Cross-Border Bond Investment and Foreign Exchange Market Stability in Emerging Market Economies

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Abstract

This paper investigates if the surge in portfolio debt inflows experienced by some emerging market economies after the global financial crisis can pose a serious threat to the stability of their foreign exchange markets. A regression analysis with panel data reveals that portfolio debt outflows are capable of destabilizing foreign exchange markets when they are accompanied by portfolio equity outflows and other investment outflows.

The possibility of large investment outflows to disrupt stability in foreign exchange markets and to give rise to currency crises in emerging market economies calls for the use of various forms of capital flow management measures to manage large capital inflows. The counter-factual analysis presented in this paper reveals that capital controls were more effective in reducing portfolio debt investment inflows than non-residency based capital flow management measures were. The same analysis demonstrates that the effects of capital flow management measures on portfolio debt inflows tend to diminish in the longer run. On the contrary, macro-prudential regulations introduced by emerging market economies were effective in managing the external debt of financial institutions in the long run as well as in the short run.

Keywords: cross-border bond investment, foreign exchange market stability, capital flow management measure, capital controls, exchange market pressure

JEL Classification: F32, F38

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1 Introduction

Emerging market economies have experienced substantial growth in the investment inflow into their domestic bond markets after the global financial crisis of 2008-09. For example, the share of foreigners in the domestic bond holdings in Korea which stood at 0.56% at the end of 2006 grew to 7.05% by the end of 2012. A number of emerging market economies including Indonesia, Thailand and Brazil also experienced a surge in the foreign investment flows to their domestic bond markets after the global financial crisis. The sovereign debt problem and the quantitative easing in some advanced economies and the prospect for economic growth in these emerging market economies are the main factors behind this recent phenomenon.

The surge of investment in domestic bonds by foreigners, however, has added a new concern to policy makers in emerging market economies. The large volume of investment flows to their domestic bond markets adds to the pressure for the currencies of these economies to appreciate, intensifying the capital inflow problem. In addition, the large amount of domestic bonds held by foreign investors itself may pose a threat to financial market stability because foreigners' investment in domestic bonds is usually driven by common factors such as country credit risk, arbitrage opportunities, prospect of currency appreciation and liquidity in international financial markets and as a result tends to move together, intensifying the potential impact on domestic financial markets. What is worse, sudden investment outflows from domestic bond markets can destabilize their foreign exchange markets and may even bring about a currency crisis as they are added to investment outflows from domestic equity markets and domestic financial institutions.

Reflecting these concerns, some emerging market economies have recently introduced various measures with the intention to manage and mitigate investment inflow to their domestic bond markets. These measures consist of introduction of a ceiling on the ratio of overall foreign exchange derivatives position to bank capital for domestic banks, introduction of a withholding tax on the interest income earned by non-residents from their domestic bond holdings and introduction of a financial transactions tax on

investment inflows.

The surge in portfolio debt investment inflow is a relatively new experience for emerging market economies. Prior to the global financial crisis, portfolio equity investment and external borrowing of financial institutions as well as foreign direct investment used to be the dominant forms of capital flows to emerging market economies. As a result, contrary to other forms investment inflow, there have been relatively few attempts to evaluate the effect of portfolio debt investment flows on emerging market economies and to suggest policy measures to minimize their potentially negative effects.[2]

This study intends to investigate if larger foreign holdings of domestic bonds can possibly pose a threat to the stability of foreign exchange markets in emerging market economies and if capital flow management measures (hereafter CFMs) introduced in emerging market economies are effective in managing large investment inflows to their domestic bond markets and in maintaining foreign exchange market stability. To find answers to these questions, we rely on the analysis of cross-country panel data consisting of emerging market economies.

This paper is organized as follows. Section 2 introduces and discusses the literature on the effect of cross-border bond investment on foreign exchange market stability and the empirical studies on the effectiveness of capital flow management measures. Section 3 estimates and compares the volatility of inflows of different types of cross-border investment. Section 4 adopts regression analysis to investigate if large investment outflows from domestic bond markets have negative effects on foreign exchange market stability. Section 5 examines if capital flow management measures introduced by emerging market economies have been effective in managing the size and the composition of investment inflows and in enhancing foreign exchange market stability. Section 6 concludes with discussion of some policy implications of the findings of this paper.

[2]For example, Lee and Lee (2009) investigated if market spillover took place between the stock market and the foreign exchange market in Korea.

2 Related Literature

This section presents a brief survey of some of the recent literature on the effects of cross-border bond investment on foreign exchange market stability and the empirical studies on the effectiveness of capital flow management measures.

2.1 Cross-border Investment Flows and Foreign Exchange Market Stability

As is well characterized by phrases like boom and bust cycles, sudden stops and sudden reversals, currency crises in emerging market economies tend to be accompanied by large capital outflows that deplete their foreign exchange reserves in a short period of time and create huge pressure for their currencies to depreciate. Consequently, empirical studies on currency crises in emerging market economies have paid attention to large capital flows as the immediate cause of crises although the fundamental source of vulnerability may differ widely.

Frankel and Rose (1996), for example, find that emerging market economies tend to experience higher proportions of external debt lent by commercial banks, higher proportions of external debt in short maturities, and disproportionately smaller amounts of FDI inflows prior to their currency crashes. As a result, Hawkins and Klau (2000) include capital flows in their early warning indicators to predict currency crashes.

Sachs, Tornell and Velasco (1996) examine the fundamentals that caused sudden reversal of capital flows in the episodes of currency crashes in emerging market economies. They find that weak fundamentals including credit boom, rapid real exchange rate appreciation, and inadequate foreign reserves were responsible for the sudden reversal of capital flows.

Aizenman and Hutchison (2010) investigate the factors that contributed to higher depreciation pressure on the currencies of emerging market economies during the recent global financial crisis. Using a regression analysis with eighteen emerging market economies, they find that economies with larger balance sheet exposure in terms of the ratio of short-term external debt to international reserves experienced higher depreciation pressure on their currencies and tended to rely less on depletion of interna-

tional reserves to absorb the exchange market pressure during the global crisis period of 2008-09.

Aizenman, Lee and Sushko (2010) investigate and compare the power of various factors in explaining the exchange market pressure experienced by emerging market economies during the great moderation period and during the 2008-09 global financial crisis period. According to their results, both financial and trade factors played important roles, but the relative magnitude of financial factors dominated that of trade factors during the global financial crisis period. The coefficient of gross short-term external debt, for example, quintupled during the onset of the crisis. In addition, they find that capital outflow was the major force behind the increase in exchange market pressure in emerging market economies during the great moderation period as well as the global financial crisis period.

Contrary to Aizenman, Lee and Sushko who investigate the contribution of different types of investment flows to the rise in exchange market pressure, Park and Park (2012) examine the explanatory power of stock variables such as portfolio investment holdings of foreigners and short-term external debt. According to their findings, short-term external debt is the only variable that consistently displays significant influence on exchange market pressure, which implies that high short-term external debt relative to international reserves was the key factor in intensifying the depreciation pressure on the currencies of emerging market economies during the global financial crisis.

Extending the previous empirical studies on foreign exchange market volatility, this paper intends to investigate the effect of portfolio debt inflows to the foreign exchange market stability of emerging market economies by adding the amount of portfolio debt inflow separately as an explanatory variable in the regression analysis to explain volatility in foreign exchange rates.

2.2 Recent Literature on the Effectiveness of CFMs

Recent literature on CFMs not only regards as CFMs capital controls that are designed to restrict cross-border investment by non-residents but also other measures that impose restrictions on cross-border investment by residents and non-residents alike. Some including Habermeier, Kokenyne and Baba (2011) and Ostry et al (2011) even regard macro-prudential reg-

ulations on financial institutions as a useful tool to manage large capital inflows.

Despite renewed interest in CFMs, researchers do not seem to agree on the effectiveness of CFMs as a policy tool to manage cross-border capital flows let alone their welfare implications. Review of previous empirical literature on CFMs reveals that evidence is mixed about their effectiveness. In particular, Magud and Reinhart (2007) point out that earlier studies produced mixed results about the effect of capital controls on overall amount of capital inflows and that even in cases where capital controls were found to be effective their effects did not seem to last long as economic agents found ways to circumvent them. Habermeier, Kokenyne and Baba (2011) also point out that empirical studies in general show that controls on capital inflows have a stronger effect on composition of capital flows and on domestic and foreign interest rate differentials rather than on overall volume of inflows and on exchange rates.

Empirical studies have adopted diverse methods to evaluate the effectiveness of CFMs. While earlier studies focused on analyzing individual cases of imposing CFMs, recent studies tend to rely more on cross-country panel data. Binici, Hutchison and Schindler (2010), for example, investigate the effectiveness of capital controls using panel data consisting of 74 countries from 1995 to 2005. Estimating a panel regression model, they conclude that capital controls are effective in reducing capital outflows. They use the capital controls index constructed by Schindler (2009) as a measure of the degree of restriction on cross-border capital flows.

Gochoco-Bautista, Jongwanich and Lee (2010) also adopt the Schindler index to study the effects of introducing capital controls in nine Asian countries between 1995 and 2005. Their results confirm the effectiveness of capital controls in managing foreign direct investment inflows. Habermeier, Kokenyne and Baba (2011) examine the effects of three different types of CFMs including capital controls, non-residency based CFMs, and macro-prudential regulations using panel data comprising 13 emerging market economies from 2000 to 2010. Their results show that both capital controls and macro-prudential regulations are effective in reducing capital inflows but that macro-prudential regulations are more effective in achieving financial market stability.

All of these studies rely on the use of a capital controls index as a measure of the degree of restriction on cross-border capital flows. For in-

stance, Binici, Hutchison and Schindler (2010) and Gochoco-Bautista et al (2010) use the capital control index from Schindler (2009). This index is constructed based on information from the IMF Annual Report on Exchange Arrangements and Exchange Restrictions. Habermeier, Kokenyne and Baba (2011) used the capital controls index constructed by Baba and Kokenyne (2011), who also utilize the information from the IMF Annual Report on Exchange Arrangements and Exchange Restrictions.

The studies based on the capital controls index, however, cannot tell us whether the introduction of a specific form of CFM in a country was actually effective in reducing the size of capital inflow. In order to evaluate if the CFMs recently introduced in emerging market economies were effective in achieving their objective of mitigating investment inflows, this paper adopts a new approach. Using a panel regression method, this paper estimates the amount of capital inflow that would have occurred had the CFM not been introduced and compares this counterfactual amount with the actual amount of investment flows.

3 Volatility of Portfolio Debt Investment Flows

One of the potential threats of large domestic bond holdings of foreigners arises from the possibility of a sudden reversal of investment flows. In order to find if an increase in cross-border bond investment flows can significantly undermine foreign exchange market stability, we compare the volatility of four different categories of investment flows, namely, foreign direct investment (FDI), portfolio equity investment, portfolio debt investment and other investment in emerging market economies.

For investment flows, we use the net investment inflow data on the liability side of the balance of payments table because we want to focus on investment flows by foreigners. The data for net investment inflows is available from the IMF International Financial Statistics. The country sample consists of 23 emerging market economies: Argentina, Brazil, Bulgaria, Chile, China, Colombia, Croatia, Czech, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Russia, South Africa, Thailand, Turkey and Venezuela. The sample period runs from the first quarter of 2001 to the last quarter of 2010.

International capital mobility differs widely among countries as well as among different forms of investment flows depending on imposition of CFMs and development of financial markets. As a result, it is possible that one gets a small value for the volatility of investment inflows when the absolute amount of investment flows is small because cross-border capital movements are strictly controlled. In order to remove the bias arising from the difference in international capital mobility, we normalize the net investment inflow as follows:

$$NNIF^{k}_{i,t}=\frac{NIF^{k}_{it}/GDP_{it}}{(1/T)\sum_{t=1}^{T} NIF^{k}_{it}/GDP_{it}}, \quad (1)$$

where NIF^{k}_{it} denotes the amount of net investment inflow of category k in country i during period t and GDP_{it} denotes the GDP of country i during period t. As equation (1) shows, $NNIF$ is computed by dividing net investment inflow of each country by the mean of the absolute amount of net investment inflow of the same country.

Then, the volatility of net investment inflows of each country is calculated as the sample standard deviation of its own time series of $NNIF$. Since the country sample consists of 23 emerging market economies, we get 23 volatility numbers for each category of investment flows.

Table 1 presents some summary statistics. In the table, the means are computed as the sample mean of the 23 volatility numbers. Each of these numbers represents one economy. According to the mean reported in Table 1, portfolio equity inflows are the most volatile of all forms of investment inflows, followed by portfolio debt inflows. FDI inflows are the least volatile of all forms of investment inflows as they tend to be driven by long-term considerations.

This result is consistent with the findings of Alfaro, Kalemli-Ocan and Volosovych (2007) except for FDI inflows. Using a larger sample of 122 countries from 1970 to 2000, they find that equity inflows including portfolio equity inflows and FDI inflows are more volatile than debt inflows including portfolio debt inflows and other investment inflows.

Table 1. Volatility of Normalized Net Investment Inflows

	Mean	Minimum	Maximum
FDI inflows	0.8162	0.3925	1.7949
Portfolio equity inflows	1.4797	1.1337	2.3719
Portfolio debt inflows	1.3435	1.0695	2.7328
Other investment inflows	1.1891	0.8611	1.4924

Note: For each category of investment inflows, the mean, the minimum and the maximum of the sample consisting of 23 countries are reported.

4 Cross-border Bond Investment and FX Market Stability

We adopt a regression analysis to investigate if cross-border flows of bond investment by foreigners are capable of disturbing foreign exchange market stability in emerging market economies.

We use two different measures of foreign exchange market instability: the exchange market pressure index (EMP) and the mean absolute change in exchange rate (MACE). Exchange market pressure of country i during period t is calculated as follows:

$$EMP_{it} = \frac{\Delta e_{it}}{e_{it}} + \frac{\Delta R_{it}}{R_{it}}, \tag{2}$$

where e_{it} denotes the exchange rate of the currency of country i against the US dollar at the end of period t and R_{it} denotes the level of foreign exchange reserves of country i at the end of period t.[3]

Mean absolute change in the exchange rate during period t is calculated as the mean of absolute daily rate of change in the exchange rate of the currency of country i against the US dollar:

[3]Exchange market pressure measures the pressure for a currency to depreciate. Since the depreciation pressure can be lessened by foreign exchange market intervention, an observed change in the exchange rate is likely to underestimate the real size of the depreciation pressure. As a result, exchange market pressure is computed by combining the observed percentage change in foreign exchange rates and the percentage change in foreign reserves. Please refer to Weymark (1995) and Park and Park (2012) for further discussion of the concept and the measurement of exchange market pressure.

$$MACE_{it} = \sum_{s=1}^{N_t} \left| \frac{\Delta e_{is}}{e_{is}} \right| / N_t, \tag{3}$$

where N_t denotes the number of trading days in period t.

4.1 Investment Inflows and Foreign Exchange Market Stability

The regression model to explain the instability in the foreign exchange market is specified as follows:

$$\begin{aligned} Y_{it} = {} & \beta_0 + \beta_1 Growth_{it} + \beta_2 Inflation_{it} + \beta_3 Govdebt_{it} + \beta_4 Exdebt_{it} \\ & + \beta_5 Current_{it} + \beta_6 REER_{it} + \beta_7 TED_{it} + \beta_8 FDI_{it} + \beta_9 Equity_{it} \\ & + \beta_{10} Debt_{it} + \beta_{11} Other_{it} + u_{it}. \end{aligned} \tag{4}$$

In equation (4), Y_{it} denotes the degree of foreign exchange market instability of country i at time t measured by EMP or MACE. The explanatory variables are chosen based on previous empirical studies including Aizenman and Hutchison (2010), Aizenman, Lee and Sushko (2010), and Park and Park (2012). Most of these variables are expected to affect the demand and the supply of foreign exchange in the foreign exchange market. In the following, we discuss the rationale for including each variable and the expected sign of its coefficient.

Growth denotes the growth rate of real gross domestic product and *Inflation* denotes the inflation rate measured by the change in the consumer price index. Lower growth and higher inflation make investment in a country less attractive, thereby increasing the pressure for its currency to depreciate and making the foreign exchange market unstable. As a result, *Growth* is expected to have a negative coefficient while *Inflation* is expected to have a positive coefficient.

Govdebt is the ratio of government debt to GDP and *Extdebt* is the ratio of external debt to international reserves. Countries with a higher burden of government debt or a larger external debt are more likely to suffer from a debt crisis or an international liquidity crisis caused by sudden reversal of capital flows, making investment in those countries less attractive. Therefore, the coefficients of *Govdebt* and *Extdebt* are expected to be positive.

Current is the current account balance as a percentage of GDP. A

large current account deficit itself is a source of depreciation pressure. In addition, economies with large current account deficits are more likely to suffer more from sudden reversal of capital flows when international financial markets become turbulent. As a result, this explanatory variable is expected to have a negative coefficient.

REER is the real effective exchange rate of country i against a group of its major trading counterparts. Real exchange rates can affect the stability of the foreign exchange market not only through their effects on the current account balance but also through their effects on cross-border investment flows. A higher value for *REER* implies that it is more likely that the currency of the country is overvalued. Since the exchange rate of an overvalued currency is expected to return to the equilibrium level in the long run, an overvalued currency is likely to depreciate in the future, making investment in the assets denominated in that currency less attractive. Thus, the coefficient of *REER* is expected to have a negative value.

TED is the difference between the interest rate on interbank loans in the London Interbank Market (LIBOR) and the interest rate on US Treasury Bills (T-bills), which is usually termed as the TED spread. It is known that the TED spread is an indicator of perceived credit risk in international financial markets. This is because T-bills are considered risk-free while LIBOR reflects the credit risk of lending to commercial banks. As the TED spread widens, emerging market economies will find it more difficult to raise funds from international financial markets. Thus, the coefficient of *TED* is expected to have a positive sign.

Finally, *FDI*, *Equity*, *Debt*, and *Other* denote net FDI inflows, net portfolio equity inflows, net portfolio debt inflows and net other inflows as a percentage of annual GDP, respectively. Unlike the previous section, the net inflows data are used without normalization.

We first estimate equation (4) using quarterly, cross-country panel data. The sample consists of 23 emerging market economies. As for the time series, our full sample period runs from the first quarter of 2001 to the last quarter of 2010.

The data on net investment inflows, GDP, international reserves (minus gold), exchange rates against the US dollar, current account balance, government debt and consumer price index are obtained from the IMF International Financial Statistics database. The gross external debt data are attained from the Quarterly External Debt Statistics database, provided

jointly by the IMF and the World Bank. The data on the TED spread are obtained from the Datastream as the difference between the 3-month Eurodollar LIBOR and the 3-month T-bill rate.

Following Aizenman, Lee and Sushko (2010), the sample period is divided into two periods, the great moderation period and the global financial crisis period. The great moderation refers to the remarkable drop in macroeconomic volatility and cost of risk in advanced economies. Since recent observers generally refer to 1987-2007 as the great moderation period, we identify the great moderation period as the period from 2001:Q1 to 2007:Q1 in this study. The great moderation period came to an abrupt end with the breakout of the global financial crisis of 2008-09 that originated in the US. In this study, we identify the global financial crisis period as the period from 2008:Q1 to 2009:Q2 during which most of the emerging market economies were faced with substantial pressure of currency depreciation. Table 2 presents some summary statistics for the variables used in the regression analysis during the great moderation period. Table 3 presents the same summary statistics for the global financial crisis period.

Table 2. Summary Statistics for Regression Variables, 2001:Q1-2007:Q1

Variables	Mean	SD	Min	Max
Growth rate (%)	3.80	3.00	-16.34	14.44
CPI inflation (%)	5.02	7.07	-3.70	70.33
Government debt (% of GDP)	51.52	31.56	4.10	191.00
External liabilities (% of Reserves)	16.13	36.60	1.96	330.21
Current account balance (fraction of GDP)	0.02	0.08	-0.32	0.31
Real effective exchange rate (2010 = 100)	96.04	22.21	45.34	281.29
TED spread (%)	27.21	9.51	14.60	45.79
Net FDI inflows (% of GDP)	4.1	6.4	-26.5	66.3
Net portfolio equity inflows (% of GDP)	0.7	2.6	-18.5	33.8
Net portfolio debt inflows (% of GDP)	3.1	11.4	-11.4	132.7
Net other investment inflows (% of GDP)	3.9	17.2	-62.6	212.3
EMP (%)	-4.0	14.8	-132.0	206.9
MACE (%)	0.41	0.29	0.001	3.88

Table 3. Summary Statistics for Regression Variables, 2008:Q1-2009:Q2

Variables	Mean	SD	Min	Max
Growth rate (%)	1.36	7.88	-14.74	50.23
CPI inflation (%)	6.76	6.10	-2.79	34.72
Government debt (% of GDP)	47.39	34.56	5.18	216.3
External liabilities (% of Reserves)	20.5	56.7	1.7	364.3
Current account balance (fraction of GDP)	0.00	0.10	-0.43	0.23
Real effective exchange rate (2010 = 100)	98.96	11.93	72.01	158.37
TED spread (%)	132.01	55.90	68.56	247.13
Net FDI inflows (% of GDP)	5.2	9.9	-25.5	92.8
Net portfolio equity inflows (% of GDP)	0.0	4.6	-34.7	34.6
Net portfolio debt inflows (% of GDP)	-0.4	14.6	-122.6	75.6
Net other investment inflows (% of GDP)	0.8	24.5	-136.1	108.1
EMP (%)	0.44	18.08	-59.64	53.68
MACE (%)	0.72	0.49	0.004	2.92

Comparing these two tables, we can find that both exchange market pressure (EMP) and foreign exchange rate volatility (MACE) on average was higher during the global financial crisis. In addition, we can observe that, except for FDI inflow, net investment inflow as a percentage of GDP was higher during the great moderation period than during the global financial crisis period.

Table 4 presents the estimation results for the exchange market pressure during the great moderation period and during the global crisis period separately. Model (1) and (3) include inflows of all four types of cross-border investment. Model (2) and (4) are estimated with only net portfolio debt investment inflows in order to focus on the analysis of the effect of foreigners' investment in domestic bonds. Since the data used for estimation has a panel structure, we first applied the Hausman test.

Based on the result of the Hausman test, the random effect model specification is rejected in favor of the fixed effect model. Since the TED spread does not vary across economies, however, the fixed effect model cannot be estimated with time dummies. As a result, we estimate equation (4) with individual country dummies by the least squares estimation method.

The coefficient estimates for most of the explanatory variables presented in Table 4 have the expected sign although a few of them are not

significantly different from zero. In particular, *Growth* has a significantly negative coefficient implying that higher growth mitigates the pressure of currency depreciation. Higher government debt to GDP ratio, on the other hand, had a statistically significant contribution to the enlarging of the exchange market pressure during the great moderation period but not during the global crisis period. The coefficient of *TED* is significantly posi-

Table 4. Estimation Results for EMP

	Moderation Period 2001:Q1-2007:Q1		Crisis Period 2008:Q1-2009:Q2	
Variables	(1)	(2)	(3)	(4)
Growth Rate	-1.050***	-1.217***	-0.185	-0.368
	(0.263)	(0.263)	(0.262)	(0.258)
Inflation Rate	-0.386***	-0.382***	1.008	0.712
	(0.127)	(0.129)	(0.752)	(0.752)
Government Debt (% of GDP)	0.357***	0.379***	1.554**	1.325**
	(0.068)	(0.068)	(0.664)	(0.637)
External Liabilities (% of Reserves)	-0.363	-0.355	-4.005	-1.719
	(0.525)	(0.521)	(3.414)	(3.243)
Current Account Balance(% of GDP)	-20.022	-1.747	15.649	25.182
	(12.554)	(11.783)	(28.714)	(28.837)
Real Effective Exchange Rate	0.311***	0.300***	0.717***	0.697***
	(0.052)	(0.053)	(0.196)	(0.188)
TED Spread	0.126*	0.082	0.085***	0.121***
	(0.065)	(0.064)	(0.031)	(0.028)
FDI Inflows (% of GDP)	-22.253	—	31.992*	—
	(17.417)		(19.215)	
Portfolio Equity Inflows (% of GDP)	-38.562	—	-99.512	—
	(37.955)		(109.967)	
Portfolio Debt Inflows (% of GDP)	-92.439***	-93.988***	-67.919*	-73.883*
	(19.541)	(19.739)	(38.468)	(37.942)
Other Investment Inflows(% of GDP)	-63.260***	—	-66.882**	—
	(16.220)		(27.570)	
Constant	-38.388***	-37.822***	-167.932***	-176.418***
	(8.260)	(8.273)	(58.952)	(59.119)
Observations	474	474	120	120
R-squared	0.376	0.352	0.470	0.427

Note: Standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

tive, meaning that decrease of risk appetite in international financial markets augments the exchange market pressure.

As for the investment inflow, all forms of investment inflows except for other investment significantly contributed to increasing appreciation pressure during the great moderation period. During the financial crisis period, however, only portfolio debt investment flows and other investment flows had a significant effect on exchange market pressure. Such a result implies that borrowings from foreigners, whether these be in the form of portfolio debt investment or loans from financial institutions, are likely to put depreciation pressure on the currencies of emerging market economies during periods of international financial turbulence.

In addition to looking into the effect on the exchange market pressure, we also investigate the effect of cross-border investment inflows on the volatility of foreign exchange rates by estimating equation (4) with mean absolute change in exchange rates ($MACE$) as the dependent variable. The results are presented in Table 5. Unlike the exchange market pressure, none of the four categories of investment inflows had significant influence on the volatility of exchange rates during the great moderation period.

Table 5 shows that only growth rates, government debt and currency overvaluation ($REER$) had significant effects on exchange rate volatility during the great moderation period. During the global financial crisis, however, portfolio debt investment inflow had a significantly negative coefficient, implying that increase in portfolio debt investment outflow significantly increased exchange rate volatility.[4]

[4]Models in tables 4 and 5 were also estimated with $Current$ excluded from the explanatory variables. The results were similar to those reported in tables 4 and 5.

Table 5. Estimation Results for FX Volatility

Dependent variable:	FX volatility			
	Moderation Period		Crisis period	
Time sample:	2001:Q1-2007:Q1		2008:Q1-2009:Q2	
	(1)	(2)	(3)	(4)
Growth Rate (%)	-0.017***	-0.017***	-0.008	-0.010*
	(0.005)	(0.005)	(0.006)	(0.005)
Inflation Rate (%)	0.004	0.004	-0.016	-0.019
	(0.002)	(0.002)	(0.016)	(0.016)
Government Debt (% of GDP)	0.011***	0.011***	0.034**	0.031**
	(0.001)	(0.001)	(0.014)	(0.013)
External Liabilities (% of Reserves)	0.001	0.000	-0.067	-0.045
	(0.010)	(0.010)	(0.073)	(0.067)
Current Account Balance (% of GDP)	-0.129	-0.114	0.318	0.409
	(0.239)	(0.221)	(0.611)	(0.595)
Real Effective Exchange Rate	0.004***	0.004***	-0.003	-0.003
	(0.001)	(0.001)	(0.004)	(0.004)
TED Spread	0.000	0.000	0.004***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
FDI Inflows (% of GDP)	0.127		0.316	
	(0.331)		(0.409)	
Portfolio Equity Inflows (% of GDP)	0.953		-1.415	
	(0.722)		(2.339)	
Portfolio Debt Inflows (% of GDP)	-0.565	-0.517	-1.431*	-1.524*
	(0.372)	(0.370)	(0.818)	(0.783)
Other Investment Inflows (% of GDP)	-0.158		-0.624	
	(0.309)		(0.586)	
Constant	0.069	0.096	-0.721	-0.758
	(0.157)	(0.155)	(1.254)	(1.220)
Observations	474	474	120	120
R-squared	0.574	0.572	0.748	0.743

Note: Standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

In conclusion, the regression analysis reveals that portfolio debt investment flows have potential to destabilize the foreign exchange market in emerging market economies especially when they are accompanied by flows of other types of investment flows including FDI, portfolio equity investment and other investment.

5 Effectiveness of Capital Flow Management Measures

The experience of the Asian currency crisis of 1997-98 and the global financial crisis of 2008-09 has inspired lively discussion on the usefulness of CFMs as a tool to sustain foreign exchange market stability against volatile cross-border capital flows. For example, Ostry et al (2010) argue that when there is little room for the role of domestic macroeconomic policies such as exchange rate adjustment, foreign exchange market intervention, and monetary and fiscal policies, CFMs can be a useful part of the policy toolkit for emerging market economies to address the problem of massive investment inflows.[5]

Inspired by this recent discussion, several emerging market economies newly introduced CFMs to cope with surges in capital inflows after the global financial crisis. Most of these economies are those that had already liberalized cross-border capital account transactions earlier. Some of these measures were intended to affect inflows of a particular type of investment such as inflows into domestic bond markets.

Thailand and Korea, for instance, introduced a withholding tax on interest income earned by non-residents from domestic bonds in October 2010 and November 2010, respectively. Since these withholding taxes are imposed on residents as well as non-residents, they are classified as non-residency based CFMs. Meanwhile, in response to the surge of investment inflows into SBIs[6], Indonesia introduced a minimum holding period of one month for investment in SBIs in June 2010. Brazil introduced a financial transactions tax on investment in domestic equities and bonds by non-residents in October 2009 and raised the tax rate in October 2010.

We evaluate the effectiveness of the CFMs recently introduced by emerging market economies by estimating the abnormal change in capital inflows, which is computed in the following way. Suppose that one wants to evaluate the effect of a CFM introduced in period t. One way to achieve this goal is to compare the investment inflows after the CFM was

[5]Park (2001) showed that devaluations can be anticipated and can actually occur even if very tight capital controls are introduced.

[6]SBIs are short-term bonds issued by Bank Indonesia to control money supply.

introduced with those before period t. This approach, however, is subject to the following critiques. Since CFMs are usually introduced when capital inflows are on an upward trend, investment inflows may still increase if CFMs are introduced, making them look ineffective. In addition, other factors affecting investment inflows may change after the introduction of CFMs.

These problems can be avoided by estimating the counter-factual investment inflows to domestic bond markets that would have taken place if the CFMs were not introduced and by comparing the counter-factual investment inflows with the actual investment inflows that took place during period t. This is the method typically employed by the finance literature to evaluate the effect of a certain event on stock returns.

The counter-factual capital inflows can be estimated by using an econometric method. Suppose that one wants to evaluate the effects of a CFM introduced at the beginning of period s on the investment inflows to the domestic bond markets of country k. At first, the following regression model is estimated using the panel data consisting of all countries in the sample and covering the period preceding period s.

$$Y_{it} = \alpha + \gamma_i + X_{it}\beta + u_{it}, \quad i = 1, ..., N, \quad t = 1, ..., s-1 \tag{5}$$

In equation (5), Y denotes the variable on which the effect of introducing a CFM is evaluated, X denotes the vector of explanatory variables, and γ denotes the coefficient representing the country fixed effect. Note that equation (5) is estimated using the sample prior to the period in which the CFM is introduced. Using the estimates for the coefficients, the amount of Y that would have appeared in country k during period s had it not been for the CFM can be estimated as follows:

$$\hat{Y}_{ks} = \hat{\alpha}_{s-1} + \hat{\gamma}_{ks-1} + X_{ks}\hat{\beta}_{s-1} \tag{6}$$

The effect of introducing the CFM on Y is measured as the difference between $Y_{ks'}$, the actual investment inflow and $\hat{Y}_{ks'}$, the counter-factual investment inflow. The effectiveness of introducing CFMs on Y can be tested by using a duality test, that is by testing if the sample mean of $Y_{ks} - \hat{Y}_{ks}$ is significantly negative.

The data for portfolio investment holdings and other investment hold-

ings of foreigners are attained from the IIP (International Investment Position) section of the IMF International Financial Statistics database. For the degree of capital market openness, we use the KAOPEN index provided by Ito and Chinn (2007). The interest rate differential is computed as the difference of the money market interest rate of each country and that of the US. The data for all the other variables are obtained from the same sources as the data used in estimating equation (4).

The sample consists of nine emerging market economies, namely, Brazil, Colombia, Czech, Indonesia, Korea, Peru, Philippines, Russia and Thailand. These are the emerging market economies that pretty much liberalized capital account transactions earlier but have recently introduced CFMs in order to manage large capital inflows.

Table 6. Estimation Results for Capital Inflows and External Debt

	Cf1	Cf2	Cf3	Debt1	Debt2
Trade Openness	0.060**	0.006	-0.005	-0.058	-0.139***
Current Account(% of GDP)	-0.130	0.002	0.003	0.002	-0.221***
Financial Openness	-0.012**	-0.002	0.001	0.021**	0.030***
Financial Deepness	0.065***	0.009**	0.017**	-0.008	-0.005
Sovereign Credit Rating	0.004	-0.001	0.003**	0.025***	0.039***
Interest Rate Differential	-0.102	-0.035	0.004	-0.021	-0.102
Growth Rate	0.081*	-0.009	-0.016	0.337***	0.212***
TED Spread	-0.003***	-0.001***	-0.001***	-0.0002***	-0.0002***
Constant	-0.055*	0.014	-0.024	-0.073	-0.097***
R-squared	0.30	0.16	0.19	0.87	0.94

Notes 1) *** $p<0.01$, ** $p<0.05$, * $p<0.1$

2) Cf1=(portfolio investment+other investment)/GDP,
Cf2=portfolio equity investment/GDP,
Cf3=portfolio debt investment/GDP,
Debt1=short-term external debt/total external debt,
Debt2=external debt of the banking sector/total external debt

3) All of the models were estimated with country dummies. The coefficient estimates of the country dummies (γ), however, are not reported in this table.

We focus on five variables to evaluate the effectiveness of introducing CFMs: sum of portfolio inflows and other investment inflows (Cf1), net portfolio equity inflows (Cf2), net portfolio debt inflows (Cf3), short-term

external liabilities (Debt1), and external liabilities of the banking sector (Debt2). All of the inflows are net inflows on the liability side of the balance of payments table measured as a percentage of annual GDP. Short-term external liabilities and external liabilities of the banking sector are measured as a ratio of total external liabilities.

Table 6 presents the estimates of the coefficients computed using the entire sample of nine countries from 2001:Q1 to 2010:Q4 with each of the five variables as the dependent variable. The estimates of the coefficients in general coincide with the prediction of economic theories especially when they are significantly different from zero. Higher degree of trade openness and financial deepness contribute to larger investment inflows. Higher sovereign rating and higher growth rate also contribute to larger investment inflows and larger short-term external liabilities. Higher TED spread reduces the size of net capital inflows.

In this paper, we investigate 15 episodes of introducing CFMs. All of these CFMs were introduced with the intention to mitigate investment inflows. Table 7 lists these episodes together with a brief description of the CFMs introduced. Among these, 8 episodes are capital controls that discriminate between residents and non-residents. The other 7 episodes (labeled other CFMs) are non-residency based CFMs that are applied to residents and non-residents alike. Among these, four can be further classified as macro-prudential regulations.[7]

Table 8 presents the results of the duality test to examine the effectiveness of introducing CFMs. The duality test is applied to all CFMs as well as separately to capital controls and other CFMs. As we can see from the table, capital controls are somewhat effective in reducing overall investment inflows and portfolio debt investment inflows. Other CFMs, however, are not effective in reducing investment inflows. On the contrary, Table 8 demonstrates that other CFMs as well as capital controls are quite effective in reducing short-term external debt and external debt of the banking sector. The findings from Table 8 are consistent with the conclusion of recent studies on the effectiveness of CFMs that these are effective in changing the composition rather than the size of capital inflows.

[7]Columbia introduced macro-prudential regulations as well as capital controls at the same time in May 2007.

Table 7. List of the CFMs Introduced by the Sample Economies

Country	Type	Time	Contents
Brazil	Other CFMs	2007.01	Introduction of reserve requirement on short-term FX position of banks
	Controls	2009.10	2% IOF tax on investment in domestic equities and bonds by non-residents
	Controls	2010.10	IOF tax raised to 6% on bond investment by non-residents and 4% on equity investment
Columbia	Controls	2007.05	Imposition of Non-remunerated reserve requirement on portfolio investment by non-residents
	Other CFMs	2007.05	Introduction of a limit on the FX derivative position of banks (500% of capital)
Czech	Controls	2008.01	Imposition of Non-remunerated reserve requirement on portfolio investment by non-residents
IIndonesia	Other CFMs	2010.06	Minimum holding period imposed on investment in SBIs
Korea	Other CFMs	2010.06	Introduction of limits on the FX derivative position of banks and foreign bank branches
	Other CFMs	2010.11	Introduction of withholding tax on income from Treasury Bonds and MSBs
Peru	Controls	2009.01	Prohibition of investment in central bank bonds by non-residents
	Other CFMs	2010.01	Limits on FX position of banks strengthened
Philippines	Controls	2007.05	Prohibition of non-residents from acquiring 100% of voting stocks of domestic banks
Russia	Controls	2004.08	Imposition of non-remunerated reserve requirement on portfolio investment
Thailand	Controls	2006.10	Non-remunerated reserve requirement imposed
	Other CFMs	2010.10	Introduction of withholding tax on income from government bonds

Table 8. Effectiveness of CFMs in Reducing Investment Inflows

	Cf1 (Portfolio +Other)	Cf2 (Equity)	Cf3 (Bond)	Debt1	Debt2
CFMs	0.0146	0.0042	0.0009	-0.0290**	-0.0009
	(1.5533)	(1.6998)	(0.2156)	(-2.4385)	(-0.0157)
Controls	-0.0341**	-0.0022	-0.0144*	-0.0191*	-0.0031
	(-2.5015)	(-0.2342)	(-1.9762)	(-1.3982)	(-0.1738)
Other CFMs	0.0113	0.0031	-0.0003	-0.0171	-0.0229*
	(0.8433)	(1.0318)	(-0.0785)	(-0.7866)	(-1.6548)

Note: 1) The numbers are calculated as the sample mean of the difference between the actual capital inflow and the estimated counter-factual capital inflow. The numbers in parentheses are the t statistics.

2) *, **, and *** mean that the null hypothesis can be rejected at 10%, 5%, 1% significance level (one-sided test).

3) Cf1=(portfolio investment+other investment)/GDP,
Cf2=portfolio equity investment/GDP,
Cf3=portfolio debt investment/GDP,
Debt1=short-term external debt/total external debt,
Debt2=external debt of the banking sector/total external debt

Table 9. Effectiveness of CFMs in Reducing Portfolio Debt Inflows

Country	Type	Time	ΔY	$Y-\hat{Y}$	Effectiveness
Brazil	control	2009Q4	-0.0070	-0.0146	○
	control	2010Q4	-0.0096	-0.0104	○
Colombia	control	2007Q2	0.0306	0.0060	×
Czech	control	2008Q1	0.0260	0.0570	×
Indonesia	other	2010Q2	-0.0335	-0.0002	×
Korea	other	2010Q4	-0.0270	-0.0262	○
Peru	control	2009Q1	0.0504	-0.0065	○
Russia	control	2004Q3	0.0060	0.0100	×
Thailand	control	2006Q4	-0.0130	-0.0180	○
	other	2010Q4	-0.0123	0.0113	×

Note: ○ means that the null hypothesis is rejected at 5% significance level.

One of the shortcomings of the duality test presented in Table 8 is that a single outlier may have too large an effect on the outcome of the test. In addition, it cannot tell us if a particular case of introducing a CFM was successful or not. In order to find out if each individual CFM introduced

was effective, we test if the actual investment inflow into country k during period s satisfies the following:

$$Y_{ks} < \hat{Y}_{ks} - t_{\alpha}\hat{\sigma} \tag{7}$$

where t_{α} stands for the t value corresponding to the significance level of $100(1-\alpha)\%$ and $\hat{\sigma}$ stands for the standard deviation of $\hat{Y}_{ks}$.

Table 9 presents the results of testing the effectiveness of individual CFMs introduced by the emerging market economies with the intention to reduce portfolio debt investment inflows. Among the 15 CFMs listed in table 7, only 10 CFMs were introduced with the intention of managing portfolio debt investment inflows. The other 5 CFMs including the 2007 capital controls of the Philippines were excluded from table 9 because these were intended to manage portfolio equity inflows or external debt of the banking sector. As the table shows, the counter-factual analysis ($Y-\hat{Y}$) and the comparison between the amount of investment inflows before and after introduction of a CFM (ΔY) produce identical verdicts about its effectiveness most of the time.[8] There are only two cases in which these two criteria produced different verdicts.

The results are mixed about the effectiveness of capital controls in reducing portfolio debt inflows. On the whole, however, capital controls seem to have been more successful in reducing portfolio debt inflows than other CFMs. In four out of seven cases, capital controls were effective. On the contrary, re-introduction of the withholding income tax in Korea is the only case in which other CFMs were effective.

Previous literature on the effectiveness of CFMs points out that although CFMs are effective, their effects are likely to be short-lived as investors find out ways to circumvent them. Tables 10 and 11 repeat the same analysis as that in Table 9 but investigate the effectiveness of CFMs during four quarters as well as one quarter after they were introduced.

Table 10 demonstrates that the effects of CFMs tend to diminish in the longer run. It turns out that in 1 out of the 3 cases in which CFMs were

[8]In addition to these, one may see if the growth rate of net investment inflows has decreased after introduction of a CFM. This criterion is applicable to gross investment inflows but not to net investment inflows. It is because the growth rate of net investment inflows are very unstable, varying widely between quarters even though net investment inflows in general show an upward trend.

effective in reducing portfolio debt inflows in the short run, they were no longer effective in the long run. On the contrary, as we can see from Table 11, in all of 4 cases macro-prudential regulations were effective in reducing short-term external debt in the long run. In the case of Brazil, the macro-prudential regulations were effective in the longer run although they did not seem to be effective in the short run.

Table 10. Long-run Effects of CFMs in Reducing Portfolio Debt Inflows

Country	Type	Time	ΔY	$Y-\hat{Y}$	Effect (1 Qr)	Effect (4 Qr)
Brazil	control	2009Q4	-0.0180	-0.0250	○	○
Colombia	control	2007Q2	-0.0080	0.0000	×	×
Czech	control	2008Q1	0.0009	0.0200	×	×
Indonesia	other	2010Q2	-0.0071	0.0062	×	×
Peru	control	2009Q1	-0.0504	-0.0065	○	○
Russia	control	2004Q3	-0.0092	0.0041	×	×
Thailand	control	2006Q4	-0.0120	0.0050	○	×

Note: ○ means that the null hypothesis is rejected at 5% significance level.

Table 11. Long-run Effects of Macro-prudential Regulations

Country	Type	Time	ΔY	$Y-\hat{Y}$	Effect (1 Qr)	Effect (4 Qr)
Brazil	macro	2007Q1	–	–	0.1040	-0.0720
Brazil	macro	2007Q1	0.1040	-0.0720	×	○
Colombia	macro	2007Q2	-0.0115	-0.0447	○	○
Korea	macro	2010Q2	-0.0086	-0.0228	○	○
Peru	macro	2010Q1	0.0306	-0.0092	○	○

Note: 1) ○ means that the null hypothesis is rejected at 5% significance level.
2) Macro stands for macro-prudential regulations.

6 Conclusion

This paper investigated if the surge in portfolio debt inflows experienced by some emerging market economies after the global financial crisis

can pose a serious threat to the stability of their foreign exchange markets. The regression analysis with the panel data comprising 23 emerging market economies reveals that portfolio debt outflows are capable of destabilizing foreign exchange markets especially when they are accompanied by portfolio equity outflows and other investment outflows.

The possibility of large investment outflows to disrupt stability in foreign exchange markets and to give rise to currency crises in emerging market economies calls for the use of CFMs to manage large capital inflows. The counter-factual analysis presented in this paper reveals that non-residency based CFMs (other CFMs) were somewhat effective in reducing portfolio debt investment inflows although they were not as effective as capital controls that are imposed on non-residents alone. The effectiveness of non-residency based CFMs and capital controls, however, tends to diminish in the long run. On the other hand, the same analysis demonstrates that the CFMs including some macro-prudential regulations introduced by emerging market economies were effective in managing the size of the external debt of financial institutions.

The findings of this paper have several important implications on designing and implementing policies to manage large investment inflows in emerging market economies. First, the efforts to manage capital inflows in emerging market economies should give priority to introducing macro-prudential regulations to manage the size of short-term external debt of financial institutions. Empirical studies have repeatedly demonstrated that large short-term external liabilities have been the key factor in the currency crisis episodes of emerging market economies. In addition, macro-prudential regulations are quite effective in managing the size of short-term external debt of financial institutions.

Secondly, although domestic bond holdings by foreigners may not be as serious a threat to foreign exchange market stability as short-term external liabilities of financial institutions, it is still possible that they disrupt foreign exchange market stability, especially when foreign investors withdraw their investment simultaneously. Therefore, emerging market economies need to monitor the size of foreign holdings of domestic bonds and introduce relevant CFMs if necessary.

Thirdly, instead of relying on capital controls that are likely to have distortionary effects on the economy, other means of maintaining foreign exchange market stability should be pursued. These include establishing

and strengthening international financial safety nets.

References

Aizenman, J. and M. Hutchison, "Exchange market pressure and absorption by international reserves: Emerging markets and fear of reserve loss during the 2008-09 Crisis," NBER Working Paper No. 16260, 2010.

Aizenman, J., J. Lee and V. Sushko, "From the great moderation to the global crisis: Exchange market pressure in the 2000s," NBER Working Paper No. 16447, 2010.

Alfaro, L., S. Kalemli-Ozcan and V. Volosovych, "Capital flows in a globalized world: The role of policies and institutions," in Sebastian Edwards (ed.) Capital Controls and Capital Flows in Emerging Economies, The University of Chicago Press: Chicago, 2007, 19-68.

Baba, C. and A. Kokenyne, "Effectiveness of capital controls in selected emerging markets in the 2000s," IMF Working Paper WP/11/281, 2011.

Binici, M., M. Hutchison, and M. Schindler, "Controlling capital? legal restrictions and the asset composition of international financial flows," IMF Working Paper, 2010.

Frankel, J.A. and A.K. Rose, "Currency crashes in emerging markets: An empirical treatment," *Journal of International Economics* 41, 1996, 351-366.

Gochoco-B., M. Socorro, J. Jongwanich, and J. Lee, "How effective are capital controls in Asia?", ADB Economics Working Paper Series No. 224, Asian Development Bank, 2010.

Habermeier, K., A. Kokenyne, and C. Baba, "The effectiveness of capital controls and prudential policies in managing large inflows," IMF Staff Discussion Note, SDN/11/14, 2011.

Hawkins, J., and M. Klau, "Measuring potential vulnerabilities in emerging market economies," BIS Working Paper No. 91, 2000.

Ito, H. and M. Chinn, "A new measure of financial openness," Working

Paper, 2007.

Lee, J. and H. Lee, "Testing for spillover between stock market and foreign exchange market in Korea," *Journal of Economic Research* 14, 2009, 329-340.

Magud, N. and C. Reinhart, "Capital controls: An evaluation," in Sebastian Edwards (ed.) Capital controls and capital flows in emerging economies, The University of Chicago Press: Chicago, 2007, 645-674.

Ostry, J.D., A. Ghosh, K. Habermeier, M. Chamon, M.S. Qureshi, and D.B.S. Reinhardt, "Capital inflows: The role of controls," IMF Staff Position Note 10/04, 2010.

Ostry, J.D., A.R. Ghosh, K. Habermeier, L. Laeven, M. Chamon, M.S. Qureshi, and A. Kokenyne, "Managing capital inflows: What tools to use?", IMF Staff Discussion Note, SDN/11/06, 2011.

Park, C.W., and D. Park, "Short-term external debt and fear of losing international reserves," *Korea and the World Economy* 13 (3), 2012, 329-49.

Park, D., "Anticipated devaluation under capital controls," *Journal of Economic Research* 6, 2001, 127-142.

Peng, Y., and W.L. Ng, "Extreme spillover effects of volatility indices," *Journal of Economic Research* 17, 2012, 1-18.

Sachs, J., A. Tornell, and A. Velasco, "Financial crises in emerging markets: The lessons from 1995," NBER Working Paper No. 5576, 1996.

Schindler, M., "Measuring financial integration: A new data set," *IMF Staff Papers* 56 (1), 2009, 222-238.

Weymark, D.N., "Estimating Exchange Market Pressure and the Degree of Exchange Market Intervention for Canada," *Journal of International Economics* 16, 1995, 55-79.