricted to the sample of top ten reporting and destination countries of portfolio investment assets. The dynamics of the country pairs with high values of FPI

[8] The CPIS was first conducted for reference date end-December 1997.

holdings can be captured in the research, but it overlooks the fact that the alleviation of information costs facilitated by the diffusion of internet may concentrate on the pair of countries whose value of FPI is near zero. Moreover, the mobile broadband subscriptions have recently increased significantly; hence, internet broadband subscriptions cannot reflect such users and underestimate the actual number of internet users. This may distort the true picture of internet accessibility worldwide, and therefore on this paper, the number of internet users are instead employed.

Furthermore, both papers lack the consideration of the contrasting effects of the internet in its initial and later phase of the diffusion, and are in short of the comparison between the effects of different information and communication technologies on FPI. Hence, this paper analyzes the varying effects of ICT diffusion on FPI when considering different information communication technologies, the holders of securities, the time periods and the quantiles of FPI.

# 3. Empirical Framework and Data

## 3.1. Gravity Model and Empirical Specification

The gravity model has been widely used in trade literature due to its strong explanatory power in describing the geography of trade in goods. Since transportation costs- captured by the bilateral distance in the trade literature- were not involved in trading financial assets, there were few attempts to adopt the gravity model to grasp the pattern of cross-border asset trades before early 2000s. Portes and Rey (2005), however, found that the gravity model can work as well in explaining the trade in financial assets, arguing that distance represents the information frictions between the two countries. In subsequent papers, many authors adopt the gravity model and its extension to analyze the cross-border financial asset trades, ranging from equity to foreign direct investment. Hence, this paper adopts the gravity model framework to analyze how ICT diffusion affects the foreign portfolio asset holdings by lowering the information barrier between countries. The total foreign asset holdings are examined since the interest of this paper mainly lies not on the specific asset class but the trade in financial assets of all asset classes.

Under the gravity model framework, the following specifications were estimated:

(A) $$ln(Asset_{ijt}) = \beta_0 + \beta_1 ln(Distance_{ij}) + \beta_2 ln(Area_i * Area_j) + \beta_3 Language_{ij} + \beta_4 Border_{ij} + \beta_5 Common\ colonizer_{ij} + \beta_6 Same\ country_{ij} + \beta_7 ln(GDP_{it} * GDP_{jt}) + \beta_8 ln(GDPpca_{it} * GDPpca_{jt}) + \sum_{t=2}^{T} D_t + \varepsilon_{ijt}$$

(B) $$ln(Asset_{ijt}) = \beta_0 + \beta_1 ln(Distance_{ij}) + \beta_2 ln(ICT_{it} * ICT_{jt}) + \beta_3 ln(Area_i * Area_j) + \beta_4 Language_{ij} + \beta_5 Border_{ij} + \beta_6 Common\ colonizer_{ij} + \beta_7 Same\ country_{ij} + \beta_8 ln(GDP_{it} * GDP_{jt}) + \beta_9 ln(GDPpca_{it} * GDPpca_{jt}) + \sum_{t=2}^{T} D_t + \varepsilon_{ijt}$$

where i and j represent the source and destination country respectively and t denotes time.

$Asset_{ijt}$ represents the financial assets of country j held by country i at time t; in other words, it shows the real value of country i's FPI holdings in country j. The paper examines both the real value of FPI *holdings by all sectors* and *those by financial*

*organizations only.*[9] This is in order to see the differential effects of information and relationship variables as to who purchase the financial assets of country j. In order to include all the observations with zero value, it is taken logarithm after adding 1.

$ICT_{it}*ICT_{jt}$ is the cross-product of the information communication technology(ICT) diffusion indices of the countries in pair and it represents the ease and efficiency of information flows between countries facilitated by ICT diffusion. Since the major medium of communication in 21st century is mainly utilizing Internet, especially when considering the cross-border information transmissions, the number of individuals using the Internet (per 100 inhabitants) is used to reflect the changes in information barrier between countries. The reason that the index of the individuals using the Internet is preferred to that of fixed (wired) broadband subscriptions is as follows: one fixed-broadband subscription often has multiple users and an increasing number of people are using wireless internet networks with the development of mobile-broadband[10]. Due to the limited data availability of active mobile-broadband subscriptions, the paper focuses on the number of internet users[11]. The number of internet users per 100 inhabitants for some countries has a value of zero; therefore, it is taken logarithm after adding 1. The influences of two different ICT indices, one of the number of individuals using the Internet, the other of fixed-telephone subscriptions, on the FPI are compared to examine the full implications of ICT diffusion on FPI.

$Distance_{ij}$ is the bilateral distance between two countries, working as a proxy for the time-invariant dimension of information frictions. $Area$ is the land area of the country, $GDP$ is real GDP, and $GDPpca$ is real GDP per capita. A number of binary variables are included to capture the relationship between the two countries: $Language_{ij}$ is equal to one if two countries share a common language; $Border_{ij}$ is equal to one if two countries share the border; $Colony_{ij}$ is equal to one if two countries have/had the same

[9] The number of observations do differ since not all the participating countries of CPIS report the data by the sector of holder. It is an encouraged item for participating countries, but certainly not the core item. The complete list of countries are available in Appendix.

[10] According to the ITU data, mobile broad band subscriptions have recently increased both in developing and developed countries. In 2015, the estimated number of active mobile broadband subscriptions for the world population is 86.7 per 100 inhabitants.

[11] Internet users are persons using the Internet within one year from any device including mobile phones.

colonizer post-1945; $Same\ country_{ij}$ is equal to one if countries were/are the same country. Time dummies are included to control the year-specific effect.

The expected signs for the coefficients of variables in regression are shown in Table 1. They are based on previous researches, and especially, the negative sign for the distance variables is a consistent conclusion from numerous researches. Following the "gravity" specification, real GDP and real GDP per capita are included to represent the economic masses of the two countries, and believe that they would positively influence the FPI. The geographical, historical and language binary variables are included to control the effects of these variables, and it is expected that having a close relationship between the two countries, irrespective of the sources of the closeness, may create some 'familiarity' effects. The coefficient of the cross-product of ICT variables is expected to be positive, since a high level of ICT diffusion of two countries may lower information barrier greatly and thereby may have led to an increase in FPI between the two countries.

The sources of data will be explained in the subsequent section.

## 3.2. Data

With the purpose of analyzing the cross-border portfolio investments, the panel data of the Coordinated Portfolio Investment Survey (CPIS) released by the International Monetary Fund (IMF)[12] from 2001 to 2013 were used. The IMF started its first survey in 1997, and conducted it annually after 2001. Despite some shortcomings of the CPIS data such as incomplete country coverage and under-reporting of asset holdings (Lane and Milesi-Ferretti, 2008), the CPIS data still provide a unique and valuable opportunity to grasp the extensive picture of cross-country portfolio investment positions. The bilateral positions of 67 source countries were analyzed for the baseline model. The dataset has a panel structure, consisting of 67 source countries and 173 destination countries[13], with 89,335

[12] Refer to the IMF website at http://www.imf.org/external/np/sta/pi/cpis.htm for detail.

[13] 56 source countries report the total FPI holdings of other financial corporation since they are the none-core items. The same analyses were taken using the same sample countries, and the results are available upon request. The main idea does not change even when we consider the same sample countries.

observations[14] from 2001 to 2013 for the baseline model excluding ICT variables. The panel data are unbalanced, and the number of observations in each year varies. Moreover, due to the availability of data, different specifications result in changes in the number of observations. A complete list of countries under examination is provided in Appendix.

To estimate the gravity model specification, the data of the aforementioned variables are collected from various sources. For each country, GDP, GDP per capita and US GDP deflator data were collected from IMF's World Economic Overview, and World Bank for missing data. The unit of GDP and GDP per capita are in U.S. dollar. All nominal values are converted to real values using U.S GDP deflator for all countries.[15] ICT indices are collected from the United Nation's International Telecommunication Union (ITU) while bilateral distance and dummy variables including common language, border, same country and common colonizer are collected from CEPII[16] data, and area data are collected from CIA Factbook[17]. The sources of data are summarized in Table 2.

Summary statistics for dependent and independent variables are provided in Table 3.1 and Table 3.2. Table 3.1 shows the summary statistics for the baseline model of total FPI holdings excluding ICT variables: (1) held by all sectors and (2) held by other financial organizations. Table 3.2 shows the summary statistics for the model, including ICT variables, of total foreign portfolio asset holdings held by all sectors: (1) with the number of internet users per 100 inhabitants and (2) with the number of fixed telephone subscriptions per 100 inhabitants.

[14] Due to short-selling, few observed data of FPI have value less than zero, and it is believed that they share different characteristics than those of positive values, and many countries indeed have restrictions on the short-positions. Therefore, following Lane and Ferretti(2008), I excluded these observations from the sample, and it is less than 0.1% of the whole sample; therefore, it would not affect the estimation results of the paper.

[15] A separate deflator for each country may be better suited to the analysis, but due to data limitations, in this paper, U.S. GDP deflator is used.

[16] Please refer to http://www.cepii.fr/CEPII/en/. Language Dataset and GeoDist Dataset are used.

[17] Please refer to https://www.cia.gov/library/publications/the-world-factbook/

**Table 1** Expected Signs in Regression

| Variables | Expected Sign |
|---|---|
| $\ln(Distance_{ij})$ | − |
| $\ln(ICT_{it}{*}ICT_{jt})$ | + |
| $\ln(Area_i{*}Area_j)$ | − |
| $Language_{ij}$ | + |
| $Border_{ij}$ | + |
| $Common\ colonizer_{ij}$ | + |
| $Same\ country_{ij}$ | + |
| $\ln(GDP_{it} * GDP_{jt})$ | + |
| $\ln(GDPpca_{it} * GDPpca_{jt})$ | + |

**Table 2** Sources of Data

| Variables | Source of data |
|---|---|
| $\ln(Asset_{ijt})$ | IMF CPIS |
| $\ln(Distance_{ij})$ | Gravity Dataset, CEPII |
| $\ln(ICT_{it}{*}ICT_{jt})$ | UN ITU |
| $\ln(Area_i{*}Area_j)$ | CIA Factbook |
| $Language_{ij}$ | Language Dataset, CEPII |
| $Border_{ij}$ | Gravity Dataset, CEPII |
| $Common\ colonizer_{ij}$ | Gravity Dataset, CEPII |
| $Same\ country_{ij}$ | Gravity Dataset, CEPII |
| $\ln(GDP_{it} * GDP_{jt})$ | IMF WEO, World Bank |
| $\ln(GDPpca_{it} * GDPpca_{jt})$ | IMF WEO, World Bank |

**Table 3.1** Summary statistics for the baseline model (2001-2013)

| | (1) | | (2) | |
|---|---|---|---|---|
| | Mean | Std.Dev | Mean | Std.Dev |
| $\ln(Asset_{ijt})$ *held by all sectors* | 8.769 | 9.188 | | |
| $\ln(Asset_{ijt})$ *held by financial organizations* | | | 5.832 | 8.496 |
| $\ln(Distance_{ij})$ | 8.628 | 0.865 | 8.624 | 0.856 |
| $\ln(Area_i{*}Area_j)$ | 23.766 | 3.397 | 23.962 | 3.179 |
| $Language_{ij}$ | 0.114 | 0.318 | 0.086 | 0.280 |
| $Border_{ij}$ | 0.023 | 0.150 | 0.021 | 0.145 |
| $Common\ colonizer_{ij}$ | 0.040 | 0.196 | 0.039 | 0.193 |
| $Same\ country_{ij}$ | 0.007 | 0.085 | 0.006 | 0.077 |
| $\ln(GDP_{it} * GDP_{jt})$ | 50.601 | 2.956 | 50.396 | 2.954 |
| $\ln(GDPpca_{it} * GDPpca_{jt})$ | 18.220 | 1.861 | 17.986 | 1.935 |
| N | 89335 | | 66250 | |

**Table 3.2** Summary statistics for the baseline model with ICT variables[18] (2001-2013)

| | (1) Internet Users | | (2) Fixed-line Users | |
|---|---|---|---|---|
| | Mean | Std.Dev | Mean | Std.Dev |
| $\ln(Asset_{ijt})$ | 8.852 | 9.191 | 8.812 | 9.197 |
| $\ln(Distance_{ij})$ | 6.551 | 1.586 | 5.798 | 1.714 |
| $\ln(ICT_{it}{*}ICT_{jt})$ | 8.622 | 0.866 | 8.624 | 0.867 |
| $\ln(Area_i{*}Area_j)$ | 23.786 | 3.367 | 23.787 | 3.380 |
| $Language_{ij}$ | 0.113 | 0.317 | 0.114 | 0.318 |
| $Border_{ij}$ | 0.023 | 0.151 | 0.023 | 0.151 |
| $Common\ colonizer_{ij}$ | 0.040 | 0.195 | 0.040 | 0.197 |
| $Same\ country_{ij}$ | 0.007 | 0.086 | 0.007 | 0.086 |
| $\ln(GDP_{it} * GDP_{jt})$ | 50.648 | 2.924 | 50.641 | 2.937 |
| $\ln(GDPpca_{it} * GDPpca_{jt})$ | 18.227 | 1.860 | 18.240 | 1.855 |
| N | 87681 | | 88308 | |

[18] The above are the summary statistics for the specification- including ICT variables - of FPI holdings by all sectors. The summary statistics for the specification, including ICT variables, but with FPI holdings by other financial sectors are available upon request.

# 4. Results

All equations include a constant term and time dummies to control the aggregate shocks, whose estimates are not reported. All variables except dummy variables are in logarithm; therefore, the corresponding coefficients are elasticities. All variables are bilateral where i and j represent the source and destination country respectively and t denotes time. The dependent variable- $Asset_{ijt}$ -represents the country i's real portfolio investment in country j. In order to include all the observations with zero value, it is taken logarithm after adding 1[19]. The number of internet users per 100 inhabitants for few countries has a value of zero; therefore, it is taken logarithm after adding one. The estimates of standard errors are heteroscedasticity-consistent, which are shown in parentheses below the coefficient estimates.

The estimation methods of the equation (A) and equation (B) in Section 3 consist of pooled OLS estimation and 'between' effects estimation. On this paper, the country-pair fixed effects are not applicable, since most of the variables of interest is time-invariant, and hence cannot be estimated when introducing country-pair fixed effects. More importantly, the paper's main focus is cross-sectional, and hence a 'between' estimator on the time-series means for the country pairs will be better suited to this paper's objective. Random effects panel estimation is not theoretically plausible for the data under examination, which are not drawn randomly from a larger population (Portes and Rey, 2005; Baltagi, 1995) Therefore, most of the analyses were pooling the time-series and cross-section data or using the 'between' estimator.

## 4.1. Baseline Model and Estimates

Equation (A) at Section 3 is estimated and summarized in Table 4.1 and Table 4.2

Table 4.1 and Table 4.2 represent the estimated results of the standard gravity model, using pooled OLS and 'between' effects estimation. Table 4.1 consists of the estimation results whose dependent variable is the real value of FPI holdings by *all sectors*,

[19] More than one third of the observations have a value of zero.

while Table 4.2 shows the estimation results when using portfolio holdings by *financial organizations only.* The first column in both of the tables represent the pooled OLS estimation results, while the second column show the 'between' effects estimation.

Looking closely at Table 4.1, all the estimated coefficients are significant at 0.1% and have the expected sign. Both columns, one from pooled OLS estimation and the other from between estimator show similar estimation results. The bilateral distance has a strong negative effect on the real FPI, supporting the idea that the distance has a negative correlation with the information frictions/costs. The economic sizes of both countries (represented by the cross-product of two countries' real GDP and real GDP per capita) are having strong positive effect on the real FPI. These results confirm the founding notions of gravity model. Moreover, the geographical, political variables and especially language binary variable also have the significant effect on FPI, accentuating the significant role of 'closeness' and/or "familiarity" between the countries in determining cross-border portfolio investment patterns. A negative impact of the cross-product of physical areas on the cross-border portfolio investments can be resulted from higher information costs between countries when their physical sizes are large.

Table 4.2 as aforementioned shows the estimation results whose dependent variable is the real value of FPI holdings by *financial organizations only.* The signs of the estimated coefficients are equivalent to the predicted ones except that for border and common colonizer. The border effect has become insignificant, and common colonizer has an ambiguous effect, negative in the pooled OLS estimation and insignificant in the between effects estimation. These may result from the fact that the financial organizations are less affected by the geographical and historical relationship when deciding where to invest i.e. "familiarity" effects play a less of a significant role when it comes to the pattern of financial organizations' foreign portfolio asset holdings. The analysis is further supported by the changes in the estimated coefficient of bilateral distance from -1.7 to -1.2 in the pooled OLS estimation. Other variables have shown similar estimates both in direction and in magnitude as those in Table 4.1, where the dependent variable is the real value of FPI holdings by all sectors.

**Table 4.1** Baseline Model: FPI Holdings by All Sectors

| | Pooled OLS | Between Effect |
|---|---|---|
| Bilateral distance | -1.699*** | -1.392*** |
| | [0.027] | [0.068] |
| Area in pair | -0.393*** | -0.415*** |
| | [0.011] | [0.026] |
| Common language | 2.961*** | 2.827*** |
| | [0.072] | [0.175] |
| Border | 0.817*** | 1.441*** |
| | [0.145] | [0.397] |
| Common colonizer | 1.969*** | 1.478*** |
| | [0.124] | [0.224 ] |
| Same Country | 1.337*** | 1.981** |
| | [0.230] | [0.555 ] |
| GDP in pair | 1.683*** | 1.436*** |
| | [0.013] | [0.031] |
| GDP per capita in pair | 1.356*** | 1.067*** |
| | [0.018] | [0.040] |
| Number of observations | 89335 | 89335 |
| R-squared | 0.53 | 0.59 |

All our estimates include time dummies and a constant, whose estimates are not reported. Robust standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

**Table 4.2** Baseline Model: FPI Holdings by Financial Organizations

| | Pooled OLS | Between Effect |
|---|---|---|
| Bilateral distance | -1.184*** | -1.240*** |
| | [0.033] | [0.078] |
| Area in pair | -0.271*** | -0.157*** |
| | [0.013] | [0.032] |
| Common language | 2.054*** | 2.075*** |
| | [0.095] | [0.207] |
| Border | 0.325 | 0.440 |
| | [0.219] | [0.496] |
| Common colonizer | -0.505*** | 0.233 |
| | [0.133] | [0.252] |
| Same Country | 2.382*** | 2.140** |
| | [0.341] | [0.674] |
| GDP in pair | 1.395*** | 1.096*** |
| | [0.016] | [0.038] |
| GDP per capita in pair | 1.254*** | 1.295*** |
| | [0.020] | [0.046] |
| Number of observations | 66250 | 66250 |
| R-squared | 0.47 | 0.52 |

All our estimates include time dummies and a constant, whose estimates are not reported. Robust standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

## 4.2. Baseline Model with ICT variables and Estimates

Equation (B) at Section 3 is estimated and summarized in Table 4.3 and Table 4.4. Table 4.3 consists of the estimation results whose dependent variable is the real value of FPI holdings by all sectors, while Table 4.4 shows the estimation results when using portfolio holdings by financial organizations only. Each of Table 4.3 and Table 4.4 summarizes the findings of pooled OLS estimation (Column 1 and 2) and between effects estimation (Column 3 and 4). The specifications include the ICT diffusion indices: the number of internet users per 100 inhabitants and the number of fixed telephone subscriptions per 100 inhabitants. It allows the comparison of how each medium of communication may have affected the FPI in 2001-13, and how these effects may differ depending on which sector holds the securities of the hosting country.

The diffusion of ICT affects the FPI through two channels. First, ICT diffusion directly helps lowering the information barrier between countries greatly and hence facilitates a greater efficiency and ease of communication between countries. A higher information transmission reduces information asymmetries and enhances "familiarity" between the countries, thereby increasing the bilateral FPI holdings. Secondly, ICT diffusion may also be a signal about the country's overall level of ICT infrastructure. When the overall ICT infrastructure is well-established and developed to facilitate financial transactions between countries, this may in turn lead to an increase in the level of bilateral FPI holdings.[20]

The diffusion of internet represented by the number of internet users per 100 inhabitants facilitates higher information transmission and lower information asymmetries. Moreover it indirectly implies a stable and well-established technological platform of the country, facilitating smooth transactions between countries. Table 4.3 shows how ICT diffusion affected the FPI holdings by all sectors. The estimated coefficient of the cross-product of internet users per 100 inhabitants is 0.549 for pooled OLS

[20] The paper focuses on the direct channel of lowering information barrier by the diffusion of ICT. However, it is important to acknowledge that ICT diffusion may also be a signal of the country's overall level of ICT infrastructure, for analysis in this Section 4.2. The subsequent analyses in other sections, however, will focus on the direct information effect, while acknowledging another channel of influence.

estimation and 0.396 for between effects estimation. It is the consequence of the both of the aforementioned effects.

The diffusion of fixed telephone, however, may have different implications. Closely examining Figure 1 in Section 1, the number of fixed-line telephone subscriptions are decreasing in trend and less people are using fixed-line telephone as a means of communication due to the development of Internet. The diffusion of fixed-line telephone therefore may imply a lesser degree of reduction in the information barrier. Moreover, an increase in the number of fixed-line telephone users may indicate that the country's ICT development is lagging behind those of other countries that may have no room for further increase in the number of fixed telephone subscriptions because the market is simply saturated and the consumers demand other communication devices as a substitute for fixed-line telephone. The increase in the number of fixed-telephone users, therefore, may represent the ICT 'under-development'[21], which hence signals that the country's overall ICT infrastructure is not well-established, disrupting smooth transactions between countries, and the very effect can have a negative impact on the bilateral FPI holdings.

Hence, while increasing access to internet has a positive influence on the FPI, the ICT diffusion captured by fixed-telephone users showed a stark contrast. The estimated coefficient of the cross-product of fixed-telephone users per 100 inhabitants is 0.154 for pooled OLS estimation and -0.144 for between effects estimation (Table 4.3). The estimated coefficient of the cross-product of the number of fixed-line telephone users is much smaller than that of the number of internet users and negative in the 'between' effects estimation. It is a result of the mixture of aforementioned channels: a positive albeit small influence through slight reduction, if any, in information barrier and a negative impact through signaling a low level of overall ICT infrastructure.

The estimated coefficients of all other variables from the baseline model are similar to the ones from Table 4.1. All the estimated coefficients are significant at 1%, and the signs of the coefficients are the same from those of predicted ones. The bilateral distance has a strong negative effect on the real FPI, while the economic sizes of both countries are having a strong positive effect. Moreover, the geographical, political and

[21] The 'under-development' here represents the relatively slow development of ICT sector in the country compared to the global standard.

especially language binary variable also have significant effects on the FPI holdings.

**Table 4.3** FPI Holdings by All Sectors with ICT Variables

| | (1)Pooled OLS | (2)Pooled OLS | (3)Between Effects | (4)Between Effects |
|---|---|---|---|---|
| Bilateral distance | -1.720*** | -1.736*** | -1.401*** | -1.414*** |
| | [0.027] | [0.027] | [0.068] | [0.067] |
| Internet users per 100 inhabitants in pair | 0.549*** | | 0.396*** | |
| | [0.034] | | [0.082] | |
| Fixed-telephone users per 100 inhabitants in pair | | 0.154*** | | -0.144** |
| | | [0.022] | | [0.048] |
| Area in pair | -0.379*** | -0.370*** | -0.387*** | -0.415*** |
| | [0.011] | [0.011] | [0.027] | [0.026] |
| Common language | 3.039*** | 2.958*** | 2.904*** | 2.779*** |
| | [0.073] | [0.072] | [0.178] | [0.176] |
| Border | 0.695*** | 0.646*** | 1.323*** | 1.463*** |
| | [0.144] | [0.145] | [0.400] | [0.400] |
| Common colonizer | 1.991*** | 2.185*** | 1.433*** | 1.562*** |
| | [0.125] | [0.124] | [0.228] | [0.226] |
| Same Country | 1.126*** | 1.352*** | 1.902** | 2.031** |
| | [0.230] | [0.230] | [0.557] | [0.559] |
| GDP in pair | 1.670*** | 1.700*** | 1.431*** | 1.455*** |
| | [0.013] | [0.013] | [0.031] | [0.031] |
| GDP per capita in pair | 1.028*** | 1.247*** | 0.844*** | 1.184*** |
| | [0.028] | [0.025] | [0.064] | [0.054] |
| Number of observations | 87681 | 88308 | 87681 | 88308 |
| R-squared | 0.54 | 0.54 | 0.59 | 0.60 |

All our estimates include time dummies and a constant, whose estimates are not reported. Robust standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

Table 4.4 shows how ICT diffusion affects the FPI holdings by financial organizations. ICT diffusion captured by the cross-product of internet users has slightly less of a significant role in influencing the FPI. The coefficients estimated are 0.182 for pooled OLS and 0.204 for 'between' estimation, lower than those of the previous analysis of FPI holdings by all sectors. It was indeed expected since the investors under examination are from the financial organization, and therefore, increasing 'familiarity' between countries due to a higher level of information transmission facilitated by the ICT diffusion will be of less significance to the intuitional investors' investment decisions. The significant and positive effect of the internet diffusion on the FPI holdings are likely to be the result of its positive signaling about the well-established ICT infrastructure.

Moreover, an increase in the number of fixed-telephone users may imply- as aforementioned- the country's ICT is 'under-development'. The increase in the number of fixed-telephone users in turn implies that the country's ICT development is lagging behind other countries. In both estimations- pooled OLS and between effects, the estimated coefficients of the cross-product of the number of fixed-telephone users in pair are negative. The coefficients estimated are negative and larger (in absolute value) compared to the ones from Table 4.2 where the analysis focuses on the FPI holdings by all sectors. The positive information effect (albeit small in the first place) becomes negligible[22] and hence, the negative signaling about the countries' ICT infrastructure may prevail, leading to a negative effect on the FPI holdings.

Same as the results of the baseline model in Table 4.2, the signs of other estimated coefficients are equivalent to the predicted ones except that for border and common colonizer. The border effect has become insignificant, and common colonizer has an ambiguous effect, negative in the pooled OLS estimation and insignificant in the between effects estimation. These may support the idea that 'familiarity' effect plays a less significant role when it comes to the pattern of financial organizations' foreign portfolio asset holdings. The estimated coefficient of bilateral distance is from -1.7 to -1.2 in the pooled OLS estimation.

[22] Increasing 'familiarity' between countries due to a higher level of information transmission facilitated by the ICT diffusion will be of less significance to the intuitional investors' investment decisions.

**Table 4.4** FPI Holdings by Financial Organizations with ICT variables

| | (1)Pooled OLS | (2)Pooled OLS | (3)Between Effects | (4)Between Effects |
|---|---|---|---|---|
| Bilateral distance | -1.202*** | -1.230*** | -1.242*** | -1.288*** |
| | [0.033] | [0.033] | [0.078] | [0.077] |
| Internet users per 100 inhabitants in pair | 0.182*** | | 0.204* | |
| | [0.037] | | [0.091] | |
| Fixed-telephone users per 100 inhabitants in pair | | -0.381*** | | -0.511*** |
| | | [0.022] | | [0.048] |
| Area in pair | -0.263*** | -0.282*** | -0.145*** | -0.196*** |
| | [0.014] | [0.014] | [0.033] | [0.032] |
| Common language | 2.126*** | 2.023*** | 2.160*** | 1.965*** |
| | [0.097] | [0.095] | [0.211] | [0.206] |
| Border | 0.300 | 0.388 | 0.333 | 0.612 |
| | [0.221] | [0.218] | [0.500] | [0.487] |
| Common colonizer | -0.570*** | -0.465*** | 0.078 | 0.152 |
| | [0.136] | [0.133] | [0.253] | [0.250] |
| Same Country | 2.255*** | 2.438*** | 2.016** | 2.129** |
| | [0.342] | [0.341] | [0.674] | [0.666] |
| GDP in pair | 1.392*** | 1.429*** | 1.090*** | 1.136*** |
| | [0.017] | [0.016] | [0.038] | [0.038] |
| GDP per capita in pair | 1.158*** | 1.535*** | 1.177*** | 1.672*** |
| | [0.030] | [0.027] | [0.070] | [0.059] |
| Number of observations | 64770 | 65500 | 64770 | 65500 |
| R-squared | 0.48 | 0.48 | 0.52 | 0.53 |

All our estimates include time dummies and a constant, whose estimates are not reported. Robust standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

# 5. Heterogeneous Effects across Time and Quantile

Equation (B) at Section 3 is estimated across the two groups of time periods, one from 2001 to 2005 and the other from 2010 to 2013 and the results are summarized in Table 5.1[23]. The real portfolio investment holdings by all sectors are used. The financial crisis period between 2007 and 2009, and one year before and after the crisis i.e. samples from 2006 to 2009 are excluded to minimize the bias arising from the global financial crisis. Comparing the two-year groups, the study tries to capture the differential effects of ICT diffusion across years.

First of all, the explanatory power of internet diffusion in analyzing the geography of cross-border portfolio investment is strikingly higher in early 2000s. The coefficient of the cross-product of internet users of the pair countries is greater than one (1.311) but becomes insignificant recently. The result may rely on the fact that in early 2000s the information barrier was greatly reduced due to the rapid propagation of internet in early 2000s; however, since diffusion has already undergone for around a decade, the recent additional 1% increase in internet users does not lead to a significant reduction in information barrier and hence is an insignificant impact on the cross-border portfolio investments.

Secondly, the effect of the fixed telephone subscriptions on the cross-border portfolio investment was positive in early 2000s when the main source of communication was still relying on telephone calls. In spite of a smaller degree of influence compared to that of internet development, the estimated coefficient is positive and of 0.382. This means that 1% increase in the cross-product of the number of fixed telephone subscriptions per 100 inhabitants leads to around 0.38% increase in FPI. The influence has become negative recently and the estimated coefficient is -0.12. The estimated negative coefficient can be explained as aforementioned: an increase in the number of fixed telephone subscriptions may in turn imply that the country's ICT development is lagging behind other countries i.e the increase in the number of fixed-telephone users does not represent ICT development but ICT 'under-development', which may l signal that the country's overall ICT

[23] The results of the between estimation of the analysis are not reported but the findings are not much different from that of pooled OLS estimation. The results are available upon request.

infrastructure is not well-established. Moreover, since less people are using fixed-line telephone as a means of communication and therefore, the diffusion of fixed-line telephone therefore may imply a lesser degree of reduction in the information barrier.

Lastly, the distance effect has become greater recently. The border effect and the "same-country" effect have become insignificant. Even though this study excludes observations from 2006 to 2009 to control the financial crisis effect, the general antipathy towards financial market integration may have led to a greater distance effect and insignificant border and "same country" effect.

Table 5.2 summarizes the results of quantile regression. Quantile regression models represent the relationship between a set of explanatory variables and specific quantiles of the dependent variable. The estimated parameter of the x variable indicates the change in a specified quantile of the dependent variable caused by one percent change in the x variable. Since more than one third of the observations of real portfolio investment holdings have zero value, the estimation focuses on the median and upper quantiles.

The estimated coefficient of the bilateral distance between countries at the median is -1.67 and falls to -0.93 at the $90^{th}$ quantile. The decreasing coefficient with the quantile of real portfolio investment holdings is a clear pattern. This indicates that the bilateral distance has a more of significant influence when the volume of asset trades is low. It is again confirmed by the decreasing coefficient of the cross product of internet users in pair as the quantile increases. The estimated coefficient 0.899 at the median but falls to -0.085 at the $90^{th}$ quantile. The results imply that the information barrier/asymmetries may work as a stronger deterrence when the volume of asset trading between countries is small or near zero.

**Table 5.1** Pooled OLS Estimation: Separate Estimation of Two Time Periods

| | (1)2001-05 | (2)2001-05 | (3)2010-13 | (4)2010-2013 |
|---|---|---|---|---|
| Bilateral distance | -1.694*** | -1.547*** | -1.967*** | -2.039*** |
| | [0.045] | [0.045] | [0.045] | [0.045] |
| Internet users per 100 inhabitants in pair | 1.311*** | | 0.044 | |
| | [0.053] | | [0.068] | |
| Fixed telephone subscriptions per 100 inhabitants in pair | | 0.382*** | | -0.120** |
| | | [0.034] | | [0.039] |
| Area in pair | -0.157*** | -0.164*** | -0.518*** | -0.517*** |
| | [0.018] | [0.018] | [0.018] | [0.018] |
| Common language | 2.642*** | 2.575*** | 3.523*** | 3.428*** |
| | [0.115] | [0.112] | [0.132] | [0.132] |
| Border | 0.711** | 0.864*** | 0.305 | 0.199 |
| | [0.260] | [0.260] | [0.244] | [0.244] |
| Common colonizer | 1.635*** | 1.728*** | 1.324*** | 1.530*** |
| | [0.200] | [0.196] | [0.216] | [0.215] |
| Same Country | 1.301** | 1.812*** | 0.556 | 0.621 |
| | [0.426] | [0.420] | [0.383] | [0.387] |
| GDP in pair | 1.468*** | 1.501*** | 1.752*** | 1.805*** |
| | [0.022] | [0.021] | [0.022] | [0.022] |
| GDP per capita in pair | 0.481*** | 1.113*** | 1.453*** | 1.524*** |
| | [0.046] | [0.039] | [0.048] | [0.043] |
| Number of observations | 31773 | 32475 | 29018 | 28916 |
| R-squared | 0.54 | 0.54 | 0.54 | 0.55 |

All our estimates include time dummies and a constant, whose estimates are not reported. Robust standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

**Table 5.2** Quantile Regression

| Quantile | (1)50th | (2)70th | (3)80th | (4)90th |
|---|---|---|---|---|
| Bilateral distance | -1.668*** | -1.290*** | -1.165*** | -0.932*** |
| | [0.025] | [0.024] | [0.026] | [0.020] |
| Internet users per 100 inhabitants in pair | 0.899*** | 0.825*** | 0.593*** | -0.085* |
| | [0.051] | [0.059] | [0.053] | [0.040] |
| Area in pair | -0.316*** | -0.293*** | -0.288*** | -0.234*** |
| | [0.012] | [0.010] | [0.009] | [0.007] |
| Common language | 2.974*** | 3.339*** | 3.412*** | 2.777*** |
| | [0.116] | [0.099] | [0.080] | [0.059] |
| Border | -0.411** | 0.123 | 0.282* | 0.430* |
| | [0.133] | [0.139] | [0.127] | [0.174] |
| Common colonizer | 2.187*** | 2.894*** | 3.005*** | 2.065*** |
| | [0.197] | [0.135] | [0.088] | [0.089] |
| Same Country | 1.709*** | 1.048*** | 0.806*** | 0.220 |
| | [0.183] | [0.138] | [0.192] | [0.191] |
| GDP in pair | 1.783*** | 1.645*** | 1.545*** | 1.186*** |
| | [0.018] | [0.014] | [0.013] | [0.011] |
| GDP per capita in pair | 1.142*** | 1.040*** | 1.066*** | 1.077*** |
| | [0.030] | [0.034] | [0.030] | [0.024] |
| Number of observations | 87681 | 87681 | 87681 | 87681 |

All our estimates include time dummies and a constant, whose estimates are not reported. Robust standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

# 6. **Robustness Check**

For robustness check, two approaches are used.[24]

First of all, the source country fixed effects model was used, where the dummy variables of the source countries are included. The results are summarized in Table 6.1. The results are almost identical with the ones obtained in Table 4.3 which uses the pooled OLS estimation and between effects estimation. All the estimated coefficients are significant at 0.1% and have the expected sign. The bilateral distance has a strong negative effect on the real FPI, and the ICT diffusion index represented by the number of internet users has a strong positive effect, supporting the idea that the advent of internet has lowered information barrier to a great extent. The geographical and political variables and especially language binary variable also have the significant effect on FPI, accentuating the significant role of 'closeness' and/or 'familiarity' between countries in determining cross-border portfolio investment patterns.

Secondly, Tobit estimation[25] is conducted for robustness check. There is more than one third of the observations of zero value, and hence Tobit regression[26] is conducted and the results are reported in Table 6.2 and Table 6.3. Looking at Table 6.2, the signs of estimated coefficients are consistent, while the estimated coefficients are larger in many cases, since they represent the partial effect of the 'latent' variable that governs the real value of FPI holdings. In Table 6.3, the first column represents the marginal effect on the unconditional expected value and the second column represents the marginal effect on the expected value conditional on FPI being greater than zero. Consistent with the results of quantile regression, the marginal effect of distance and internet diffusion on conditional expectation is smaller. The results again support the idea that the information

[24] The equation (B) at Section 3 is estimated and the dependent variable is the real value of FPI holdings by *all sectors*. The regression results of source country fixed effects and tobit estimation for the specification of the FPI holdings by *financial organizations* are available upon request.

[25] The Tobit model is applicable when y is an observable choice or outcome with the following characteristics: y takes on the value 0 with positive probability but is a continuous random variable over strictly positive values. It is a corner solution model and as Wooldridge (2002, 517-520) points out, the problem may arise when using OLS in this setting.

[26] Lane and Ferretti (2008) report the Tobit estimation results and argue that such censoring is possible due to the equity shorting restrictions in many countries.

barrier/asymmetries work as stronger deterrence when the volume of asset trading between countries is small or near zero.

**Table 6.12** Robustness Check: Source Country Fixed Effects Estimation

| | Source Country Fixed Effect |
|---|---|
| Bilateral distance | -1.564*** |
| | [0.027] |
| Internet users per 100 inhabitants in pair | 0.584*** |
| | [0.037] |
| Area in pair | -0.254*** |
| | [0.014] |
| Common language | 2.425*** |
| | [0.072] |
| Border | 1.217*** |
| | [0.135] |
| Common colonizer | 0.439*** |
| | [0.118] |
| Same Country | 1.187*** |
| | [0.210] |
| GDP in pair | 1.895*** |
| | [0.017] |
| GDP per capita in pair | 0.800*** |
| | [0.031] |
| Number of observations | 87681 |
| R-squared | 0.60 |

All our estimates include time dummies and a constant, whose estimates are not reported. Robust standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

**Table 6.2** Robustness Check: Tobit Regression

| | Tobit |
|---|---|
| Bilateral distance | -2.743*** |
| | [0.046] |
| Internet users per 100 inhabitants in pair | 1.599*** |
| | [0.071] |
| Area in pair | -0.661*** |
| | [0.019] |
| Common language | 5.755*** |
| | [0.126] |
| Border | -0.389 |
| | [0.249] |
| Common colonizer | 4.283*** |
| | [0.238] |
| Same Country | 2.341*** |
| | [0.368] |
| GDP in pair | 2.938*** |
| | [0.025] |
| GDP per capita in pair | 1.494*** |
| | [0.054] |
| Number of observations | 87681 |

All our estimates include time dummies and a constant, whose estimates are not reported. The standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

**Table 6.3** Robustness Check: Marginal Effects of Tobit Estimation

| Marginal Effects at Observed Censoring Rate | | |
|---|---|---|
| Variable | Unconditional Expected Value | Conditional on Being Uncensored |
| Bilateral distance | -1.378 | -1.000 |
| Internet users per 100 inhabitants in pair | 0.803 | 0.583 |
| Area in pair | -0.332 | -0.241 |
| Common language | 2.890 | 2.098 |
| Border | -0.195 | -0.142 |
| Common colonizer | 2.151 | 1.561 |
| Same Country | 1.176 | 0.854 |
| GDP in pair | 1.475 | 1.071 |
| GDP per capita in pair | 0.750 | 0.545 |

# 7. Conclusion

Under the gravity model specification, this paper explores the relationship between ICT diffusion and FPI holdings. A panel dataset of 67 source countries and 173 host countries is used for the analysis. Major finding of this paper is that the ICT diffusion captured by the cross-product of the number of internet users in pair positively affect the FPI holdings. The diffusion of internet facilitates higher information transmission and lower information asymmetries. Moreover, it indirectly implies a stable and well-established technological platform of the country, facilitating smooth transactions between the countries. The two channels lead to an increase in the bilateral FPI holdings. Further, it again confirms that the conventional factors including language, bilateral distance and economic size are playing important roles in shaping the geography of foreign portfolio investment holdings.

Various other specifications are examined as well. A comparison between the two different ICT indices - one of the number of individuals using the Internet and the other of fixed-telephone subscriptions- is made to clearly grasp their differential effects on the bilateral FPI holdings. Moreover, the estimations of the two different time periods are separately conducted to compare the explanatory power of internet diffusion in analyzing the geography of cross-border portfolio investment. The coefficient of the cross-product of internet users of the pair countries is higher in earlier periods, due to the rapid propagation of internet in early 2000s. Further, the estimation of the effects across quantiles and Tobit estimation conclude that the information asymmetries or 'familiarity effect' has a more of significant influence when the volume of asset trades is low. It is shown that the information barrier/asymmetries may work as a huge deterrence when the volume of asset trading between countries is small or near zero. This very finding may shed light on the home-bias puzzle in international portfolio.

This study can spark further researches concentrating on the lower dynamics of financial asset trades, focusing on the decision making of one country in investing in the other country. Moreover, further implications about risk-sharing and welfare can be closely examined.

# Appendix

## 67 Source Countries *

| | | | |
|---|---|---|---|
| Argentina | France | Netherlands | Ukraine |
| Australia | Germany | New Zealand | United Kingdom |
| Austria | Greece | Norway | United States of America |
| Bahamas | Hungary | Pakistan | Uruguay |
| Bahrain | Iceland | Panama | Vanuatu |
| Barbados | India | Philippines | Venezuela |
| Belgium | Indonesia | Poland | China, Hong Kong |
| Bolivia | Ireland | Portugal | |
| Brazil | Israel | Republic of Korea | |
| Bulgaria | Italy | Romania | |
| Canada | Japan | Russian Federation | |
| Chile | Kazakhstan | Singapore | |
| Colombia | Kuwait | Slovakia | |
| Costa Rica | Latvia | Slovenia | |
| Cyprus | Lebanon | South Africa | |
| Czech Republic | Lithuania | Spain | |
| Denmark | Malaysia | Sweden | |
| Egypt | Malta | Switzerland | |
| Estonia | Mauritius | Thailand | |
| Finland | Mexico | Turkey | |

*Note: For FPI holdings by other financial organizations, data are available for 56 source countries on the list. The data for Bolivia, Canada, Malaysia, Malta, Mauritius, Philippines, Singapore, South Africa, Switzerland, USA and China, Hong Kong Special Administrative are not available.

## 173 Host Countries

| | | | | |
|---|---|---|---|---|
| Afghanistan | Burkina Faso | Egypt | Iraq | Mauritius |
| Albania | Burundi | El Salvador | Ireland | Mexico |
| Algeria | Cambodia | Eritrea | Israel | Micronesia |
| Andorra | Cameroon | Estonia | Italy | Morocco |
| Angola | Canada | Fiji | Jamaica | Mozambique |
| Antigua and Barbuda | Cape Verde | Finland | Japan | Nepal |
| Argentina | Central African Republic | France | Jordan | Netherlands |
| Armenia | Chad | Gabon | Kazakhstan | New Zealand |
| Australia | Chile | Gambia | Kenya | Nicaragua |
| Austria | China | Georgia | Kiribati | Niger |
| Azerbaijan | Colombia | Germany | Kuwait | Nigeria |
| Bahamas | Comoros | Ghana | Kyrgyzstan | Norway |
| Bahrain | Congo | Greece | Laos | Oman |
| Bangladesh | Costa Rica | Grenada | Latvia | Pakistan |
| Barbados | Côte d'Ivoire | Guatemala | Lebanon | Palau |
| Belarus | Croatia | Guinea | Liberia | Panama |
| Belgium | Cuba | Guinea-Bissau | Libyan Arab Jamahiriya | Papua New Guinea |
| Belize | Cyprus | Guyana | Lithuania | Paraguay |
| Benin | Czech Republic | Haiti | Madagascar | Peru |
| Bhutan | Congo | Honduras | Malawi | Philippines |
| Bolivia | Denmark | Hungary | Malaysia | Poland |
| Bosnia and Herzegovina | Djibouti | Iceland | Mali | Portugal |
| Brazil | Dominica | India | Malta | Qatar |
| Brunei Darussalam | Dominican Republic | Indonesia | Marshall Islands | Republic of Korea |
| Bulgaria | Ecuador | Iran | Mauritania | Republic of Moldova |

Romania
Russian Federation
Rwanda
Saint Kitts and Nevis
Saint Lucia
Saint Vincent and the Grenadines
Sao Tome and Principe
Saudi Arabia
Senegal
Seychelles
Sierra Leone
Singapore
Slovakia
Slovenia
Solomon Islands
South Africa
Spain
Sri Lanka
Sudan
Suriname
Sweden
Switzerland
Syrian Arab Republic
Tajikistan
Thailand
Republic of Macedonia
Togo
Tonga
Trinidad and Tobago
Tunisia
Turkey
Turkmenistan
Tuvalu
Uganda
Ukraine
United Arab Emirates
United Kingdom
United Republic of Tanzania
United States of America
Uruguay
Uzbekistan
Vanuatu
Venezuela
Viet Nam
Yemen
Zambia
Zimbabwe
China, Hong Kong

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국문 초록

# 국가 간 금융자산거래에 정보 접근성이 미치는 영향

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## 초록

국제 자본 이동량이 지속적으로 증가함에 따라 다수의 연구들이 국가간 투자 결정 요인에 대한 논의를 지속해왔다. 기존 문헌들은 자본이동과 거리가 음의 상관관계를 가지고 있으며, 이는 국가간 정보 비대칭이 자본이동에 영향을 미치기 때문이라고 주장하였다. 한편, 정보통신기술의 발달 및 확산과 같은 정보비대칭에 영향을 미치는 요인을 고려한 연구는 아직 제한적인 수준이다. 따라서, 본 연구는 정보통신기술의 발달 및 확산으로 인한 "정보 접근성" 의 증가, 즉 정보교류수단 활용법의 단순화 및 효율성의 제고가, 국가간 금융자산 거래에 어떠한 영향을 미쳤는지에 관하여 탐구하고자 한다. 국가간 금융자산거래에 정보 접근성이 미치는 영향을 알아보기 위하여 우선, 양 국가의 정보통신기술 지표의 곱을 두 국가 간의 정보 접근성의 프록시로 사용하였다. 이는, 양 국가의 정보통신기술이 발달할수록 국가간 정보장벽이 낮아지고 이에 따라 두 국가간의 정보교류가 늘어날 것이라는 가정 하에서 설정하였다. 분석을 위해 67개 투자국과 173개 투자대상국 간의 해외 간접 투자(FPI)와 정보 접근성의 관계를 중력모형(gravity model)을 사용하여 분석하였다. 본 연구를 통해, 거리, 언어더미변수, 경제규모 등 기존에 연구되었던 요인들을 비롯하여, 정보 접근성이 해외 간접 투자 패턴을 설명하는데 중요한 역할을 한다는 것을 알 수 있었다. 정보 접근성이 높아질수록 해외 간접 투자는 증가하였고, 이러한 한계효과는 양 국가의 투자량이 적을수록 증가함을 알 수 있었다. 이는, 정보장벽이 국가간 자본이동이 작을수록 더 큰 장애물임을 시사한다.

주요어: 정보통신기술, 그래비티 모형, 정보 비대칭, 해외 포트폴리오 투자

학 번: 2013-22859

경제학석사 학위논문

# The Geography of Cross Border Portfolio Investment and Information Accessibility : The relationship between ICT and FPI

국가간 금융자산거래에 정보 접근성이 미치는 영향

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경제학부 경제학 전공

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# The Geography of Cross Border Portfolio Investment and Information Accessibility : The relationship between ICT and FPI

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**Abstract**

On the backdrop of increasing international capital mobility, a large volume of research was devoted to dissecting the factors that facilitate the observed international investment patterns. While many studies focused on the role of distance to examine the significance of information frictions in financial asset trades, little work has considered various factors that may shape information asymmetries between countries, such as the diffusion of the information and communications technology (ICT).

The main purpose of this study is, therefore, to explore how the ease and efficiency of information transmission, namely the "information accessibility" facilitated by the diffusion of the ICT, may affect the cross-border financial asset trades between countries. The product of the ICT diffusion indices of two countries in a pair is used as a proxy for the degree of information accessibility between the two, i.e. a high value of the product implies lower information barrier and higher information transmission between the two countries. Under the gravity model specification, a panel dataset of 67 source countries and 173 host countries from 2001 to 2013 is used to grasp the relationship between the information accessibility and foreign portfolio investments (FPI). Major finding of this paper is that the information accessibility is playing a significant role in determining the geography of FPI alongside conventional factors such as language, bilateral distance and economic size. As it turns out, higher information accessibility positively influences FPI, while the magnitude of the effect may increase as the level of FPI holdings approach zero, indicating that information barrier is a stronger deterrence at the near-zero level of asset trades.

*Keywords:* ICT, Gravity Model, Information Asymmetries, Cross-border Asset Trades, FPI

*Student Number:* 2013-22859

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# 1. Introduction

To shed light on the so-called 'home bias puzzle'[1], numerous researches focus on the determinants of cross-border investments. Some authors try to find the answer in trading costs on the goods market (Obstfeld and Rogoff, 2001), while others hail information asymmetries and/or 'familiarity' effects[2] as the key determinant of the financial trades between countries. Especially in finance literature, information asymmetries and/or 'familiarity' effects on the portfolio investment holdings are closely studied by many researches, notably French and Poterba (1991), Coval and Moskowitz (1999), Tesar and Werner (1995) and Gordon and Bovenberg (1996). However, there is a still no unanimous conclusion as to which factor drives such international portfolio holdings.

In the effort to understand the lack of international diversification, many studies were devoted to dissecting the factors that may affect the international investment patterns. Notably, Portes and Rey (2005), under the gravity model specification, argue for the importance of information costs, captured by the bilateral distance between two countries, in shaping the geography of foreign portfolio holdings. While the key contributions of related researches do vary, many explicitly or implicitly admit the significant role of information costs in determining the cross-border financial asset trades. In almost all of the specifications examined, the negative sign of the coefficient of the bilateral distance, a proxy for information frictions between two countries, was consistently shown.

Whereas many researchers ground their work on the importance of information barrier, they seldom focus on the factors that shape the information asymmetries or costs

[1] French and Poterba (1991), Cooper and Kaplanis(1994), Tesar and Werner(1995), and Lewis(1999) are the early papers that formally document the home-bias puzzle, where the authors argue that the lack of international diversification is hardly explained by the explicit barrier and/or transaction costs.

[2] Two notable examples that explore familiarity effects are Heath and Tversky(1991) and Huberman(2000). Heath and Tversky(1991) ,after a series of experiments, conclude that people are willing to pay extra premium for their belief and prefer "betting on their judgments over an equi-probable chance event". Huberman (2000) defines "familiarity as information ranges from the investor actually possessing superior information, to the investor thinking that he currently has superior information, to the investor thinking that he will have superior information at some important point in the future". It is often hard to identify 'pure' information asymmetries from 'familiarity' effects.

between countries. Especially, the studies that focus on the role of time-invariant bilateral distance to analyze the effects of information frictions are certainly overlooking the fact that information barrier between two countries may change due to many possible factors. One notable factor in the 21st century is the digital divide- unequal access to, use of, or knowledge of information and communication technologies (ICTs). To some countries, the diffusion of ICT has increased the information accessibility- the ease and efficiency of information transmission- thereby lowering the information barrier between two countries; in contrast, other countries that lag behind this technological diffusion may face lower information accessibility, leading to higher information frictions between the countries. Observing the lacking consideration of the underlying causes that shape the information barrier, this paper tries to include that very factor into the analysis.

On this paper, one of the important driving forces of the alleviation of information barrier between countries is considered to be the ICT diffusion. Unanimously, the advent of internet is hailed as one of the most influential inventions and has sparked many other technological advancements, ranging from e-mail to smart phones. The diffusion of internet has led to an ease and efficiency of cross-border communication, lowering information barrier between countries. The increase in information accessibility facilitated by the ICT diffusion may enrich the picture of the role of information asymmetries in shaping the geography of cross-border portfolio investments. It is especially more of significance, when the key objective of the paper is to dissect the effect of information, which this paper is in line with.

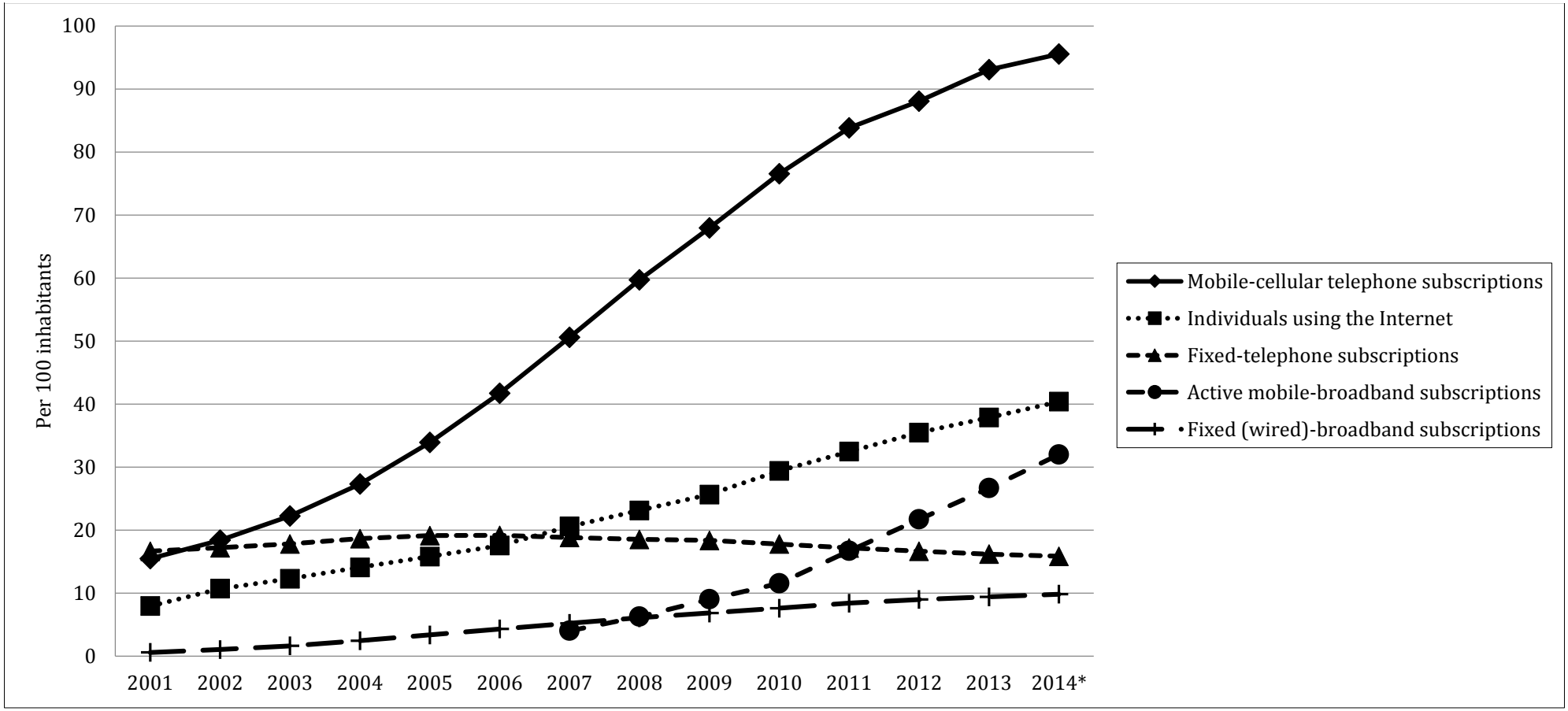
Figure 1 shows the global ICT diffusion indices from 2001 to 2014, including mobile-cellular telephone subscriptions, individuals using the Internet, fixed-telephone subscriptions, active mobile-broadband subscriptions and fixed (wired)-broadband subscriptions. As evident from the graph, the number of internet users globally has quadrupled. The major medium of communication in 21st century is mainly utilizing Internet, especially when considering the cross-border information transmission. In contrast, the fixed telephone subscriptions are almost constant over the time horizon examined and has been decreasing after mid-2000s. The two different ICT diffusion indices, therefore, may indicate the varying degree of the reduction in the information barrier, and they may also have different implications in terms of the overall level of ICT infrastructure

development. Therefore, while the paper focuses on the number of individuals using the Internet (per 100 inhabitants) to reflect the variant information accessibility across countries, it also compares the results of two different ICT indices.

The paper, therefore, empirically analyzes how ICT diffusion may influence foreign portfolio investment (FPI). In many countries, ICT diffusion has been rapid in 21st century and lowered the information barrier between countries significantly. To truly gauge the significance of information asymmetries and 'familiarity effects' as a determining factor of FPI patterns, ICT diffusion should be taken into consideration. Using the panel data of 67 source countries and 173 destination countries over a period between 2001 and 2013, this paper follows the gravity model specification, as in Portes and Rey (2005), to analyze the geography of cross-border portfolio investments. A comparison between the two different ICT indices - one of the number of individuals using the Internet and the other of fixed-telephone subscriptions- is made to clearly grasp their differential effects on the bilateral FPI holdings. Moreover, *FPI holdings by all sectors* and *FPI holdings by financial organizations* are separately analyzed to see if lowering information barrier has a contrasting influence on FPI as to who holds the securities. Furthermore, two different periods are separately examined to see how early and later phrases of the two ICT diffusion indices have heterogeneous effects on FPI. The contrasting effects of internet diffusion at different quantiles of FPI holdings are also examined.

The rest of the paper is organized as follows. Section 2 reviews the information asymmetries and 'familiarity effects' in the finance literature and moreover examines the relevant empirical studies using gravity model. Section 3 presents the baseline model, the data used for the analysis and the summary statistics. Section 4 then summarizes the estimates from the baseline model without ICT indices and with ICT indices separately using pooled OLS and 'between' estimators. The estimation results for FPI holdings by all sectors and FPI holdings by financial organizations are reported separately. The analyses were further taken to consider the differential effects across time and across quantiles of FPI holdings of country pairs. Section 5 presents the results of the robustness check, using source country fixed effects and Tobit estimation for the baseline model with the ICT index of the number of internet users per 100 inhabitants. Concluding remarks follow in Section 6.

**Figure 1** Global ICT Diffusion, 2001-2014




Note: * Estimate

Source: ITU World Telecommunication/ICT indicators database

# 2. Literature Review

## 2.1. Home Bias and Information Asymmetries

Under a close examination of the data, several papers point out the discrepancy between the portfolio theory and the observed allocation of investments, i.e. the so-called 'home-bias puzzle'. Lewis (1999) offers a thorough analysis of home-bias but abstains from arguing for one definite cause of the phenomenon. Tesar and Werner (1995) maintain that transaction costs cannot adequately explain the lack of international diversification. Moreover, Cooper and Kaplanis (1994) test theoretically whether inflation hedging and observable costs of international investments are possible explanations to the home-bias, and conclude that it is not probable. Tesar and Werner (1995) and Cooper and Kaplanis (1995) both argue that explicit barriers are unlikely to be the reason.

While no direct costs explain such observed pattern of international investments, information asymmetries and/or 'familiarity effect' are offered as one of the explanations of the home-bias puzzle. Theoretically, Gehrig (1993) and Gordon and Bovenberg (1996) derive the home-bias from the model with the asymmetric information between domestic and foreign investors. Empirically, French and Poterba (1991) find that investors are optimistic about the domestic returns, due to 'familiarity' effects, and Coval and Moskowitz (1999) and Tesar and Werner (1995) contend that the geographical proximity is playing an important role in determining the international investment holdings.

In fact, numerous researches in the finance literature find the presence of information asymmetries (where the market participants have unequal information availability) and/or familiarity effect. Coval and Moskowitz (2001) analyze the US mutual managers' investment patterns and find that the geographical distance of headquarters is an important factor in determining the investment holdings.[3] Grinblatt and Keloharju (2001) analyze the 97 publicly traded companies of Finland and find that investors have a

[3] On this paper, the authors find that fund managers, who make investments more in the geographically close firms, tend to yield higher returns, reflecting that they may indeed have some information advantage in investing locally.

strong inclination towards "the proximate and for same-language and same-culture firms". Similarly, with the German Security Exchange data of the equity trades of 756 traders located in 23 different cities, Hau (2001) finds that traders located outside Germany in non-German speaking cities underperform while the geographical proximity of traders to corporate headquarters shows a strong information advantage. Moreover, Huberman (2001) examines the shareholders of a Regional Bell Operating Company and finds that shareholders tend to live where the company is located and the employees hold their employers' stocks. A strong evidence of so-called 'familiarity' and information asymmetries is pronounced in various researches.

## 2.2. Gravity Specification in Cross-Border Asset Trades

The gravity model[4] has a long history in the analysis of trade flows between countries. For instance, Rose(2000) used the gravity model to examine the role of currency union in trade patterns. It is relatively recent for international finance literature to adopt the gravity model for the analysis of the international investment patterns. Martin and Rey(2004) theoretically show that the gravity model is applicable to the analysis of cross-border investments. A notable example of an earlier empirical work is Portes and Rey(2005), where the authors show that the gravity model works for international transactions in financial assets as well as for trade in goods and services.

Analyzing cross-border asset trades under the gravity specification, some of the papers focus on the complementarity of trade in goods and trade in assets (Rose and Spiegel, 2002; Shin and Yang, 2006; Aviat and Coeurdacier, 2007; Lane and Ferretti, 2008), the cultural factors in the cross-border investments (Aggarwal et al, 2012), and the regional integration in East Asia (Kim, Lee and Shin, 2005; Garcia-Herrero, Wooldridge, Yang, 2009). Others mainly focus on the significance of distance - a proxy of information costs- as a key determinant of cross-border investments. Portes and Rey (2005) examine the equity flows between countries and accentuate the role of information asymmetries as a key driver in the geography of equity flows. Hattari and Rajan (2008) study the cross-border foreign direct investment flows and accentuate the role of distance and time zones, while Hattari

[4] The gravity model was first used by Jan Tinbergen in 1962 to explain the bilateral trade flows by the economic sizes and the bilateral distance between the two units.

and Rajan (2011) examine the heterogeneous effects of distance to the ratio of FDI/FPI, M&A/FDI and M&A/FPI[5].

Examining a few researches on the pattern of FPI holdings which this study focuses on, Lane and Ferretti(2008) use the CPIS data[6] of 67 source countries in 2001 to examine the effects of trade and information proxy variables, such as distance, tax treaty, colony, currency union, common language and common legal origin, on the FPI. The main finding of this paper is a strong correlation between the portfolio equity investments and trade flows; moreover, information links such as distance and common language play significant roles in determining the international investment patterns. Similarly, Aviat and Coeurdacier (2007) accentuate the role of bilateral trade in alleviating the information asymmetries in the cross-border equity flows. In their analysis of equity flows, the authors show that when controlling for trade, the influence of distance is smaller; however, even after considering the complementarity of trade in goods and trade in assets, the effect of distance on the foreign equity flows still remain unanswered. On the other hand, focusing on the effects of the introduction of euro, Coeurdacier and Martin(2009) analyze cross-sectionally the factors that affect FPI of equity and bond holdings, and bank claims[7]. The implications of currency union are closely dissected and examined.

## 2.3. Information Costs and Asset Trades under Gravity Model

Among the papers examining the factors that affect the cross-border asset trades, not many papers have examined the role of information asymmetries as a determinant of cross-border investments. The lack of researches on this area may ascribe to the data limitation.

Portes and Rey (2005), based on the modelling of asset markets (Martin and Rey, 2003), analyze the cross-border equity flows of 14 countries in 1989-1996. The bilateral telephone call traffic, the degree of overlap in trading hours and multinational bank branches are used to reflect the information transmission between countries and an index of degree of insider trading is included to directly represent the information asymmetries

[5] FDI, M&A and FPI stand for foreign direct investment, merge and acquisition and foreign portfolio investment, respectively.
[6] Refer to the IMF website at http://www.imf.org/external/np/sta/pi/cpis.htm for details.
[7] Refer to BIS website at http://www.bis.org/statistics/histstats10.htm for details

between domestic and foreign investors. The paper estimates the coefficients of the information variables using the 'between' estimator to focus on the cross-sectional variations. The authors argue that the geography of information is of importance in explaining the cross-border equity flows.

Faruqee et al. (2004) use IMF international portfolio holdings survey data of 1997[8] to dissect the factors that affect the FPI and asserts that market size, transaction costs, and information asymmetries are major determinants of cross-border portfolio investments. The number of main phone lines in use per 1000 inhabitants and the per-minute international phone costs to call from one country to the other during business hours are used to analyze the effects of information asymmetries/costs on the FPI. The authors conclude that there is a strong evidence that the product of the number of phone lines of the two countries in pair has a positive and the per-minute international phone costs have a negative impact on the FPI holdings. Moreover, Loungani, Mody and Razin (2002) estimate the impact of information barrier to trade and FDI flows, employing the bilateral distance and the telephone traffic data. 12 source countries and 45 host countries of FDI flow data are used for the analysis. For possible endogeneity issue of using traffic data, telephone densities are used for instrument variable estimation.

Very few papers examine the effect of internet on the cross-border asset trades. Choi (2003) using bilateral FDI flow data in 1995 from 14 source countries and 53 host countries, estimates the impact of the Internet- the number of internet hosts and users of the hosting country as proxies – on the FDI flows. The author argues that the FDI flows between the two countries is positively related to the internet development in the host country due to the lower search costs and entry barrier, and higher productivity. The estimated results support the idea where the number of internet hosts in a host country increased by 10% and consequently FDI inflows increased by more than 2%.

Bae (2011) examines the effect of internet infrastructure on the FPI holdings. The fixed-line internet broadband subscriptions are used as a proxy for internet infrastructure, and the analysis is restricted to the sample of top ten reporting and destination countries of portfolio investment assets. The dynamics of the country pairs with high values of FPI

[8] The CPIS was first conducted for reference date end-December 1997.

holdings can be captured in the research, but it overlooks the fact that the alleviation of information costs facilitated by the diffusion of internet may concentrate on the pair of countries whose value of FPI is near zero. Moreover, the mobile broadband subscriptions have recently increased significantly; hence, internet broadband subscriptions cannot reflect such users and underestimate the actual number of internet users. This may distort the true picture of internet accessibility worldwide, and therefore on this paper, the number of internet users are instead employed.

Furthermore, both papers lack the consideration of the contrasting effects of the internet in its initial and later phase of the diffusion, and are in short of the comparison between the effects of different information and communication technologies on FPI. Hence, this paper analyzes the varying effects of ICT diffusion on FPI when considering different information communication technologies, the holders of securities, the time periods and the quantiles of FPI.

# 3. Empirical Framework and Data

## 3.1. Gravity Model and Empirical Specification

The gravity model has been widely used in trade literature due to its strong explanatory power in describing the geography of trade in goods. Since transportation costs- captured by the bilateral distance in the trade literature- were not involved in trading financial assets, there were few attempts to adopt the gravity model to grasp the pattern of cross-border asset trades before early 2000s. Portes and Rey (2005), however, found that the gravity model can work as well in explaining the trade in financial assets, arguing that distance represents the information frictions between the two countries. In subsequent papers, many authors adopt the gravity model and its extension to analyze the cross-border financial asset trades, ranging from equity to foreign direct investment. Hence, this paper adopts the gravity model framework to analyze how ICT diffusion affects the foreign portfolio asset holdings by lowering the information barrier between countries. The total foreign asset holdings are examined since the interest of this paper mainly lies not on the specific asset class but the trade in financial assets of all asset classes.

Under the gravity model framework, the following specifications were estimated:

(A) $$ln(Asset_{ijt}) = \beta_0 + \beta_1 ln(Distance_{ij}) + \beta_2 ln(Area_i * Area_j) + \beta_3 Language_{ij} + \beta_4 Border_{ij} + \beta_5 Common\ colonizer_{ij} + \beta_6 Same\ country_{ij} + \beta_7 ln(GDP_{it} * GDP_{jt}) + \beta_8 ln(GDPpca_{it} * GDPpca_{jt}) + \sum_{t=2}^{T} D_t + \varepsilon_{ijt}$$

(B) $$ln(Asset_{ijt}) = \beta_0 + \beta_1 ln(Distance_{ij}) + \beta_2 ln(ICT_{it} * ICT_{jt}) + \beta_3 ln(Area_i * Area_j) + \beta_4 Language_{ij} + \beta_5 Border_{ij} + \beta_6 Common\ colonizer_{ij} + \beta_7 Same\ country_{ij} + \beta_8 ln(GDP_{it} * GDP_{jt}) + \beta_9 ln(GDPpca_{it} * GDPpca_{jt}) + \sum_{t=2}^{T} D_t + \varepsilon_{ijt}$$

where i and j represent the source and destination country respectively and t denotes time.

$Asset_{ijt}$ represents the financial assets of country j held by country i at time t; in other words, it shows the real value of country i's FPI holdings in country j. The paper examines both the real value of FPI *holdings by all sectors* and *those by financial*

*organizations only.*[9] This is in order to see the differential effects of information and relationship variables as to who purchase the financial assets of country j. In order to include all the observations with zero value, it is taken logarithm after adding 1.

$ICT_{it}*ICT_{jt}$ is the cross-product of the information communication technology(ICT) diffusion indices of the countries in pair and it represents the ease and efficiency of information flows between countries facilitated by ICT diffusion. Since the major medium of communication in 21st century is mainly utilizing Internet, especially when considering the cross-border information transmissions, the number of individuals using the Internet (per 100 inhabitants) is used to reflect the changes in information barrier between countries. The reason that the index of the individuals using the Internet is preferred to that of fixed (wired) broadband subscriptions is as follows: one fixed-broadband subscription often has multiple users and an increasing number of people are using wireless internet networks with the development of mobile-broadband[10]. Due to the limited data availability of active mobile-broadband subscriptions, the paper focuses on the number of internet users[11]. The number of internet users per 100 inhabitants for some countries has a value of zero; therefore, it is taken logarithm after adding 1. The influences of two different ICT indices, one of the number of individuals using the Internet, the other of fixed-telephone subscriptions, on the FPI are compared to examine the full implications of ICT diffusion on FPI.

$Distance_{ij}$ is the bilateral distance between two countries, working as a proxy for the time-invariant dimension of information frictions. $Area$ is the land area of the country, $GDP$ is real GDP, and $GDPpca$ is real GDP per capita. A number of binary variables are included to capture the relationship between the two countries: $Language_{ij}$ is equal to one if two countries share a common language; $Border_{ij}$ is equal to one if two countries share the border; $Colony_{ij}$ is equal to one if two countries have/had the same

[9] The number of observations do differ since not all the participating countries of CPIS report the data by the sector of holder. It is an encouraged item for participating countries, but certainly not the core item. The complete list of countries are available in Appendix.

[10] According to the ITU data, mobile broad band subscriptions have recently increased both in developing and developed countries. In 2015, the estimated number of active mobile broadband subscriptions for the world population is 86.7 per 100 inhabitants.

[11] Internet users are persons using the Internet within one year from any device including mobile phones.

colonizer post-1945; $Same\ country_{ij}$ is equal to one if countries were/are the same country. Time dummies are included to control the year-specific effect.

The expected signs for the coefficients of variables in regression are shown in Table 1. They are based on previous researches, and especially, the negative sign for the distance variables is a consistent conclusion from numerous researches. Following the "gravity" specification, real GDP and real GDP per capita are included to represent the economic masses of the two countries, and believe that they would positively influence the FPI. The geographical, historical and language binary variables are included to control the effects of these variables, and it is expected that having a close relationship between the two countries, irrespective of the sources of the closeness, may create some 'familiarity' effects. The coefficient of the cross-product of ICT variables is expected to be positive, since a high level of ICT diffusion of two countries may lower information barrier greatly and thereby may have led to an increase in FPI between the two countries.

The sources of data will be explained in the subsequent section.

## 3.2. Data

With the purpose of analyzing the cross-border portfolio investments, the panel data of the Coordinated Portfolio Investment Survey (CPIS) released by the International Monetary Fund (IMF)[12] from 2001 to 2013 were used. The IMF started its first survey in 1997, and conducted it annually after 2001. Despite some shortcomings of the CPIS data such as incomplete country coverage and under-reporting of asset holdings (Lane and Milesi-Ferretti, 2008), the CPIS data still provide a unique and valuable opportunity to grasp the extensive picture of cross-country portfolio investment positions. The bilateral positions of 67 source countries were analyzed for the baseline model. The dataset has a panel structure, consisting of 67 source countries and 173 destination countries[13], with 89,335

[12] Refer to the IMF website at http://www.imf.org/external/np/sta/pi/cpis.htm for detail.

[13] 56 source countries report the total FPI holdings of other financial corporation since they are the none-core items. The same analyses were taken using the same sample countries, and the results are available upon request. The main idea does not change even when we consider the same sample countries.

observations[14] from 2001 to 2013 for the baseline model excluding ICT variables. The panel data are unbalanced, and the number of observations in each year varies. Moreover, due to the availability of data, different specifications result in changes in the number of observations. A complete list of countries under examination is provided in Appendix.

To estimate the gravity model specification, the data of the aforementioned variables are collected from various sources. For each country, GDP, GDP per capita and US GDP deflator data were collected from IMF's World Economic Overview, and World Bank for missing data. The unit of GDP and GDP per capita are in U.S. dollar. All nominal values are converted to real values using U.S GDP deflator for all countries.[15] ICT indices are collected from the United Nation's International Telecommunication Union (ITU) while bilateral distance and dummy variables including common language, border, same country and common colonizer are collected from CEPII[16] data, and area data are collected from CIA Factbook[17]. The sources of data are summarized in Table 2.

Summary statistics for dependent and independent variables are provided in Table 3.1 and Table 3.2. Table 3.1 shows the summary statistics for the baseline model of total FPI holdings excluding ICT variables: (1) held by all sectors and (2) held by other financial organizations. Table 3.2 shows the summary statistics for the model, including ICT variables, of total foreign portfolio asset holdings held by all sectors: (1) with the number of internet users per 100 inhabitants and (2) with the number of fixed telephone subscriptions per 100 inhabitants.

[14] Due to short-selling, few observed data of FPI have value less than zero, and it is believed that they share different characteristics than those of positive values, and many countries indeed have restrictions on the short-positions. Therefore, following Lane and Ferretti(2008), I excluded these observations from the sample, and it is less than 0.1% of the whole sample; therefore, it would not affect the estimation results of the paper.

[15] A separate deflator for each country may be better suited to the analysis, but due to data limitations, in this paper, U.S. GDP deflator is used.

[16] Please refer to http://www.cepii.fr/CEPII/en/. Language Dataset and GeoDist Dataset are used.

[17] Please refer to https://www.cia.gov/library/publications/the-world-factbook/

**Table 1** Expected Signs in Regression

| Variables | Expected Sign |
|---|---|
| $\ln(Distance_{ij})$ | − |
| $\ln(ICT_{it}{*}ICT_{jt})$ | + |
| $\ln(Area_i{*}Area_j)$ | − |
| $Language_{ij}$ | + |
| $Border_{ij}$ | + |
| $Common\ colonizer_{ij}$ | + |
| $Same\ country_{ij}$ | + |
| $\ln(GDP_{it} * GDP_{jt})$ | + |
| $\ln(GDPpca_{it} * GDPpca_{jt})$ | + |

**Table 2** Sources of Data

| Variables | Source of data |
|---|---|
| $\ln(Asset_{ijt})$ | IMF CPIS |
| $\ln(Distance_{ij})$ | Gravity Dataset, CEPII |
| $\ln(ICT_{it}{*}ICT_{jt})$ | UN ITU |
| $\ln(Area_i{*}Area_j)$ | CIA Factbook |
| $Language_{ij}$ | Language Dataset, CEPII |
| $Border_{ij}$ | Gravity Dataset, CEPII |
| $Common\ colonizer_{ij}$ | Gravity Dataset, CEPII |
| $Same\ country_{ij}$ | Gravity Dataset, CEPII |
| $\ln(GDP_{it} * GDP_{jt})$ | IMF WEO, World Bank |
| $\ln(GDPpca_{it} * GDPpca_{jt})$ | IMF WEO, World Bank |

**Table 3.1** Summary statistics for the baseline model (2001-2013)

| | (1) | | (2) | |
|---|---|---|---|---|
| | Mean | Std.Dev | Mean | Std.Dev |
| $\ln(Asset_{ijt})$ *held by all sectors* | 8.769 | 9.188 | | |
| $\ln(Asset_{ijt})$ *held by financial organizations* | | | 5.832 | 8.496 |
| $\ln(Distance_{ij})$ | 8.628 | 0.865 | 8.624 | 0.856 |
| $\ln(Area_i{*}Area_j)$ | 23.766 | 3.397 | 23.962 | 3.179 |
| $Language_{ij}$ | 0.114 | 0.318 | 0.086 | 0.280 |
| $Border_{ij}$ | 0.023 | 0.150 | 0.021 | 0.145 |
| $Common\ colonizer_{ij}$ | 0.040 | 0.196 | 0.039 | 0.193 |
| $Same\ country_{ij}$ | 0.007 | 0.085 | 0.006 | 0.077 |
| $\ln(GDP_{it} * GDP_{jt})$ | 50.601 | 2.956 | 50.396 | 2.954 |
| $\ln(GDPpca_{it} * GDPpca_{jt})$ | 18.220 | 1.861 | 17.986 | 1.935 |
| N | 89335 | | 66250 | |

**Table 3.2** Summary statistics for the baseline model with ICT variables[18] (2001-2013)

| | (1) Internet Users | | (2) Fixed-line Users | |
|---|---|---|---|---|
| | Mean | Std.Dev | Mean | Std.Dev |
| $\ln(Asset_{ijt})$ | 8.852 | 9.191 | 8.812 | 9.197 |
| $\ln(Distance_{ij})$ | 6.551 | 1.586 | 5.798 | 1.714 |
| $\ln(ICT_{it}{*}ICT_{jt})$ | 8.622 | 0.866 | 8.624 | 0.867 |
| $\ln(Area_i{*}Area_j)$ | 23.786 | 3.367 | 23.787 | 3.380 |
| $Language_{ij}$ | 0.113 | 0.317 | 0.114 | 0.318 |
| $Border_{ij}$ | 0.023 | 0.151 | 0.023 | 0.151 |
| $Common\ colonizer_{ij}$ | 0.040 | 0.195 | 0.040 | 0.197 |
| $Same\ country_{ij}$ | 0.007 | 0.086 | 0.007 | 0.086 |
| $\ln(GDP_{it} * GDP_{jt})$ | 50.648 | 2.924 | 50.641 | 2.937 |
| $\ln(GDPpca_{it} * GDPpca_{jt})$ | 18.227 | 1.860 | 18.240 | 1.855 |
| N | 87681 | | 88308 | |

[18] The above are the summary statistics for the specification- including ICT variables - of FPI holdings by all sectors. The summary statistics for the specification, including ICT variables, but with FPI holdings by other financial sectors are available upon request.

# 4. Results

All equations include a constant term and time dummies to control the aggregate shocks, whose estimates are not reported. All variables except dummy variables are in logarithm; therefore, the corresponding coefficients are elasticities. All variables are bilateral where i and j represent the source and destination country respectively and t denotes time. The dependent variable- $Asset_{ijt}$ -represents the country i's real portfolio investment in country j. In order to include all the observations with zero value, it is taken logarithm after adding 1[19]. The number of internet users per 100 inhabitants for few countries has a value of zero; therefore, it is taken logarithm after adding one. The estimates of standard errors are heteroscedasticity-consistent, which are shown in parentheses below the coefficient estimates.

The estimation methods of the equation (A) and equation (B) in Section 3 consist of pooled OLS estimation and 'between' effects estimation. On this paper, the country-pair fixed effects are not applicable, since most of the variables of interest is time-invariant, and hence cannot be estimated when introducing country-pair fixed effects. More importantly, the paper's main focus is cross-sectional, and hence a 'between' estimator on the time-series means for the country pairs will be better suited to this paper's objective. Random effects panel estimation is not theoretically plausible for the data under examination, which are not drawn randomly from a larger population (Portes and Rey, 2005; Baltagi, 1995) Therefore, most of the analyses were pooling the time-series and cross-section data or using the 'between' estimator.

## 4.1. Baseline Model and Estimates

Equation (A) at Section 3 is estimated and summarized in Table 4.1 and Table 4.2

Table 4.1 and Table 4.2 represent the estimated results of the standard gravity model, using pooled OLS and 'between' effects estimation. Table 4.1 consists of the estimation results whose dependent variable is the real value of FPI holdings by *all sectors*,

[19] More than one third of the observations have a value of zero.

while Table 4.2 shows the estimation results when using portfolio holdings by *financial organizations only.* The first column in both of the tables represent the pooled OLS estimation results, while the second column show the 'between' effects estimation.

Looking closely at Table 4.1, all the estimated coefficients are significant at 0.1% and have the expected sign. Both columns, one from pooled OLS estimation and the other from between estimator show similar estimation results. The bilateral distance has a strong negative effect on the real FPI, supporting the idea that the distance has a negative correlation with the information frictions/costs. The economic sizes of both countries (represented by the cross-product of two countries' real GDP and real GDP per capita) are having strong positive effect on the real FPI. These results confirm the founding notions of gravity model. Moreover, the geographical, political variables and especially language binary variable also have the significant effect on FPI, accentuating the significant role of 'closeness' and/or "familiarity" between the countries in determining cross-border portfolio investment patterns. A negative impact of the cross-product of physical areas on the cross-border portfolio investments can be resulted from higher information costs between countries when their physical sizes are large.

Table 4.2 as aforementioned shows the estimation results whose dependent variable is the real value of FPI holdings by *financial organizations only.* The signs of the estimated coefficients are equivalent to the predicted ones except that for border and common colonizer. The border effect has become insignificant, and common colonizer has an ambiguous effect, negative in the pooled OLS estimation and insignificant in the between effects estimation. These may result from the fact that the financial organizations are less affected by the geographical and historical relationship when deciding where to invest i.e. "familiarity" effects play a less of a significant role when it comes to the pattern of financial organizations' foreign portfolio asset holdings. The analysis is further supported by the changes in the estimated coefficient of bilateral distance from -1.7 to -1.2 in the pooled OLS estimation. Other variables have shown similar estimates both in direction and in magnitude as those in Table 4.1, where the dependent variable is the real value of FPI holdings by all sectors.

**Table 4.1** Baseline Model: FPI Holdings by All Sectors

| | Pooled OLS | Between Effect |
|---|---|---|
| Bilateral distance | -1.699*** | -1.392*** |
| | [0.027] | [0.068] |
| Area in pair | -0.393*** | -0.415*** |
| | [0.011] | [0.026] |
| Common language | 2.961*** | 2.827*** |
| | [0.072] | [0.175] |
| Border | 0.817*** | 1.441*** |
| | [0.145] | [0.397] |
| Common colonizer | 1.969*** | 1.478*** |
| | [0.124] | [0.224 ] |
| Same Country | 1.337*** | 1.981** |
| | [0.230] | [0.555 ] |
| GDP in pair | 1.683*** | 1.436*** |
| | [0.013] | [0.031] |
| GDP per capita in pair | 1.356*** | 1.067*** |
| | [0.018] | [0.040] |
| Number of observations | 89335 | 89335 |
| R-squared | 0.53 | 0.59 |

All our estimates include time dummies and a constant, whose estimates are not reported. Robust standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

**Table 4.2** Baseline Model: FPI Holdings by Financial Organizations

| | Pooled OLS | Between Effect |
|---|---|---|
| Bilateral distance | -1.184*** | -1.240*** |
| | [0.033] | [0.078] |
| Area in pair | -0.271*** | -0.157*** |
| | [0.013] | [0.032] |
| Common language | 2.054*** | 2.075*** |
| | [0.095] | [0.207] |
| Border | 0.325 | 0.440 |
| | [0.219] | [0.496] |
| Common colonizer | -0.505*** | 0.233 |
| | [0.133] | [0.252] |
| Same Country | 2.382*** | 2.140** |
| | [0.341] | [0.674] |
| GDP in pair | 1.395*** | 1.096*** |
| | [0.016] | [0.038] |
| GDP per capita in pair | 1.254*** | 1.295*** |
| | [0.020] | [0.046] |
| Number of observations | 66250 | 66250 |
| R-squared | 0.47 | 0.52 |

All our estimates include time dummies and a constant, whose estimates are not reported. Robust standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

## 4.2. Baseline Model with ICT variables and Estimates

Equation (B) at Section 3 is estimated and summarized in Table 4.3 and Table 4.4. Table 4.3 consists of the estimation results whose dependent variable is the real value of FPI holdings by all sectors, while Table 4.4 shows the estimation results when using portfolio holdings by financial organizations only. Each of Table 4.3 and Table 4.4 summarizes the findings of pooled OLS estimation (Column 1 and 2) and between effects estimation (Column 3 and 4). The specifications include the ICT diffusion indices: the number of internet users per 100 inhabitants and the number of fixed telephone subscriptions per 100 inhabitants. It allows the comparison of how each medium of communication may have affected the FPI in 2001-13, and how these effects may differ depending on which sector holds the securities of the hosting country.

The diffusion of ICT affects the FPI through two channels. First, ICT diffusion directly helps lowering the information barrier between countries greatly and hence facilitates a greater efficiency and ease of communication between countries. A higher information transmission reduces information asymmetries and enhances "familiarity" between the countries, thereby increasing the bilateral FPI holdings. Secondly, ICT diffusion may also be a signal about the country's overall level of ICT infrastructure. When the overall ICT infrastructure is well-established and developed to facilitate financial transactions between countries, this may in turn lead to an increase in the level of bilateral FPI holdings.[20]

The diffusion of internet represented by the number of internet users per 100 inhabitants facilitates higher information transmission and lower information asymmetries. Moreover it indirectly implies a stable and well-established technological platform of the country, facilitating smooth transactions between countries. Table 4.3 shows how ICT diffusion affected the FPI holdings by all sectors. The estimated coefficient of the cross-product of internet users per 100 inhabitants is 0.549 for pooled OLS

[20] The paper focuses on the direct channel of lowering information barrier by the diffusion of ICT. However, it is important to acknowledge that ICT diffusion may also be a signal of the country's overall level of ICT infrastructure, for analysis in this Section 4.2. The subsequent analyses in other sections, however, will focus on the direct information effect, while acknowledging another channel of influence.

estimation and 0.396 for between effects estimation. It is the consequence of the both of the aforementioned effects.

The diffusion of fixed telephone, however, may have different implications. Closely examining Figure 1 in Section 1, the number of fixed-line telephone subscriptions are decreasing in trend and less people are using fixed-line telephone as a means of communication due to the development of Internet. The diffusion of fixed-line telephone therefore may imply a lesser degree of reduction in the information barrier. Moreover, an increase in the number of fixed-line telephone users may indicate that the country's ICT development is lagging behind those of other countries that may have no room for further increase in the number of fixed telephone subscriptions because the market is simply saturated and the consumers demand other communication devices as a substitute for fixed-line telephone. The increase in the number of fixed-telephone users, therefore, may represent the ICT 'under-development'[21], which hence signals that the country's overall ICT infrastructure is not well-established, disrupting smooth transactions between countries, and the very effect can have a negative impact on the bilateral FPI holdings.

Hence, while increasing access to internet has a positive influence on the FPI, the ICT diffusion captured by fixed-telephone users showed a stark contrast. The estimated coefficient of the cross-product of fixed-telephone users per 100 inhabitants is 0.154 for pooled OLS estimation and -0.144 for between effects estimation (Table 4.3). The estimated coefficient of the cross-product of the number of fixed-line telephone users is much smaller than that of the number of internet users and negative in the 'between' effects estimation. It is a result of the mixture of aforementioned channels: a positive albeit small influence through slight reduction, if any, in information barrier and a negative impact through signaling a low level of overall ICT infrastructure.

The estimated coefficients of all other variables from the baseline model are similar to the ones from Table 4.1. All the estimated coefficients are significant at 1%, and the signs of the coefficients are the same from those of predicted ones. The bilateral distance has a strong negative effect on the real FPI, while the economic sizes of both countries are having a strong positive effect. Moreover, the geographical, political and

[21] The 'under-development' here represents the relatively slow development of ICT sector in the country compared to the global standard.

especially language binary variable also have significant effects on the FPI holdings.

**Table 4.3** FPI Holdings by All Sectors with ICT Variables

| | (1)Pooled OLS | (2)Pooled OLS | (3)Between Effects | (4)Between Effects |
|---|---|---|---|---|
| Bilateral distance | -1.720*** | -1.736*** | -1.401*** | -1.414*** |
| | [0.027] | [0.027] | [0.068] | [0.067] |
| Internet users per 100 inhabitants in pair | 0.549*** | | 0.396*** | |
| | [0.034] | | [0.082] | |
| Fixed-telephone users per 100 inhabitants in pair | | 0.154*** | | -0.144** |
| | | [0.022] | | [0.048] |
| Area in pair | -0.379*** | -0.370*** | -0.387*** | -0.415*** |
| | [0.011] | [0.011] | [0.027] | [0.026] |
| Common language | 3.039*** | 2.958*** | 2.904*** | 2.779*** |
| | [0.073] | [0.072] | [0.178] | [0.176] |
| Border | 0.695*** | 0.646*** | 1.323*** | 1.463*** |
| | [0.144] | [0.145] | [0.400] | [0.400] |
| Common colonizer | 1.991*** | 2.185*** | 1.433*** | 1.562*** |
| | [0.125] | [0.124] | [0.228] | [0.226] |
| Same Country | 1.126*** | 1.352*** | 1.902** | 2.031** |
| | [0.230] | [0.230] | [0.557] | [0.559] |
| GDP in pair | 1.670*** | 1.700*** | 1.431*** | 1.455*** |
| | [0.013] | [0.013] | [0.031] | [0.031] |
| GDP per capita in pair | 1.028*** | 1.247*** | 0.844*** | 1.184*** |
| | [0.028] | [0.025] | [0.064] | [0.054] |
| Number of observations | 87681 | 88308 | 87681 | 88308 |
| R-squared | 0.54 | 0.54 | 0.59 | 0.60 |

All our estimates include time dummies and a constant, whose estimates are not reported. Robust standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

Table 4.4 shows how ICT diffusion affects the FPI holdings by financial organizations. ICT diffusion captured by the cross-product of internet users has slightly less of a significant role in influencing the FPI. The coefficients estimated are 0.182 for pooled OLS and 0.204 for 'between' estimation, lower than those of the previous analysis of FPI holdings by all sectors. It was indeed expected since the investors under examination are from the financial organization, and therefore, increasing 'familiarity' between countries due to a higher level of information transmission facilitated by the ICT diffusion will be of less significance to the intuitional investors' investment decisions. The significant and positive effect of the internet diffusion on the FPI holdings are likely to be the result of its positive signaling about the well-established ICT infrastructure.

Moreover, an increase in the number of fixed-telephone users may imply- as aforementioned- the country's ICT is 'under-development'. The increase in the number of fixed-telephone users in turn implies that the country's ICT development is lagging behind other countries. In both estimations- pooled OLS and between effects, the estimated coefficients of the cross-product of the number of fixed-telephone users in pair are negative. The coefficients estimated are negative and larger (in absolute value) compared to the ones from Table 4.2 where the analysis focuses on the FPI holdings by all sectors. The positive information effect (albeit small in the first place) becomes negligible[22] and hence, the negative signaling about the countries' ICT infrastructure may prevail, leading to a negative effect on the FPI holdings.

Same as the results of the baseline model in Table 4.2, the signs of other estimated coefficients are equivalent to the predicted ones except that for border and common colonizer. The border effect has become insignificant, and common colonizer has an ambiguous effect, negative in the pooled OLS estimation and insignificant in the between effects estimation. These may support the idea that 'familiarity' effect plays a less significant role when it comes to the pattern of financial organizations' foreign portfolio asset holdings. The estimated coefficient of bilateral distance is from -1.7 to -1.2 in the pooled OLS estimation.

[22] Increasing 'familiarity' between countries due to a higher level of information transmission facilitated by the ICT diffusion will be of less significance to the intuitional investors' investment decisions.

**Table 4.4** FPI Holdings by Financial Organizations with ICT variables

| | (1)Pooled OLS | (2)Pooled OLS | (3)Between Effects | (4)Between Effects |
|---|---|---|---|---|
| Bilateral distance | -1.202*** | -1.230*** | -1.242*** | -1.288*** |
| | [0.033] | [0.033] | [0.078] | [0.077] |
| Internet users per 100 inhabitants in pair | 0.182*** | | 0.204* | |
| | [0.037] | | [0.091] | |
| Fixed-telephone users per 100 inhabitants in pair | | -0.381*** | | -0.511*** |
| | | [0.022] | | [0.048] |
| Area in pair | -0.263*** | -0.282*** | -0.145*** | -0.196*** |
| | [0.014] | [0.014] | [0.033] | [0.032] |
| Common language | 2.126*** | 2.023*** | 2.160*** | 1.965*** |
| | [0.097] | [0.095] | [0.211] | [0.206] |
| Border | 0.300 | 0.388 | 0.333 | 0.612 |
| | [0.221] | [0.218] | [0.500] | [0.487] |
| Common colonizer | -0.570*** | -0.465*** | 0.078 | 0.152 |
| | [0.136] | [0.133] | [0.253] | [0.250] |
| Same Country | 2.255*** | 2.438*** | 2.016** | 2.129** |
| | [0.342] | [0.341] | [0.674] | [0.666] |
| GDP in pair | 1.392*** | 1.429*** | 1.090*** | 1.136*** |
| | [0.017] | [0.016] | [0.038] | [0.038] |
| GDP per capita in pair | 1.158*** | 1.535*** | 1.177*** | 1.672*** |
| | [0.030] | [0.027] | [0.070] | [0.059] |
| Number of observations | 64770 | 65500 | 64770 | 65500 |
| R-squared | 0.48 | 0.48 | 0.52 | 0.53 |

All our estimates include time dummies and a constant, whose estimates are not reported. Robust standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

# 5. Heterogeneous Effects across Time and Quantile

Equation (B) at Section 3 is estimated across the two groups of time periods, one from 2001 to 2005 and the other from 2010 to 2013 and the results are summarized in Table 5.1[23]. The real portfolio investment holdings by all sectors are used. The financial crisis period between 2007 and 2009, and one year before and after the crisis i.e. samples from 2006 to 2009 are excluded to minimize the bias arising from the global financial crisis. Comparing the two-year groups, the study tries to capture the differential effects of ICT diffusion across years.

First of all, the explanatory power of internet diffusion in analyzing the geography of cross-border portfolio investment is strikingly higher in early 2000s. The coefficient of the cross-product of internet users of the pair countries is greater than one (1.311) but becomes insignificant recently. The result may rely on the fact that in early 2000s the information barrier was greatly reduced due to the rapid propagation of internet in early 2000s; however, since diffusion has already undergone for around a decade, the recent additional 1% increase in internet users does not lead to a significant reduction in information barrier and hence is an insignificant impact on the cross-border portfolio investments.

Secondly, the effect of the fixed telephone subscriptions on the cross-border portfolio investment was positive in early 2000s when the main source of communication was still relying on telephone calls. In spite of a smaller degree of influence compared to that of internet development, the estimated coefficient is positive and of 0.382. This means that 1% increase in the cross-product of the number of fixed telephone subscriptions per 100 inhabitants leads to around 0.38% increase in FPI. The influence has become negative recently and the estimated coefficient is -0.12. The estimated negative coefficient can be explained as aforementioned: an increase in the number of fixed telephone subscriptions may in turn imply that the country's ICT development is lagging behind other countries i.e the increase in the number of fixed-telephone users does not represent ICT development but ICT 'under-development', which may l signal that the country's overall ICT

[23] The results of the between estimation of the analysis are not reported but the findings are not much different from that of pooled OLS estimation. The results are available upon request.

infrastructure is not well-established. Moreover, since less people are using fixed-line telephone as a means of communication and therefore, the diffusion of fixed-line telephone therefore may imply a lesser degree of reduction in the information barrier.

Lastly, the distance effect has become greater recently. The border effect and the "same-country" effect have become insignificant. Even though this study excludes observations from 2006 to 2009 to control the financial crisis effect, the general antipathy towards financial market integration may have led to a greater distance effect and insignificant border and "same country" effect.

Table 5.2 summarizes the results of quantile regression. Quantile regression models represent the relationship between a set of explanatory variables and specific quantiles of the dependent variable. The estimated parameter of the x variable indicates the change in a specified quantile of the dependent variable caused by one percent change in the x variable. Since more than one third of the observations of real portfolio investment holdings have zero value, the estimation focuses on the median and upper quantiles.

The estimated coefficient of the bilateral distance between countries at the median is -1.67 and falls to -0.93 at the $90^{th}$ quantile. The decreasing coefficient with the quantile of real portfolio investment holdings is a clear pattern. This indicates that the bilateral distance has a more of significant influence when the volume of asset trades is low. It is again confirmed by the decreasing coefficient of the cross product of internet users in pair as the quantile increases. The estimated coefficient 0.899 at the median but falls to -0.085 at the $90^{th}$ quantile. The results imply that the information barrier/asymmetries may work as a stronger deterrence when the volume of asset trading between countries is small or near zero.

**Table 5.1** Pooled OLS Estimation: Separate Estimation of Two Time Periods

| | (1)2001-05 | (2)2001-05 | (3)2010-13 | (4)2010-2013 |
|---|---|---|---|---|
| Bilateral distance | -1.694*** | -1.547*** | -1.967*** | -2.039*** |
| | [0.045] | [0.045] | [0.045] | [0.045] |
| Internet users per 100 inhabitants in pair | 1.311*** | | 0.044 | |
| | [0.053] | | [0.068] | |
| Fixed telephone subscriptions per 100 inhabitants in pair | | 0.382*** | | -0.120** |
| | | [0.034] | | [0.039] |
| Area in pair | -0.157*** | -0.164*** | -0.518*** | -0.517*** |
| | [0.018] | [0.018] | [0.018] | [0.018] |
| Common language | 2.642*** | 2.575*** | 3.523*** | 3.428*** |
| | [0.115] | [0.112] | [0.132] | [0.132] |
| Border | 0.711** | 0.864*** | 0.305 | 0.199 |
| | [0.260] | [0.260] | [0.244] | [0.244] |
| Common colonizer | 1.635*** | 1.728*** | 1.324*** | 1.530*** |
| | [0.200] | [0.196] | [0.216] | [0.215] |
| Same Country | 1.301** | 1.812*** | 0.556 | 0.621 |
| | [0.426] | [0.420] | [0.383] | [0.387] |
| GDP in pair | 1.468*** | 1.501*** | 1.752*** | 1.805*** |
| | [0.022] | [0.021] | [0.022] | [0.022] |
| GDP per capita in pair | 0.481*** | 1.113*** | 1.453*** | 1.524*** |
| | [0.046] | [0.039] | [0.048] | [0.043] |
| Number of observations | 31773 | 32475 | 29018 | 28916 |
| R-squared | 0.54 | 0.54 | 0.54 | 0.55 |

All our estimates include time dummies and a constant, whose estimates are not reported. Robust standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

**Table 5.2** Quantile Regression

| Quantile | (1)50th | (2)70th | (3)80th | (4)90th |
|---|---|---|---|---|
| Bilateral distance | -1.668*** | -1.290*** | -1.165*** | -0.932*** |
| | [0.025] | [0.024] | [0.026] | [0.020] |
| Internet users per 100 inhabitants in pair | 0.899*** | 0.825*** | 0.593*** | -0.085* |
| | [0.051] | [0.059] | [0.053] | [0.040] |
| Area in pair | -0.316*** | -0.293*** | -0.288*** | -0.234*** |
| | [0.012] | [0.010] | [0.009] | [0.007] |
| Common language | 2.974*** | 3.339*** | 3.412*** | 2.777*** |
| | [0.116] | [0.099] | [0.080] | [0.059] |
| Border | -0.411** | 0.123 | 0.282* | 0.430* |
| | [0.133] | [0.139] | [0.127] | [0.174] |
| Common colonizer | 2.187*** | 2.894*** | 3.005*** | 2.065*** |
| | [0.197] | [0.135] | [0.088] | [0.089] |
| Same Country | 1.709*** | 1.048*** | 0.806*** | 0.220 |
| | [0.183] | [0.138] | [0.192] | [0.191] |
| GDP in pair | 1.783*** | 1.645*** | 1.545*** | 1.186*** |
| | [0.018] | [0.014] | [0.013] | [0.011] |
| GDP per capita in pair | 1.142*** | 1.040*** | 1.066*** | 1.077*** |
| | [0.030] | [0.034] | [0.030] | [0.024] |
| Number of observations | 87681 | 87681 | 87681 | 87681 |

All our estimates include time dummies and a constant, whose estimates are not reported. Robust standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

# 6. **Robustness Check**

For robustness check, two approaches are used.[24]

First of all, the source country fixed effects model was used, where the dummy variables of the source countries are included. The results are summarized in Table 6.1. The results are almost identical with the ones obtained in Table 4.3 which uses the pooled OLS estimation and between effects estimation. All the estimated coefficients are significant at 0.1% and have the expected sign. The bilateral distance has a strong negative effect on the real FPI, and the ICT diffusion index represented by the number of internet users has a strong positive effect, supporting the idea that the advent of internet has lowered information barrier to a great extent. The geographical and political variables and especially language binary variable also have the significant effect on FPI, accentuating the significant role of 'closeness' and/or 'familiarity' between countries in determining cross-border portfolio investment patterns.

Secondly, Tobit estimation[25] is conducted for robustness check. There is more than one third of the observations of zero value, and hence Tobit regression[26] is conducted and the results are reported in Table 6.2 and Table 6.3. Looking at Table 6.2, the signs of estimated coefficients are consistent, while the estimated coefficients are larger in many cases, since they represent the partial effect of the 'latent' variable that governs the real value of FPI holdings. In Table 6.3, the first column represents the marginal effect on the unconditional expected value and the second column represents the marginal effect on the expected value conditional on FPI being greater than zero. Consistent with the results of quantile regression, the marginal effect of distance and internet diffusion on conditional expectation is smaller. The results again support the idea that the information

[24] The equation (B) at Section 3 is estimated and the dependent variable is the real value of FPI holdings by *all sectors*. The regression results of source country fixed effects and tobit estimation for the specification of the FPI holdings by *financial organizations* are available upon request.

[25] The Tobit model is applicable when y is an observable choice or outcome with the following characteristics: y takes on the value 0 with positive probability but is a continuous random variable over strictly positive values. It is a corner solution model and as Wooldridge (2002, 517-520) points out, the problem may arise when using OLS in this setting.

[26] Lane and Ferretti (2008) report the Tobit estimation results and argue that such censoring is possible due to the equity shorting restrictions in many countries.

barrier/asymmetries work as stronger deterrence when the volume of asset trading between countries is small or near zero.

**Table 6.12** Robustness Check: Source Country Fixed Effects Estimation

| | Source Country Fixed Effect |
|---|---|
| Bilateral distance | -1.564*** |
| | [0.027] |
| Internet users per 100 inhabitants in pair | 0.584*** |
| | [0.037] |
| Area in pair | -0.254*** |
| | [0.014] |
| Common language | 2.425*** |
| | [0.072] |
| Border | 1.217*** |
| | [0.135] |
| Common colonizer | 0.439*** |
| | [0.118] |
| Same Country | 1.187*** |
| | [0.210] |
| GDP in pair | 1.895*** |
| | [0.017] |
| GDP per capita in pair | 0.800*** |
| | [0.031] |
| Number of observations | 87681 |
| R-squared | 0.60 |

All our estimates include time dummies and a constant, whose estimates are not reported. Robust standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

**Table 6.2** Robustness Check: Tobit Regression

| | Tobit |
|---|---|
| Bilateral distance | -2.743*** |
| | [0.046] |
| Internet users per 100 inhabitants in pair | 1.599*** |
| | [0.071] |
| Area in pair | -0.661*** |
| | [0.019] |
| Common language | 5.755*** |
| | [0.126] |
| Border | -0.389 |
| | [0.249] |
| Common colonizer | 4.283*** |
| | [0.238] |
| Same Country | 2.341*** |
| | [0.368] |
| GDP in pair | 2.938*** |
| | [0.025] |
| GDP per capita in pair | 1.494*** |
| | [0.054] |
| Number of observations | 87681 |

All our estimates include time dummies and a constant, whose estimates are not reported. The standard errors of the estimated coefficients are reported in parentheses. To include the observations with zero value of real portfolio investment holdings and the number of internet users per 100 inhabitants, it is taken logarithm after adding one. ***, ** and * indicate that the estimated coefficients are statistically significant at 0.1%, 1%, and 5% respectively.

**Table 6.3** Robustness Check: Marginal Effects of Tobit Estimation

| Marginal Effects at Observed Censoring Rate | | |
|---|---|---|
| Variable | Unconditional Expected Value | Conditional on Being Uncensored |
| Bilateral distance | -1.378 | -1.000 |
| Internet users per 100 inhabitants in pair | 0.803 | 0.583 |
| Area in pair | -0.332 | -0.241 |
| Common language | 2.890 | 2.098 |
| Border | -0.195 | -0.142 |
| Common colonizer | 2.151 | 1.561 |
| Same Country | 1.176 | 0.854 |
| GDP in pair | 1.475 | 1.071 |
| GDP per capita in pair | 0.750 | 0.545 |

# 7. Conclusion

Under the gravity model specification, this paper explores the relationship between ICT diffusion and FPI holdings. A panel dataset of 67 source countries and 173 host countries is used for the analysis. Major finding of this paper is that the ICT diffusion captured by the cross-product of the number of internet users in pair positively affect the FPI holdings. The diffusion of internet facilitates higher information transmission and lower information asymmetries. Moreover, it indirectly implies a stable and well-established technological platform of the country, facilitating smooth transactions between the countries. The two channels lead to an increase in the bilateral FPI holdings. Further, it again confirms that the conventional factors including language, bilateral distance and economic size are playing important roles in shaping the geography of foreign portfolio investment holdings.

Various other specifications are examined as well. A comparison between the two different ICT indices - one of the number of individuals using the Internet and the other of fixed-telephone subscriptions- is made to clearly grasp their differential effects on the bilateral FPI holdings. Moreover, the estimations of the two different time periods are separately conducted to compare the explanatory power of internet diffusion in analyzing the geography of cross-border portfolio investment. The coefficient of the cross-product of internet users of the pair countries is higher in earlier periods, due to the rapid propagation of internet in early 2000s. Further, the estimation of the effects across quantiles and Tobit estimation conclude that the information asymmetries or 'familiarity effect' has a more of significant influence when the volume of asset trades is low. It is shown that the information barrier/asymmetries may work as a huge deterrence when the volume of asset trading between countries is small or near zero. This very finding may shed light on the home-bias puzzle in international portfolio.

This study can spark further researches concentrating on the lower dynamics of financial asset trades, focusing on the decision making of one country in investing in the other country. Moreover, further implications about risk-sharing and welfare can be closely examined.

# Appendix

## 67 Source Countries *

| | | | |
|---|---|---|---|
| Argentina | France | Netherlands | Ukraine |
| Australia | Germany | New Zealand | United Kingdom |
| Austria | Greece | Norway | United States of America |
| Bahamas | Hungary | Pakistan | Uruguay |
| Bahrain | Iceland | Panama | Vanuatu |
| Barbados | India | Philippines | Venezuela |
| Belgium | Indonesia | Poland | China, Hong Kong |
| Bolivia | Ireland | Portugal | |
| Brazil | Israel | Republic of Korea | |
| Bulgaria | Italy | Romania | |
| Canada | Japan | Russian Federation | |
| Chile | Kazakhstan | Singapore | |
| Colombia | Kuwait | Slovakia | |
| Costa Rica | Latvia | Slovenia | |
| Cyprus | Lebanon | South Africa | |
| Czech Republic | Lithuania | Spain | |
| Denmark | Malaysia | Sweden | |
| Egypt | Malta | Switzerland | |
| Estonia | Mauritius | Thailand | |
| Finland | Mexico | Turkey | |

*Note: For FPI holdings by other financial organizations, data are available for 56 source countries on the list. The data for Bolivia, Canada, Malaysia, Malta, Mauritius, Philippines, Singapore, South Africa, Switzerland, USA and China, Hong Kong Special Administrative are not available.

## 173 Host Countries

| | | | | |
|---|---|---|---|---|
| Afghanistan | Burkina Faso | Egypt | Iraq | Mauritius |
| Albania | Burundi | El Salvador | Ireland | Mexico |
| Algeria | Cambodia | Eritrea | Israel | Micronesia |
| Andorra | Cameroon | Estonia | Italy | Morocco |
| Angola | Canada | Fiji | Jamaica | Mozambique |
| Antigua and Barbuda | Cape Verde | Finland | Japan | Nepal |
| Argentina | Central African Republic | France | Jordan | Netherlands |
| Armenia | Chad | Gabon | Kazakhstan | New Zealand |
| Australia | Chile | Gambia | Kenya | Nicaragua |
| Austria | China | Georgia | Kiribati | Niger |
| Azerbaijan | Colombia | Germany | Kuwait | Nigeria |
| Bahamas | Comoros | Ghana | Kyrgyzstan | Norway |
| Bahrain | Congo | Greece | Laos | Oman |
| Bangladesh | Costa Rica | Grenada | Latvia | Pakistan |
| Barbados | Côte d'Ivoire | Guatemala | Lebanon | Palau |
| Belarus | Croatia | Guinea | Liberia | Panama |
| Belgium | Cuba | Guinea-Bissau | Libyan Arab Jamahiriya | Papua New Guinea |
| Belize | Cyprus | Guyana | Lithuania | Paraguay |
| Benin | Czech Republic | Haiti | Madagascar | Peru |
| Bhutan | Congo | Honduras | Malawi | Philippines |
| Bolivia | Denmark | Hungary | Malaysia | Poland |
| Bosnia and Herzegovina | Djibouti | Iceland | Mali | Portugal |
| Brazil | Dominica | India | Malta | Qatar |
| Brunei Darussalam | Dominican Republic | Indonesia | Marshall Islands | Republic of Korea |
| Bulgaria | Ecuador | Iran | Mauritania | Republic of Moldova |

Romania
Russian Federation
Rwanda
Saint Kitts and Nevis
Saint Lucia
Saint Vincent and the Grenadines
Sao Tome and Principe
Saudi Arabia
Senegal
Seychelles
Sierra Leone
Singapore
Slovakia
Slovenia
Solomon Islands
South Africa
Spain
Sri Lanka
Sudan
Suriname
Sweden
Switzerland
Syrian Arab Republic
Tajikistan
Thailand
Republic of Macedonia
Togo
Tonga
Trinidad and Tobago
Tunisia
Turkey
Turkmenistan
Tuvalu
Uganda
Ukraine
United Arab Emirates
United Kingdom
United Republic of Tanzania
United States of America
Uruguay
Uzbekistan
Vanuatu
Venezuela
Viet Nam
Yemen
Zambia
Zimbabwe
China, Hong Kong

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국문 초록

# 국가 간 금융자산거래에 정보 접근성이 미치는 영향

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## 초록

국제 자본 이동량이 지속적으로 증가함에 따라 다수의 연구들이 국가간 투자 결정 요인에 대한 논의를 지속해왔다. 기존 문헌들은 자본이동과 거리가 음의 상관관계를 가지고 있으며, 이는 국가간 정보 비대칭이 자본이동에 영향을 미치기 때문이라고 주장하였다. 한편, 정보통신기술의 발달 및 확산과 같은 정보비대칭에 영향을 미치는 요인을 고려한 연구는 아직 제한적인 수준이다. 따라서, 본 연구는 정보통신기술의 발달 및 확산으로 인한 "정보 접근성" 의 증가, 즉 정보교류수단 활용법의 단순화 및 효율성의 제고가, 국가간 금융자산 거래에 어떠한 영향을 미쳤는지에 관하여 탐구하고자 한다. 국가간 금융자산거래에 정보 접근성이 미치는 영향을 알아보기 위하여 우선, 양 국가의 정보통신기술 지표의 곱을 두 국가 간의 정보 접근성의 프록시로 사용하였다. 이는, 양 국가의 정보통신기술이 발달할수록 국가간 정보장벽이 낮아지고 이에 따라 두 국가간의 정보교류가 늘어날 것이라는 가정 하에서 설정하였다. 분석을 위해 67개 투자국과 173개 투자대상국 간의 해외 간접 투자(FPI)와 정보 접근성의 관계를 중력모형(gravity model)을 사용하여 분석하였다. 본 연구를 통해, 거리, 언어더미변수, 경제규모 등 기존에 연구되었던 요인들을 비롯하여, 정보 접근성이 해외 간접 투자 패턴을 설명하는데 중요한 역할을 한다는 것을 알 수 있었다. 정보 접근성이 높아질수록 해외 간접 투자는 증가하였고, 이러한 한계효과는 양 국가의 투자량이 적을수록 증가함을 알 수 있었다. 이는, 정보장벽이 국가간 자본이동이 작을수록 더 큰 장애물임을 시사한다.

주요어: 정보통신기술, 그래비티 모형, 정보 비대칭, 해외 포트폴리오 투자

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