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Information and Capital Flows Revisited: the Internet as a Determinant of Transactions in Financial Assets

Changkyu Choi, Dong-Eun Rhee, and Yonghyup Oh

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KIEP Working Paper 10-10
Published December 30, 2010 in Korea by KIEP
ISBN 978-89-322-4214-9
978-89-322-4026-8(set)
Price USD 3

Executive Summary

This paper investigates the determinants of international transactions in financial assets empirically. We extend the gravity model in Portes *et al*. (2000) by introducing an internet variable. Using cross-country panel data on the portfolio flows between the US and other countries from 1990 to 2008, we found that the Internet turns out to mitigate the information asymmetries and thus increases cross-border portfolio flows between countries.

Keywords: The Internet, portfolio flows, gravity equation
JEL Classifications: C23; F21; O33

국문요약

본 논문은 국제자본거래의 결정요인을 실증 분석하고 있다. 관련 문헌에서는 중력모형으로 국제자본거래를 설명하고 있는데, 이는 국제자본거래량이 거래 당사국 간의 물리적 거리에 반비례함을 의미한다. Portes *et al.* (2000)에서는 이 반비례 관계를 정보의 비대칭성으로 설명하였으며, 국제전화 교신량을 통해 이를 실증 분석 하였다. 본 논문에서는 인터넷 변수를 사용하여 Portes *et al.*의 가설을 재검증하였으며, 1990년부터 2008년까지 미국과 38개국의 자본거래량 패널 데이터를 사용 하였다. 실증분석을 통해 인터넷이 국제자본거래의 중요한 결정요인이라는 사실을 발견 하였으며, 인터넷 사용량이 증가할수록 정보의 비대칭성이 완화되어 국가간 자본 거래가 증가하는 것으로 나타났다.

핵심용어: 국제자본이동, 중력모형, 인터넷

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"The Future of the Eurozone and Gold" (공저, 2010)
"Monetary Integration with or without Capital Market Integration"(*Asian Economic Papers,* Vol. 8(2), 2009) 외

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Information and Capital Flows Revisited: the Internet as a Determinant of Transactions in Financial Assets

Changkyu Choi, Dong-Eun Rhee, and Yonghyup Oh*

I. Introduction

Traditionally, the gravity equation has been used to explain flows of a good between pairs of countries mainly in terms of distance and GDP. The negative relationship between the international trade volume of a good and distance is interpreted as the transaction cost. However, it seems puzzling when the gravity equation also fits the transaction of international financial assets, since financial assets are weightless and entails little transaction cost. In this vein, Portes *et al.* (2000) and Portes and Rey (2005) did find that the information asymmetry is a very important determinant of trade in financial assets. They also explain that the negative correlation between the distance and financial asset trade

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can be explained by information asymmetry. This implies that as two countries are located farther away from each other, the information asymmetry becomes larger and trade volume in financial assets is reduced. This can also explain the home bias of financial assets in relation to information asymmetry. They used international telephone call traffic as a proxy for information flows between two countries and found empirical evidence of the role of international telephone call traffic in mitigating the information asymmetry in financial assets transaction.

If the information friction is the prime factor for explaining the gravity model in the international financial markets, the new development of information technology might account for the recent dramatic increase in international financial transaction. Therefore, the main idea of this paper is to reinvestigate the gravity equation of the international financial markets while taking the development of the internet into account. The positive effect of the Internet on macroeconomic variables such as inflation and economic growth has been studied by recent research efforts, respectively (Yi and Choi 2005; Choi and Yi 2008). The Internet also turned out to play a positive role in international goods trade (Freund and Weinhold 2004), international service trade (Freund and Weinhold 2002; Choi 2010), and international direct investment (Choi 2003). Recently, Choi (2010) used cross-country panel data for over 110 countries from 1990 to 2007 and found that the Internet reduces the information asymmetry between two countries and thus increases cross-border portfolio flows. The above research on the effect of the Internet in international transactions in goods and financial assets

are based mainly on gravity models.

In our paper we are going to analyze the effect of the Internet on portfolio flows between the US and other countries. The financial asset transactions in this paper include foreign residents' transactions in US corporate stocks, corporate bonds, Treasury bonds, and US residents' transactions in foreign (non-US) stocks, and bonds. In this paper, we reconfirm that the gravity model of the international financial transaction is still valid in an extended period, and information flow is an important determinant in the volume of the transaction. We found that the Internet carries information not available when using the telephone, to international financial dealers and stimulates transaction in certain international financial markets.

The rest of the paper is as follows: section 2 describes the model and data, section 3 outline the estimation results, and the paper ends with concluding remarks in section 4.

II. Model and Data

To test whether an increase in the Internet use increases portfolio flows, we used a standard gravity equation. Here, the US GDP is the same to all countries and omitted in the gravity equation.

$$\log(Portfolio_{it}) = \beta_0 + \beta_1 \log(DIST_{it}) + \beta_2 \log(GDP)_{it} + \beta_3 English_i + \beta_4 \log(SOPH_{it}) + \beta_5 \log(TEL_{it}) + \beta_6 \log(Internet)_{it} + u_{it} \quad (1)$$

where t = 1990, 1991, …, 2008.

Portfolio represents portfolio flows between the US and a partner country. There are various types of portfolio flows. They are STOCK (foreign residents' transactions in US corporate stocks), BOND (foreign residents' transactions in US corporate bonds), TB (foreign residents' transactions in US Treasury bond and notes), FSTOCK (US residents' transactions in foreign (non-US) stocks), and FBOND (US residents' transactions in foreign (non-US) bonds). *DIST* stands for the distance between the US and the partner country. *GDP* is GDP of a partner country. *English* stands for a dummy variable for the English speaking country. *FS* is a survey data to indicate the degree of financial skill of a country. *TEL* is international telephone call traffic. *Internet* is the number of Internet users per one hundred people. Natural logarithms are used for all the variables except *English* dummies.

The coefficient of the distance is expected to be negative. It is because the transaction cost and information asymmetry become bigger

when the distance between two countries increases. Coefficients of GDP are expected to have positive signs. Coefficient of *English* is also expected to have a positive sign. An English speaking country is expected to have an advantage in communication between two countries. The coefficient of financial skill is expected to have a positive sign. Portfolio flows are large when a partner country is financially developed. Finally, the level of Internet development is expected to have a positive relationship with portfolio flows. As Internet use increases, the information asymmetry between two countries decrease and portfolio flows between them increase. The definition and source of the variables are detailed in Appendix 1. The list of the countries included in the empirical results is in Appendix 2.

Ⅲ. Empirical Results

Table 1 shows the summary statistics for the variables. Tables 2 ~ 6 describe the main results and in each tables six regressions are reported for the independent variables and estimation methods. Tables 2 ~ 4 deal with foreign residents' transactions in US markets, while Tables 5 and 6 concern US residents' transactions in foreign markets.

Table 1. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
STOCK	707	66611.86	288310.6	2	3671086
BOND	707	20226.97	112802.1	0	1548650
TB	707	249313.5	1092795	0	1.56E+07
FSTOCK	707	59032.34	252247.6	0	3511734
FBOND	707	54269.01	215638	0	2190293
GDP	707	563.7491	844.4232	26.42198	5264.852
Internet	707	19.46704	23.91114	1	87.8
Financial Skill	707	4.60294	1.124013	1.722	6.8
distance	707	8811.014	3576.393	1037.087	15810.22

Table 2 summarizes the empirical results for the estimation of the foreign residents' transactions in US corporate stocks. Transactions here include the purchase and sales of stocks. A gravity model is employed in the estimation. A pooled OLS (ordinary least squares) is utilized in equations (1) to (3). Year dummies are included as independent

Table 2. Foreign Residents' Transactions in US Corporate Stocks[1, 2]

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Log (Stock)**					
Estimation	**Pooled OLS[3]**			**Random effects**		
Log (DIST)	-0.842***	-0.700***	-0.800***	-0.514	-1.000***	-1.087***
	(0.101)	(0.107)	(0.103)	(0.366)	(0.367)	(0.367)
Log (GDP)	0.611***	0.647***	0.939***	0.844***	0.448***	0.468***
	(0.065)	(0.071)	(0.049)	(0.108)	(0.103)	(0.093)
Log (FS)	3.723***	3.622***	3.995***	1.593***	0.743***	0.717***
	(0.227)	(0.281)	(0.262)	(0.232)	(0.237)	(0.231)
Log (TEL)	0.495***	0.427***		1.032***	0.142	
	(0.063)	(0.076)		(0.071)	(0.088)	
Log (Internet)		0.114**	0.238***		0.343***	0.364***
		(0.057)	(0.054)		(0.024)	(0.019)
Constant	-2.703*	-3.195*	4.364***	-15.118***	10.437***	13.990***
	(1.469)	(1.695)	(1.107)	(3.558)	(3.922)	(3.378)
Observations	672	567	605	672	567	605
R-squared	0.746	0.714	0.697	0.645	0.581	0.542
Number of country				38	38	38

Notes: 1. Standard errors are in parentheses
2. *** p<0.01, ** p<0.05, * p<0.1
3. Coefficients for time dummy variables are not reported.
Source: author's calculation.

variables in equations (1) to (3) but are not reported. A Random effect model is employed in equations (4) to (6). The equation (1) and (4) describe the standard gravity model and the significant negative estimated coefficient of distance (DIST) reconfirms that the power of gravi-

ty is still working in the international financial market. Other estimated coefficients turn out as we expected. The national income (GDP) is positive and significant at the 1% level. As the national income grows, the foreign residents' transactions in US corporate stock become larger. The coefficient for financial skill is positive and significant at the 1% level in all the equations. The telephone traffic (TEL) is added as an explanatory variable in the gravity model, and the results are consistent with Portes *et al.* (2001). The coefficient of the telephone traffic is positive and significant at 1% level. The telephone traffic is a significant determinant of the foreigners' transaction volume for US stock.

Equations (2) and (5) add the number of Internet user (*Internet*) to equations (1) and (4), respectively. In equation (2) both the telephone traffic and the Internet user number are positive and significant. The estimated coefficient of the telephone traffic of equation (2) is smaller than the coefficient of equation (1), which implies that the Internet variable takes over some explanatory power from the telephone traffic. The telephone traffic becomes insignificant in the random effects model estimation of equation (5), while the internet variable is significant at the 1% level.

Lastly, the equations (3) and (6) of Table 2 exclude telephone traffic from equations (2) and (5), so that the Internet explains all the information flows. As is expected, Internet variable is still significant and the coefficients become slightly larger than those of equation (2) and (5).

A similar storyline to Table 2 is repeated for the case of foreign residents' transactions in US corporate bonds in Table 3. Equations (1) and (4) show that the gravity model holds in the foreign residents' transac-

Table 3. Foreign Residents' Transaction in US Corporate Bonds[1, 2]

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Log (Stock)**					
Estimation	**Pooled OLS[3]**			**Random effects**		
Log (DIST)	-0.904***	-0.740***	-0.822***	-0.612	-0.920**	-1.041**
	(0.120)	(0.125)	(0.121)	(0.429)	(0.417)	(0.419)
Log (GDP)	0.643***	0.671***	0.966***	1.147***	0.901***	0.967***
	(0.077)	(0.083)	(0.058)	(0.124)	(0.127)	(0.115)
Log (FS)	2.908***	2.830***	3.181***	1.056***	0.403	0.373
	(0.272)	(0.330)	(0.308)	(0.267)	(0.298)	(0.292)
Log (TEL)	0.547***	0.435***		0.899***	0.330***	
	(0.075)	(0.089)		(0.082)	(0.109)	
Log (Internet)		0.135**	0.278***		0.246***	0.301***
		(0.067)	(0.064)		(0.030)	(0.024)
Constant	-3.859**	-3.379*	4.227***	-13.952***	2.463	9.878**
	(1.746)	(1.979)	(1.297)	(4.159)	(4.555)	(3.876)
Observations	664	565	603	664	565	603
R-squared	0.655	0.628	0.606	0.568	0.552	0.513
Number of country				38	38	38

Notes: 1. Standard errors are in parentheses
2. *** p<0.01, ** p<0.05, * p<0.1
3. Coefficients for time dummy variables are not reported.
Source: author's calculation.

tions in US corporate bonds market, although coefficient of the distance is insignificant in equation (4). Information flows represented by the telephone traffic is a significant determinant of the international corporate bonds transactions. Equations (2) and (5) show that the In-

ternet is also a significant determinant for the foreigners' transaction of US corporate bonds. The telephone traffic coefficients of equations (2) and (5) decreased by incorporating the Internet variable, which implies that the Internet delivers information which telephones cannot convey to the international bond dealers. Also, it is worth noting that the financial skill variable (FS) become insignificant by including the Internet in the random effect estimation (5), which may imply that the explanatory power of the finance skill absorbs that of the internet. Lastly, in equations (4) and (8) of the table, the Internet is the only variable representing information flows. In the results of equations (3) and (6), the coefficient of the Internet gets bigger than that of equations (2) and (5), as expected. The finance skill becomes insignificant in equation (6) again, which means it is the information carried by the Internet, not by the telephone traffic that renders the finance skill insignificant.

Table 4 lists the empirical results for the foreign residents' transactions in US Treasury bonds and notes. It is worth noting that coefficients of distance are insignificant in all the random effect estimations. This implies that the distance may not be an important factor in transacting government bonds internationally. However, the distance is significantly negative in the gravity model of equation (3) estimated by a pooled OLS method. The distance becomes insignificant by adding telephone traffic, which means that information flows entirely account for the gravity model. The distance variable remains insignificant after adding the Internet variable in equation (2), but becomes significant by excluding the telephone traffic in equation (3). These results imply that the telephone is more correlated with the distance than the Internet in

Table 4. Foreign Residents' Transaction in US Treasury Bonds and Notes [1, 2]

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Log (Stock)**					
Estimation	**Pooled OLS[3]**			**Random effects**		
Log (DIST)	-0.161	-0.116	-0.245**	-0.278	-0.517	-0.631
	(0.121)	(0.115)	(0.113)	(0.435)	(0.406)	(0.427)
Log (GDP)	0.622***	0.688***	1.095***	1.006***	0.799***	0.784***
	(0.078)	(0.076)	(0.054)	(0.122)	(0.120)	(0.111)
Log (FS)	1.880***	1.399***	2.017***	0.064	0.041	-0.001
	(0.272)	(0.300)	(0.287)	(0.260)	(0.279)	(0.276)
Log (TEL)	0.896***	0.589***		0.678***	0.197*	
	(0.075)	(0.081)		(0.080)	(0.103)	
Log (Internet)		0.259***	0.411***		0.108***	0.144***
		(0.061)	(0.060)		(0.028)	(0.023)
Constant	-13.483***	-6.240***	3.902***	-7.112*	5.984	11.126***
	(1.754)	(1.811)	(1.215)	(4.201)	(4.400)	(3.942)
Observations	667	566	604	667	566	604
R-squared	0.647	0.624	0.591	0.582	0.506	0.443
Number of country				38	38	38

Notes: 1. Standard errors are in the parentheses
2. *** p<0.01, ** p<0.05, * p<0.1
3. Coefficients for time dummy variables are not reported.
Source: author's calculation.

the international government bond market. The coefficient of the Internet is positive and significant at 1% level in all the equations including it, which means the Internet carries information which cannot be delivered through telephones.

Table 5 shows the estimation results for the US residents' transac-

tions in foreign corporate stocks. Again, the distance variable is insignificant in all equations from (1) through (4). The distance becomes insignificant when the telephone traffic or the Internet is considered. This implies that the distance is not an important factor in deciding the US residents' transaction in foreign corporate equities. Nevertheless, coefficients

Table 5. US Residents' Transaction in Foreign Corporate Equities[1, 2]

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Log (Stock)**					
Estimation	**Pooled OLS[3]**			**Random effects**		
Log (DIST)	-0.122	0.057	0.007	0.271	-0.071	-0.122
	(0.087)	(0.083)	(0.079)	(0.290)	(0.282)	(0.269)
Log (GDP)	0.790***	0.799***	1.010***	1.096***	0.872***	1.027***
	(0.056)	(0.055)	(0.038)	(0.106)	(0.089)	(0.080)
Log (FS)	3.940***	3.600***	3.974***	1.636***	1.444***	1.467***
	(0.196)	(0.217)	(0.199)	(0.239)	(0.213)	(0.212)
Log (TEL)	0.374***	0.308***		0.986***	0.287***	
	(0.054)	(0.059)		(0.073)	(0.078)	
Log (Internet)		0.109**	0.182***		0.176***	0.220***
		(0.044)	(0.041)		(0.021)	(0.018)
Constant	-7.901***	-8.569***	-3.498***	-22.528***	-3.820	1.541
	(1.265)	(1.307)	(0.844)	(2.958)	(3.125)	(2.505)
Observations	670	567	605	670	567	605
R-squared	0.790	0.784	0.780	0.657	0.706	0.682
Number of country				38	38	38

Notes: 1. Standard errors are in the parentheses

2. *** p<0.01, ** p<0.05, * p<0.1

3. Coefficients for time dummy variables are not reported.

Source: author's calculation.

of the GDP, financial skill, and telephone call traffic are all positive and significant in all the equations estimated. The coefficient of the Internet is also positive and significant at the 5% level in equation (2) and at the 1% level in equations (3), (5), and (6). This means that the Internet is a very important determinant in the US residents' transaction in foreign

Table 6. US Residents' Transaction in Foreign Bonds[1, 2]

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Log (Stock)**					
Estimation	**Pooled OLS[3]**			**Random effects**		
Log (DIST)	-0.975***	-0.843***	-0.870***	-0.745*	-0.916**	-0.992**
	(0.124)	(0.123)	(0.115)	(0.417)	(0.433)	(0.413)
Log (GDP)	0.868***	0.900***	0.952***	1.231***	1.239***	1.282***
	(0.080)	(0.081)	(0.055)	(0.131)	(0.125)	(0.111)
Log (FS)	2.789***	3.004***	3.004***	0.151	0.688**	0.843***
	(0.279)	(0.320)	(0.290)	(0.286)	(0.289)	(0.282)
Log (TEL)	0.272***	0.066		0.608***	0.235**	
	(0.078)	(0.087)		(0.088)	(0.107)	
Log (Internet)		0.031	0.073		-0.015	0.018
		(0.065)	(0.060)		(0.029)	(0.023)
Constant	2.620	5.666***	6.250***	-4.423	3.986	8.962**
	(1.805)	(1.936)	(1.222)	(4.104)	(4.659)	(3.816)
Observations	671	568	606	671	568	606
R-squared	0.591	0.562	0.566	0.500	0.472	0.477
Number of country				38	38	38

Notes: 1. Standard errors are in the parentheses
2. *** p<0.01, ** p<0.05, * p<0.1
3. Coefficients for time dummy variables are not reported.
Source: author's calculation.

corporate equities.

Table 6 is the estimation result for US residents' transaction in foreign corporate bonds. Unlike the case of Table 5, the distance variables are negative and significant in all the equations. Coefficients of telephone

Table 7. Foreign Residents' Transactions in US Corporate Stocks[1, 2]

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Log (Stock)**					
Estimation	**Pooled OLS[3]**			**Random effects**		
Log (DIST)	-0.864***	-0.725***	-0.810***	-0.517	-1.040***	-1.110***
	(0.101)	(0.106)	(0.101)	(0.372)	(0.369)	(0.367)
Log (GDP)	0.641***	0.736***	0.954***	0.854***	0.466***	0.475***
	(0.067)	(0.073)	(0.048)	(0.108)	(0.103)	(0.092)
English	0.291**	0.625***	0.709***	0.221	1.284***	1.361***
	(0.142)	(0.153)	(0.140)	(0.472)	(0.470)	(0.464)
Log (FS)	3.562***	3.132***	3.263***	1.573***	0.654***	0.625***
	(0.240)	(0.302)	(0.294)	(0.233)	(0.238)	(0.231)
Log (TEL)	0.460***	0.323***		1.028***	0.101	
	(0.065)	(0.079)		(0.071)	(0.089)	
Log (Internet)		0.176***	0.290***		0.353***	0.367***
		(0.058)	(0.054)		(0.024)	(0.019)
Constant	-1.738	-0.678	5.367***	-15.099***	11.360***	14.011***
	(1.539)	(1.780)	(1.102)	(3.604)	(3.939)	(3.376)
Observations	672	567	605	672	567	605
R-squared	0.747	0.722	0.710	0.648	0.624	0.596
Number of country				38	38	38

Notes: 1. Standard errors are in the parentheses
2. *** p<0.01, ** p<0.05, * p<0.1
3. Coefficients for time dummy variables are not reported.
Source: author's calculation.

call traffic are positive and significant at the 1% level in equations (1) and (4) and at 5% level in equation (5). The Internet, however, is not significant in all the equations. We can say that the Internet does not influence the US residents' transaction in foreign bonds.

Table 8. Foreign Residents' Transactions in US Corporate Bonds[1, 2]

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Log (Bond)**					
Estimation	**Pooled OLS[3]**			**Random effects**		
Log (DIST)	-0.946***	-0.784***	-0.837***	-0.619	-0.959**	-1.067***
	(0.120)	(0.121)	(0.116)	(0.435)	(0.411)	(0.411)
Log (GDP)	0.703***	0.830***	0.991***	1.165***	0.924***	0.978***
	(0.079)	(0.084)	(0.056)	(0.125)	(0.126)	(0.114)
English	0.570***	1.125***	1.133***	0.472	1.268**	1.503***
	(0.169)	(0.174)	(0.161)	(0.553)	(0.525)	(0.522)
Log (FS)	2.590***	1.942***	2.002***	1.022***	0.300	0.254
	(0.286)	(0.347)	(0.340)	(0.269)	(0.300)	(0.293)
Log (TEL)	0.478***	0.247***		0.892***	0.285***	
	(0.077)	(0.091)		(0.082)	(0.111)	
Log (Internet)		0.250***	0.364***		0.257***	0.306***
		(0.067)	(0.063)		(0.030)	(0.024)
Constant	-1.976	1.165	5.844***	-13.877***	3.477	9.903***
	(1.820)	(2.035)	(1.267)	(4.212)	(4.518)	(3.807)
Observations	664	565	603	664	565	603
R-squared	0.661	0.655	0.637	0.579	0.618	0.595
Number of country				38	38	38

Notes: 1. Standard errors in parentheses
2. *** p<0.01, ** p<0.05, * p<0.1
3. Coefficients for time dummy variables not shown.
Source: author's calculation.

We found the evidence that information carried by the Internet is important when US residents transact foreign corporate equities in Table 5, but not important when they transact foreign bonds in Table 6.

Table 9. Foreign Residents' Transactions in US Treasury Bonds and Notes[1, 2]

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Log (TB)**					
Estimation	**Pooled OLS[3]**			**Random effects**		
Log (DIST)	-0.189	-0.154	-0.261**	-0.295	-0.555	-0.654
	(0.121)	(0.112)	(0.108)	(0.441)	(0.402)	(0.416)
Log (GDP)	0.663***	0.823***	1.119***	1.029***	0.823***	0.798***
	(0.079)	(0.077)	(0.052)	(0.123)	(0.119)	(0.110)
English	0.394**	0.957***	1.108***	0.880	1.319**	1.458***
	(0.170)	(0.160)	(0.151)	(0.560)	(0.513)	(0.528)
Log (FS)	1.666***	0.648**	0.873***	0.016	-0.060	-0.101
	(0.286)	(0.316)	(0.315)	(0.261)	(0.281)	(0.278)
Log (TEL)	0.848***	0.430***		0.664***	0.155	
	(0.078)	(0.083)		(0.080)	(0.104)	
Log (Internet)		0.355***	0.493***		0.118***	0.147***
		(0.061)	(0.058)		(0.028)	(0.023)
Constant	-12.187***	-2.387	5.467***	-6.905	6.908	11.094***
	(1.835)	(1.870)	(1.182)	(4.250)	(4.370)	(3.843)
Observations	667	566	604	667	566	604
R-squared	0.650	0.648	0.626	0.605	0.576	0.523
Number of country				38	38	38

Notes: 1. Standard errors in parentheses

2. *** p<0.01, ** p<0.05, * p<0.1

3. Coefficients for time dummy variables not shown.

Source: author's calculation.

To improve the explanatory power of the estimations, we repeat the estimation with the English dummy variable included. Language barrier can be another source of information asymmetry. Countries using English are assumed to have less information asymmetry between countries

Table 10. US residents' Transactions in Foreign Corporate Stocks[1, 2]

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Log (FSTOCK)**					
Estimation	**Pooled OLS[3]**			**Random effects**		
Log (DIST)	-0.158*	0.019	-0.007	0.266	-0.108	-0.146
	(0.087)	(0.078)	(0.073)	(0.294)	(0.272)	(0.256)
Log (GDP)	0.841***	0.938***	1.031***	1.117***	0.896***	1.038***
	(0.057)	(0.054)	(0.035)	(0.107)	(0.088)	(0.078)
English	0.485***	0.984***	1.008***	0.351	1.164***	1.397***
	(0.122)	(0.112)	(0.101)	(0.376)	(0.349)	(0.325)
Log (FS)	3.670***	2.828***	2.932***	1.591***	1.344***	1.336***
	(0.205)	(0.221)	(0.212)	(0.242)	(0.213)	(0.212)
Log (TEL)	0.316***	0.143**		0.978***	0.242***	
	(0.056)	(0.058)		(0.074)	(0.078)	
Log (Internet)		0.206***	0.256***		0.186***	0.225***
		(0.042)	(0.039)		(0.021)	(0.017)
Constant	-6.317***	-4.606***	-2.072***	-22.436***	-2.806	1.590
	(1.312)	(1.304)	(0.793)	(2.992)	(3.053)	(2.384)
Observations	670	567	605	670	567	605
R-squared	0.795	0.811	0.812	0.664	0.764	0.759
Number of country				38	38	38

Notes: 1. Standard errors in parentheses
2. *** p<0.01, ** p<0.05, * p<0.1
3. Coefficients for time dummy variables not shown
Source: author's calculation.

and thus have more financial transactions. The results are reported in Tables 7~11.

The empirical results for the estimation of the foreign residents' transactions of the US financial assets are shown in Tables 7~9. As is ex-

Table 11. US Residents' Transactions in Foreign Bonds[1, 2]

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Log (FBOND)**					
Estimation	**Pooled OLS[3]**			**Random effects**		
Log (DIST)	-1.031***	-0.894***	-0.886***	-0.763*	-0.950**	-1.014**
	(0.123)	(0.117)	(0.110)	(0.420)	(0.428)	(0.409)
Log (GDP)	0.946***	1.085***	0.976***	1.261***	1.255***	1.289***
	(0.081)	(0.081)	(0.053)	(0.132)	(0.124)	(0.111)
English	0.751***	1.305***	1.107***	0.897*	1.102**	1.240**
	(0.173)	(0.168)	(0.153)	(0.535)	(0.547)	(0.519)
Log (FS)	2.371***	1.981***	1.861***	0.086	0.612**	0.747***
	(0.292)	(0.331)	(0.320)	(0.288)	(0.291)	(0.284)
Log (TEL)	0.182**	-0.152*		0.591***	0.199*	
	(0.079)	(0.087)		(0.088)	(0.108)	
Log (Internet)		0.161**	0.154***		-0.006	0.022
		(0.064)	(0.059)		(0.029)	(0.023)
Constant	5.108***	10.923***	7.588***	-4.171	4.809	8.989**
	(1.871)	(1.959)	(1.186)	(4.133)	(4.631)	(3.785)
Observations	671	568	606	671	568	606
R-squared	0.603	0.606	0.602	0.527	0.540	0.554
Number of country				38	38	38

Notes: 1. Standard errors in parentheses

2. *** p<0.01, ** p<0.05, * p<0.1

3. Coefficients for time dummy variables not shown

Source: author's calculation.

pected, English dummy variables are significant in all equations but equation (4) in each Table. Overall R-squared values are increased by including the English dummy, and all other main results are preserved.

Table 12. Foreign Residents' Transactions in US Corporate Stocks[1, 2]

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Log (Stock)**					
Estimation	**Pooled OLS[3]**			**Random effects**		
Log (DIST)	-0.864***	-0.832***	-0.914***	-0.517	-0.872**	-1.067***
	(0.101)	(0.101)	(0.097)	(0.372)	(0.368)	(0.367)
Log (GDP)	0.641***	0.683***	0.943***	0.854***	0.609***	0.775***
	(0.067)	(0.067)	(0.046)	(0.108)	(0.101)	(0.090)
English	0.291**	0.423***	0.596***	0.221	1.003**	1.414***
	(0.142)	(0.146)	(0.135)	(0.472)	(0.470)	(0.465)
Log (FS)	3.562***	3.067***	3.150***	1.573***	0.326	0.218
	(0.240)	(0.273)	(0.271)	(0.233)	(0.227)	(0.226)
Log (TEL)	0.460***	0.374***		1.028***	0.454***	
	(0.065)	(0.069)		(0.071)	(0.078)	
Log (Internet)		0.287***	0.482***		0.445***	0.555***
		(0.082)	(0.075)		(0.034)	(0.028)
Constant	-1.738	-0.715	5.181***	-15.099***	1.970	11.857***
	(1.539)	(1.554)	(1.059)	(3.604)	(3.759)	(3.380)
Observations	672	669	707	672	669	707
R-squared	0.747	0.753	0.740	0.648	0.697	0.661
Number of country				38	38	38

Notes: 1. Standard errors are in the parentheses
2. *** p<0.01, ** p<0.05, * p<0.1
3. Coefficients for time dummy variables are not reported.
Source: author's calculation.

Table 10 and Table 11 show the estimation results for the US residents' transaction of foreign financial assets. Again, the English dummy variables are significant in all equations but equation (4) in Tables

Table 13. Foreign Residents' Transactions in US Corporate Bonds[1, 2]

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Log (BOND)**					
Estimation	**Pooled OLS[3]**			**Random effects**		
Log (DIST)	-0.946***	-0.897***	-0.951***	-0.619	-0.888**	-1.032**
	(0.120)	(0.118)	(0.113)	(0.435)	(0.417)	(0.416)
Log (GDP)	0.703***	0.758***	0.997***	1.165***	0.987***	1.161***
	(0.079)	(0.078)	(0.053)	(0.125)	(0.122)	(0.108)
English	0.570***	0.753***	0.900***	0.472	1.074**	1.476***
	(0.169)	(0.171)	(0.158)	(0.553)	(0.533)	(0.526)
Log (FS)	2.590***	1.900***	1.930***	1.022***	0.093	-0.050
	(0.286)	(0.324)	(0.321)	(0.269)	(0.278)	(0.274)
Log (TEL)	0.478***	0.354***		0.892***	0.426***	
	(0.077)	(0.081)		(0.082)	(0.096)	
Log (Internet)		0.388***	0.603***		0.347***	0.457***
		(0.096)	(0.089)		(0.042)	(0.034)
Constant	-1.976	-0.276	5.754***	-13.877***	-0.403	8.473**
	(1.820)	(1.817)	(1.181)	(4.212)	(4.339)	(3.837)
Observations	664	661	699	664	661	699
R-squared	0.661	0.672	0.657	0.579	0.629	0.607
Number of country				38	38	38

Notes: 1. Standard errors in parentheses
2. *** p<0.01, ** p<0.05, * p<0.1
3. Coefficients for time dummy variables not shown.
Source: author's calculation.

10 and 11. In Table 10, the Internet is significant at 1% level in all equations. In equations (2) and (4), both telephone call traffic and the Internet

Table 14. Foreign Residents' Transactions in US Treasury Bonds and Notes[1, 2]

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Log (TB)**					
Estimation	**Pooled OLS[3]**			**Random effects**		
Log (DIST)	-0.189	-0.134	-0.291**	-0.295	-0.331	-0.578
	(0.121)	(0.119)	(0.118)	(0.441)	(0.421)	(0.435)
Log (GDP)	0.663***	0.715***	1.220***	1.029***	0.984***	1.197***
	(0.079)	(0.078)	(0.056)	(0.123)	(0.125)	(0.114)
English	0.394**	0.571***	0.980***	0.880	0.952*	1.499***
	(0.170)	(0.172)	(0.165)	(0.560)	(0.538)	(0.551)
Log (FS)	1.666***	0.988***	1.244***	0.016	-0.093	-0.242
	(0.286)	(0.323)	(0.333)	(0.261)	(0.285)	(0.290)
Log (TEL)	0.848***	0.725***		0.664***	0.599***	
	(0.078)	(0.081)		(0.080)	(0.098)	
Log (Internet)		0.402***	0.732***		0.055	0.209***
		(0.096)	(0.093)		(0.043)	(0.036)
Constant	-12.187***	-9.625***	0.431	-6.905	-4.970	8.033**
	(1.835)	(1.825)	(1.296)	(4.250)	(4.391)	(4.015)
Observations	667	664	702	667	664	702
R-squared	0.650	0.662	0.618	0.605	0.610	0.533
Number of country				38	38	38

Notes: 1. Standard errors in parentheses
2. *** p<0.01, ** p<0.05, * p<0.1
3. Coefficients for time dummy variables not shown
Source: author's calculation.

are significant. In Table 11, the Internet is significant in a pooled OLS estimation, but insignificant in the random effects estimation. Even after adding the English dummy, we cannot find clear evidence that the

Table 15. US Residents' Transactions in Foreign Corporate Stocks[1, 2]

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Log (FSTOCK)**					
Estimation	**Pooled OLS[3]**			**Random effects**		
Log (DIST)	-0.158*	-0.126	-0.152*	0.266	0.142	-0.105
	(0.087)	(0.086)	(0.081)	(0.294)	(0.284)	(0.269)
Log (GDP)	0.841***	0.878***	1.038***	1.117***	1.041***	1.419***
	(0.057)	(0.057)	(0.038)	(0.107)	(0.107)	(0.092)
English	0.485***	0.601***	0.729***	0.351	0.645*	1.343***
	(0.122)	(0.124)	(0.113)	(0.376)	(0.368)	(0.344)
Log (FS)	3.670***	3.230***	3.317***	1.591***	1.119***	1.052***
	(0.205)	(0.234)	(0.228)	(0.242)	(0.264)	(0.268)
Log (TEL)	0.316***	0.234***		0.978***	0.759***	
	(0.056)	(0.059)		(0.074)	(0.089)	
Log (Internet)		0.259***	0.368***		0.173***	0.360***
		(0.070)	(0.063)		(0.039)	(0.033)
Constant	-6.317***	-5.479***	-2.057**	-22.436***	-16.131***	-1.016
	(1.312)	(1.326)	(0.886)	(2.992)	(3.206)	(2.539)
Observations	670	667	705	670	667	705
R-squared	0.795	0.800	0.800	0.664	0.688	0.691
Number of country				38	38	38

Notes: 1. Standard errors in parentheses

2. *** p<0.01, ** p<0.05, * p<0.1

3. Coefficients for time dummy variables not shown.

Source: author's calculation.

Internet is an important determinant for US residents' transaction of foreign bonds.

In previous estimation results, natural logarithms of the number of the Internet users are used. For that reason many observations such as

Table 16. US Residents' Transactions in Foreign Bonds[1, 2]

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Log (FBOND)**					
Estimation	**Pooled OLS[3]**			**Random effects**		
Log (DIST)	-1.031***	-1.016***	-1.037***	-0.763*	-0.704*	-0.957**
	(0.123)	(0.124)	(0.116)	(0.420)	(0.419)	(0.400)
Log (GDP)	0.946***	0.963***	1.055***	1.261***	1.302***	1.591***
	(0.081)	(0.082)	(0.055)	(0.132)	(0.136)	(0.118)
English	0.751***	0.800***	0.829***	0.897*	0.765	1.361***
	(0.173)	(0.178)	(0.162)	(0.535)	(0.538)	(0.509)
Log (FS)	2.371***	2.185***	2.187***	0.086	0.305	0.266
	(0.292)	(0.336)	(0.326)	(0.288)	(0.316)	(0.315)
Log (TEL)	0.182**	0.143*		0.591***	0.687***	
	(0.079)	(0.085)		(0.088)	(0.108)	
Log (Internet)		0.106	0.212**		-0.077	0.092**
		(0.100)	(0.091)		(0.047)	(0.039)
Constant	5.108***	5.661***	7.738***	-4.171	-7.029	7.174*
	(1.871)	(1.905)	(1.270)	(4.133)	(4.485)	(3.727)
Observations	671	668	706	671	668	706
R-squared	0.603	0.602	0.602	0.527	0.518	0.526
Number of country				38	38	38

Notes: 1. Standard errors in parentheses
2. *** p<0.01, ** p<0.05, * p<0.1
3. Coefficients for time dummy variables not shown
Source: author's calculation.

zero are omitted in the regression. Therefore, in Table 12 to Table 16 the logarithm of the Internet plus 1 (log(Internet+1)) is used instead of the Internet itself. The number of observations of the Internet variable increased from 605 to 707 in some estimations. Almost all the regression results are similar to those from Table 2 to Table 6, especially the estimation result from Table 16, which improved marginally. Coefficients of international telephone call traffic become positive and significant at the 5% level in equation (1), 10% level in equation (2) and 1% level in equations (4) and (5). Coefficients of the Internet are insignificant in equations (2) and (5) but positive and significant at 5% level in equations (3) and (6). In general, the results from Table 12 to Table 16 show the robustness of the empirical analysis.

Ⅳ. Conclusion

In this paper, we investigated the determinants of international financial transaction using cross-country panel data on portfolio flows between the US and 38 countries from 1990 to 2008. First, we reconfirmed that the gravity model explains international transactions in financial assets and information friction accounts for the negative relationship between distance and the transaction volume. Second, it is hypothesized that the development of the Internet will increase portfolio flows and we found that the Internet can mitigate the information asymmetry between two countries and thus increase cross-border portfolio flows. We tested the hypothesis with various empirical models, and the results turned out to be very robust.

The results of this paper suggest that information friction is one of the key factors impeding international transaction and recent rapid increase in the cross-country portfolio investment can be explained by IT development. We can expect that international integration in financial markets will be accelerated by IT technology development. Since the relationship between IT technology and international finance will become stronger in the future, it is necessary for policymakers to observe the internet-related financial technologies more carefully.

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Appendix

Appendix 1. Description on Data

DISTANCE: The distance between New York and financial center of a foreign country from Portes, Rey and Oh (2001) and Shang-JinWei
website (http://www.ksg.harvard.edu/people/sjwei)

GDP: World Development Indicator (2008), World Bank

English dummy: a dummy variable that takes 1 for English speaking country, and 0 otherwise.

Finance Skill: World Competitiveness Yearbook, IMD

Telephone traffic: time of international telephone traffic of that country from International Telecommunication Union

Internet users: number of Internet users per 100 people from World Development Indicator (2008), World Bank

Appendix 2. Countries Included

1	Argentina	20	Korea
2	Australia	21	Malaysia
3	Austria	22	Mexico
4	Brazil	23	Netherlands
5	Canada	24	Norway
6	Chile	25	Pakistan
7	China - Mainland	26	Peru
8	Colombia	27	Philippines
9	Denmark	28	Poland
10	Finland	29	Portugal
11	France	30	Singapore
12	Germany	31	South Africa
13	Greece	32	Spain
14	Hong Kong	33	Sweden
15	India	34	Switzerland
16	Indonesia	35	Thailand
17	Ireland	36	Turkey
18	Italy	37	United Kingdom
19	Japan	38	Venezuela

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9 788932 242149 94320

ISBN 978-89-322-4214-9
978-89-322-4026-8(Set)
Price : USD 3