

PRINCETON UNIVERSITY

SENIOR THESIS

Capital Inflows into Emerging Markets
Post-Global Financial Crisis:
A Story of Portfolio Rebalancing

VU THANH CHAU

ADVISOR: PROFESSOR NOBUHIRO KIYOTAKI

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Abstract

Prior to 2005, emerging markets (EMs) frequently experienced large surges in portfolio investments (“hot money”) followed by sudden stop events, in which foreign capital dries up quickly, disrupting the domestic economy and putting depreciating pressure on EM’s currency. In the aftermath of the 2008-2009 global financial crisis (GFC), conditions from the US and other advanced economies have recreated this exact situation, in which capital inflows into EMs surged from 2009-2011 and destabilized EM’s currency in 2011-2015. However, as we document in this paper, the magnitude of capital outflows and currency depreciation which unfolded in 57 EMs in 2011-2015 is at best moderate, and we find that EMs are less susceptible now to sudden stops than before. To explain this phenomenon, we provide a theory of portfolio rebalancing, in which foreign investors re-balance their debt-equity holding to reduce risk, therefore lending to EMs *more* in risky times. This nets out equity outflows and reduces the total negative effects on the EMs. We also estimate a panel vector autoregressive (PVAR) model to identify the interactions between different channels of capital inflows and the exchange rate, and find that a negative shock to the equity market prompts capital to flow *more* into the same country’s debt market, instead of flowing out. We conclude by extending Mendoza (2006)’s sudden stop model to include portfolio choice in order to provide a theoretical framework of portfolio rebalancing.¹

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1 Introduction

Emerging markets (EMs) are often thought to be vulnerable during episodes of sudden surges in capital inflows. While capital inflows often provide increasing capital availability, allowing domestic residents in EMs to smooth their consumption and firms to expand their production, large amount of capital inflows traditionally caused domestic inflation, local currency appreciation, and most importantly, the risk of sudden-stops. Historically, in the late 1980s Latin American crisis, 1994 Mexican Tequila crisis, and 1997-1998 Asian Crisis, EMs experienced large capital flows only to suffer later from capital flights when foreign investors were convinced that the currency would depreciate. As a result, they liquidated their assets in EMs and dumped the local currencies.

In the aftermath of the 2008-2009 Great Financial Crisis (GFC), a continuing recession in the United States and Europe forced the advanced economies' central banks to keep an environment of low interest rates and implement many unconventional measures such as quantitative easing in the US and elsewhere. While the effects of such policies on advanced economies are still debatable, it is widely agreed that monetary loosening in advanced economies has created an episode of capital surge in emerging markets starting in 2010. Deep-pocketed foreign investors either deposit money into money market funds, which eventually flows into EMs via the global banking system (Bruno and Shin, 2013), or directly purchase emerging market bonds and equities in the search for high-yield investments.

A good example of an emerging market with volatile capital surge is Brazil. Both direct and portfolio investment into Brazil increased by more than 2.5 times from a trough in 2008Q3 to a peak in 2011Q2. Portfolio investment increase was driven strongly by equity investment (more than 3-fold growth) and a less dramatic increase in debt securities investment (increased by 1.8 times). This equity-led capital surge is no surprise, since historically portfolio investment is often referred to as "hot-money" due to its nature of being easy to liquidate. The same behavior of dramatic expansion of capital inflows can be observed in many other emerging markets, including, but not limited to, India, Turkey, and South Africa.

Naturally, EMs were believed to confront the risk of "sudden-stop," a term coined by

Calvo (1998) to indicate a period of (1) sudden loss of access to international capital markets, (2) large capital deficit reversals, (3) sharp reduction of domestic production and GDP, and (4) correction of domestic asset prices as well as the exchange rate. The sudden stop risk "realized" in August 2011, and again in summer 2014, when there was a sharp depreciation of EM currencies as well as slow growth of capital inflows, or in some cases, capital outflows. Figure 1 illustrates the movements of net current account (row 1), the local exchange rate vis-a-vis the US dollar (row 2), domestic industrial production index (row 3), and the outstanding stock of portfolio investment inflows (row 4). The two vertical lines mark the first quarter of 2011 and third quarter of 2014, the two significant EM assets "sell-off" periods.

However, contrary to the experience in previous crises, the depreciation of local currencies was accompanied by neither current account reversal nor collapse of domestic production (see figure 1). Growth in production and current account deficit only paused for two quarters at best, before continuing their trends. In terms of capital flows, the first criterion of Calvo's definition of a sudden stop was also not met: EMs did not lose access to international capital markets. We provide the evidence in figure 2 using a sample of emerging markets, the so-called "Fragile Five." As we can see, while both nominal and real effective exchange rate² depreciated after 2011 (row 1), both debt securities issuance (row 2) and domestic credit extension³ (row 4) grew very robustly. Therefore, contrary to the general misconception, there was no selling-off of EMs' debts. Rather, quite the opposite occurred: foreign investors bought more and more debt as the currencies depreciated.

Therefore, by all account, a sudden stop as defined in Calvo (1998) did not occur in the EMs after GFC. This paper aims to answer the question of how emerging markets can still borrow despite their depreciating currencies. In fact, during the 2011-2014 depreciating period, they seemed to borrow even **more strongly**. The current literature on sudden stops relies on a borrowing constraint (of bond-financing) and other exogenous shocks (liquidity, external interest rate, income shock, etc.) to generate investors' anticipation and sell-off

²Another composite measure of the exchange rate constructed by the BIS, provides the general movement for all bilateral rates instead of the usually reported exchange rate against the US dollar.

³A large part of domestic credit extension is actually also foreign lending via the domestic banking sector using the global bank system.

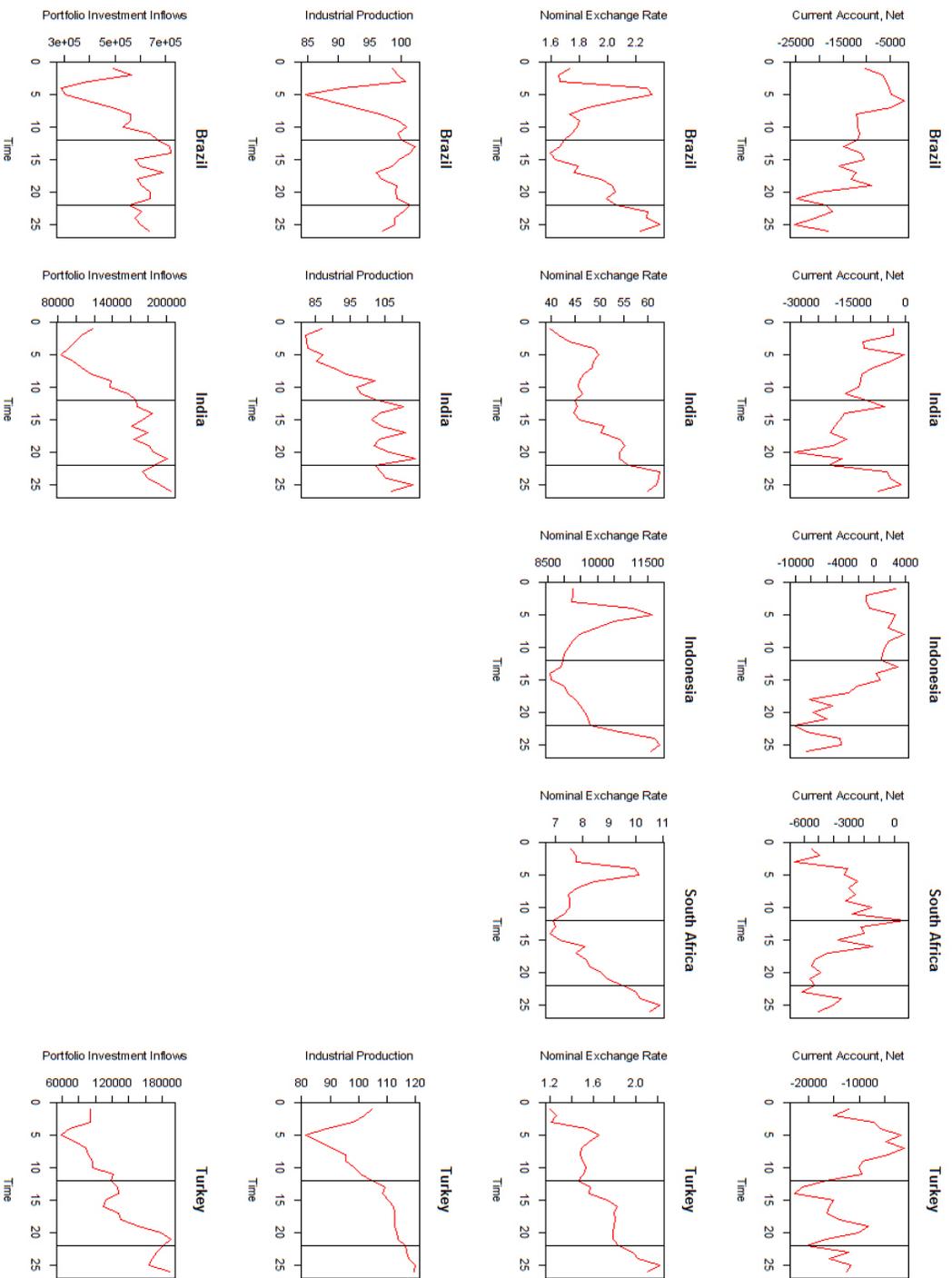


Figure 1: Movements of current account deficits, exchange rates, industrial production and portfolio inflows of the Fragile Five

Source: International Financial Statistics (IFS) by the IMF

From left to right: Turkey, South Africa, Brazil, India, Indonesia.
 From top to bottom: Current Account, Net; Nominal Exchange Rate vis-a-vis US dollar; Industrial Production Index; Portfolio Investment Inflows (liability side of the international investment position).

periods of emerging market bonds. However, the robust growth of debt securities issuance from emerging markets that we observed from 2011-2014 was clearly an empirical counter-example that does not fit in the sudden-stop literature. Therefore, answering the above question can further our understanding of capital inflows into emerging markets, and of when sudden stops happen or not.

To answer that question, this paper focuses on the **components** of capital inflows:

$$\text{Capital inflow} = \text{FDI} + \underbrace{\text{Debt financing} + \text{Equity financing}}_{\text{Portfolio Investment (FPI)}} + \text{Credit flows}$$

and studies the movements of portfolio debt and equity separately instead of total portfolio investments as in traditional literature. This is made possible by using the new data set starting in 2005 of the IMF’s International Financial Statistics data (previously countries only report total portfolio investments, not its decomposition). We document an interesting empirical phenomenon which we term the “**decoupling of equity- and debt-financing,**” in which, in the data, while portfolio debt and equity inflows generally co-move in normal times, in a period of substantial currency risk (i.e. persistent depreciating EM currency) like the 2011-2014 period, they turned to move in opposite directions. From a sample of 54 advanced and emerging markets, we documented this decoupling phenomenon in multiple emerging economies: Brazil, Bulgaria, Chile, Croatia, India, Lithuania, Peru, and Romania. It must also be noted that this decoupling phenomenon in many countries is mainly driven by a combination of fast growth in EM debt securities and sell-off of EM equities.

This finding is somewhat contradictory to Calvo (1998), who suggested that equity financing and long-term bond financing may reduce sudden-stop risk, since when part of the shock-induced loss of the firm is shared on to foreign holders of equity, there is less probability of the firm going bankrupt. The period of 2011-2014 showcases that in period of high currency risk, it was equity investments that were disposed first; not debt. From the observation, we want to make an argument that it was the presence of a healthy local currency bond market in many emerging markets that helped prevent disruptive sudden-stop type events this time. In particular, during episodes of rapid EM currency depreciation, if dividends to equities are not high enough (which was the case for many EMs that had

domestic fundamental issues as well), it may not be worth it for foreign investors to hold on to EM equities. Debt securities, however, remain a solid investment so long as the rate of return is high and the firms are not likely to go bankrupt. Therefore, we argue that for deep pocket investors who are looking for investment opportunities in emerging markets, if the domestic currency is expected to depreciate, foreign investors have an incentive to swap equity holdings into debt holdings, making them substitutes of one another. During normal times, of course, as long as equity and debt investments give comparable returns, foreign investors are indifferent, and therefore, equity and debt co-move.

This paper is organized as follows: section 1 is the introduction, and section 2 provides a literature review on sudden stops and capital inflows into emerging markets. Section 3 provides our empirical findings, answering three questions:

- (1) How are the negative effects of capital inflows on EMs in 2011-2015 compared to prior to the GFC?
- (2) Do portfolio debt and portfolio equity co-move in risky times?
- (3) What channel of capital flows is most important in determining currency depreciation of an EM?

In part (3) of section 3, we use a country fixed effects panel data model to identify the relationship between currency depreciation, channels of capital inflows, global push factors, and local pull factors. However, there may be some endogeneity issue with the standard OLS fixed effects model. Therefore, in chapter 5, we employ a new technique developed by Love and Zicchino (2006) to estimate a **panel vector autoregressive** (PVAR) model on the same data set to address endogeneity issues. The results are presented in section 4. Finally, section 5 provides a theoretical model which provides a framework for our analysis on the dynamics of portfolio equity/debt investment in emerging market. Section 6 concludes.

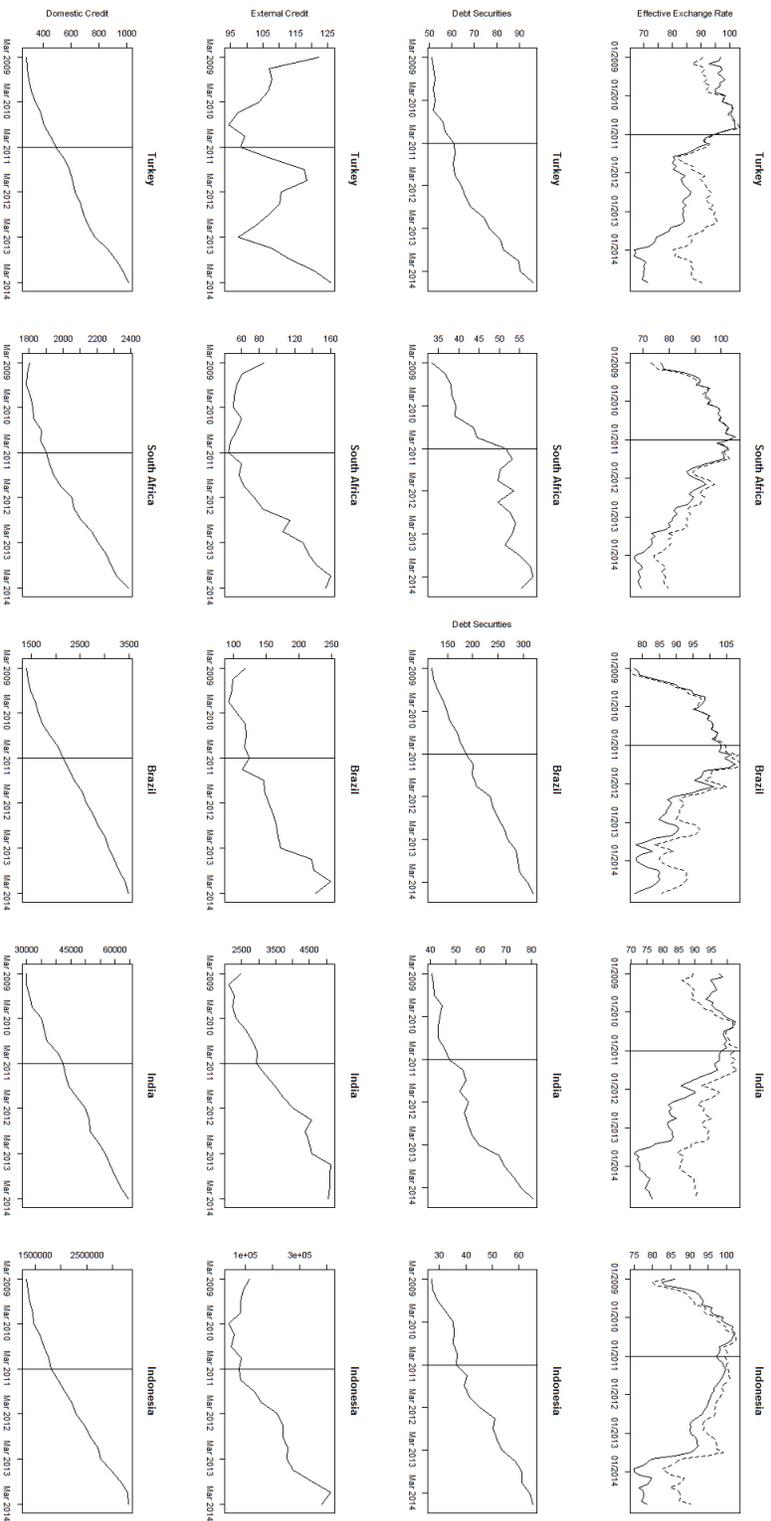


Figure 2: Financial developments in emerging economies

Source: BIS banking statistics, debt securities, and long series on credit extension data. Authors' own calculations.

From left to right: Turkey, South Africa, Brazil, India, Indonesia.

From top to bottom: Nominal (connected) and real (dashed) effective exchange rate; Debt securities issuance; External credit extension to non-financial private sector; Domestic credit extension to non-financial private sector.

2 Literature Review

We can generally classify the existing literature into two branches of research: (1) one branch of research documents empirical facts about capital inflows into emerging markets, its effects and potential causes; and (2) the other branch aims to define and explain "sudden stops" - large fluctuation in output, current account, and prices in emerging markets.

Documenting Capital Inflows

Capital inflows into emerging markets were first carefully analyzed by Reinhart et al. (1993), studying Latin America in late 1980s. The authors categorize the potential factors which induced foreign capital to flow into Latin America into the "push factors", e.g. external forces such as external borrowing cost, economic conditions in advanced economies, world money supply, etc., and the "pull factors", i.e. country's fundamentals. The authors argue that while emerging markets' fundamentals do play a role in explaining capital inflows/outflows, the exaggerated amount of flows is usually caused by external factors. Forbes and Warnock (2012), Shin (2013), and Bruno and Shin (2013) document that the same phenomenon is happening in emerging markets post-GFC, with external factors playing the dominant role once again. Forbes and Warnock (2012) found that the VIX could serve as a single best predictor that explain a large portion of the variation of cross-border flows. Also studying the close linkage between the VIX and levels of cross-border flows, Miranda-Agrippino and Rey (2014) establishes the transmission of financial conditions cross-border via asset prices. Finally we have the part of the literature which studies specifically the "Fed's Taper Tantrum", i.e. the effect of Fed's announcement of possible ending of the quantitative easing program and/or raising US interest rate on emerging market capital flows. Mishra et al. (2014) and Eichengreen and Gupta (2014) both found a clear effect of Fed's announcement on the emerging markets' currency depreciation. Especially, Eichengreen and Gupta (2014) found that bigger and more open emerging markets saw larger impacts on currency depreciation, foreign reserves, and **equity prices**. They hypothesize that this is the result of ability for foreign investors to re-balance their portfolios. This is consistent to the finding and hypothesis that we are putting forth: there are signs of decoupling of equity and debt

financing in emerging markets during periods of heavy local currency depreciation.

The GFC also renewed the interest in revising our theoretical modeling of capital inflows, since the world financial market has evolved a long way since the last sudden stop, and emerging markets have altered the way in which they borrow. We have an accounting identity:

$$\text{Capital inflow} = \text{FDI} + \underbrace{\text{Debt financing} + \text{Equity financing}}_{\text{Portfolio Investment (FPI)}} + \text{Credit flows}$$

In the past, the dominant portion of capital inflows have been FDI, and the "hot-money", which was sensitive to sudden stops, was FPI. However, since most emerging economies did not have a developed financial system, especially a local currency bond market, in the past, portfolio investment usually takes the form of equity investment in the private sector or government bonds. Credit flows, which are loans made from the global banking system to domestic banking system, then to domestic firms in EMs are relatively insignificant compared to the other two components. In recent years, we have seen very fast growth in debt financing and credit flows - the two components that were relatively insignificant in the past - and they now play a great role in international finance. The literature studying credit flows and local bond market has been relatively limited. Bruno and Shin (2013) lays down a framework that allows us to understand the interaction between global banks, domestic banks, and domestic firms. From the model, they devise a mechanism in which an exogenous shock, say local currency appreciation, on exchange rate will increase lending via the banking channels.

Finally, in this paper we look explicitly at capital inflows only, instead of net flows due to the recent concern that net flows may not reveal the kind of important information that we could see by observing gross flow instead. Literature that argues for looking at gross instead of net flows include Forbes and Warnock (2012), Borio and Disyatat (2011), Bruno and Shin (2013).

Literature on Sudden Stops and Portfolio Rebalancing

The term "sudden stop" was coined by Calvo in Calvo (1998), where he argues that sudden stops could appear even if capital inflows take the form of foreign direct investment alone. He went on to argue further that countries may be shielded from sudden stops by financing using equities or long-term bonds. However, our experience in the 1990s crises, and from the movement of capital flows during the Fed's taper tantrum (for which we will give evidence later), equities are always the first form of capital to fly out of the countries. Reinhart and Calvo (2000) documents evidence of painful adjustment following a sudden stop for emerging market.

There have been two main opinions on why sudden stops occur. First, sudden stops may occur as the result of the realization of a bad equilibrium (sun spot models, see Calvo et al. (2008)). However, this explanation is not entirely convincing, as sudden stops do happen in very specific periods (i.e. large surge of capital inflows, depreciating currency, etc.) instead of being entirely random. Furthermore, Morris and Shin (2001) showed that by adding a very little amount of noise to investors, multiple equilibria will not be possible anymore.

A second, and more prominent, explanation for sudden stops is the so-called "Fisherian deflation channel", proposed in Reinhart and Calvo (2000) and Mendoza (2010). These types of models involve an open economy real business cycle with collateral constraint on the emerging market. Reinhart and Calvo (2000) focus specifically on the demand-side effect: a sudden reversal in current account deficit induces aggregate demand to fall, which lowers output via sticky prices through the normal Keynesian channel. However, the effect on output and production in sudden stops is bigger because we also have the Fisherian channel: price of non-tradable is forced to drop through exchange rate pressure, which makes it harder for firms to borrow more or service their debts, causing defaults. However, Mendoza (2006) and Mendoza (2010) argue that there is also a supply side effect, i.e. sudden stops were triggered by a drop in TFP and/or input prices rather than current account reversal, and this was supported by empirical evidence of the Mexican 1995 crisis. The channel of transmission, however, remains the same. Arellano and Mendoza (2002) also show theoretically that sudden stop phenomena are very forward-looking: agents factor in

the risk of sudden stop in their decision making, forcing prices and allocations to be distorted even when constraints do not actually bind.

It is natural then to ask why sudden stops did not happen over the period 2011-2015, during which we had heavy EM currency depreciation (which makes foreign investors prone to loss, since debts are increasingly denominated in local currency), TFP drops in some countries⁴, or the world's potential interest rate rise (Fed's taper tantrum, end of QE). The effects on EMs so far have been limited to currency depreciation, and not so much on the level of capital inflows, as you would expect from the forward-looking sudden stops literature currently.

This paper focuses on portfolio re-balancing (swapping equities for debts) as an option for investors to deal with sudden stop risk; this option is not available in the current literature, as most models only have a single risk-free one-period bond and no holding of equities. Acharya et al. (2007) provides a model of portfolio holding of FDI, documenting that foreign investors bought up Korean firms through FDI despite the ongoing crisis in the economy, since they expect to sell those firms later at a higher price. This counter-cyclical movement of flows is similar to the foreign purchase of debt securities that we document in this paper, only with different motives since debt has short-maturities and are not usually bought for reselling purposes. A more similar paper to ours would be Caballero and Krishnamurthy (2005), who wrote a model which shares similar thinking: when investors are uncertain about the distribution of shocks, they demand safe financial assets for insurance. In our model, risk-free debt securities are non-contingent claims, and therefore safer than state-contingent equities during bad times.

⁴South Africa for example, with ongoing protests in the mining sector.

3 Characteristics of Capital Inflows into Emerging Markets in 2011-2014

In this section, we explore empirically two questions:

- (1) *Did a sudden stop happen in emerging markets between 2011-2014?*

We employ the methodology proposed by Forbes and Warnock (2012) and (Calvo, 1998) on IMF's International Financial Statistics data from 1994 to 2014 to see if there were any sudden stop episodes in EMs after the GFC. We explore two criteria that Calvo (1998) put forth for a sudden stop: (1) large reversal of capital inflows, and (2) sharp correction of prices (here we focus on currency depreciation).

- (2) *Do the interactions between bond holding and equity holding in foreign investors' portfolio differ during normal times (in general, from 2005-2014) from during risky time (2011-2014)?*

We calculate the correlation between outstanding debt and equity holding by foreign investors for both advanced and emerging markets over two periods: 2005-2014 (the whole sample) and 2011-2014 (periods of great EM uncertainty). We found that for emerging markets, especially, in normal time, debt and equity tends to be extremely positively correlated, which one would expect since a favorable EM condition would induce foreign investors to buy both equity and debt of EM due to high profitability. However, the interesting part of our finding is that this correlation quickly turns insignificant (very close to 0) or even extremely negative during "risky time" (2011-2014): investors purchase more and more EM debt while dumping EM's equities. We term this the "de-coupling of debt- and equity-financing," and use this to motivate our hypothesis that investors actively re-balance their portfolios conditional on the state of the economy.

The analysis proceeds in the following pages.

3.1 Capital Inflows Reversals and Currency Depreciation in Emerging Markets after GFC

3.1.1 Detecting Capital Flows Sudden Stops since 2005

In summer 2013, there was a wave of emerging market bonds and equities sell-off that appear similar to a so-called “sudden stop” episode in the past: there was large reversal of capital inflows, accompanied by strong depreciating pressure on the emerging market currencies. In this section, we employed the methodology proposed by Forbes and Warnock (2012) and Calvo et al. (2008) to determine whether a sudden stop episode, defined by large flow reversal, has happened in the aftermath of 2008-2009 financial crisis in emerging markets. Furthermore, we apply the same methodology not only to the overall portfolio investment data, but also to its decomposition, debt and equity investments, data to see which type of investment is more vulnerable and likely to trigger a crisis in risky times.

Methodology: We obtain quarterly data of portfolio investment inflows, debt investment inflows, and equity investment inflows of selected emerging markets⁵ from the IMF’s *International Financial Statistics* database. We need to properly define a “sudden stop” episode. Let $\{\xi_t\}$ be the time series of the variable of interest (portfolio flow, debt flow, or equity flow), where each t is a quarterly observation. We can calculate the moving year-to-year annual value of flow as:

$$\Xi_t = \xi_t + \xi_{t-1} + \xi_{t-2} + \xi_{t-3}$$

This allows us to smooth out changes in flows due to seasonal fluctuation within each economy; and we define the year-to year change in value as

$$\Delta\Xi_t = \Xi_t - \Xi_{t-4}$$

Then, for each quarter t , we can calculate the moving sum m_t and standard deviation s_t of $\{\Delta\Xi_t\}_{t-19}^t$ for the past 5 years (or 20 quarters). A sudden stop is considered to start when there is a quarter t in which $\Delta\Xi_t$ falls a fraction a of one standard deviation below its historical mean ($\Delta\Xi_t < m_t - as_t$), and it is considered to end when $\Delta\Xi_t$ is above a standard

⁵Please refer to appendix A for more information about our sample.

deviation below its historical mean ($\Delta \Xi_t > m_t - as_t$) again. Finally, for this period to be included as a sudden stop, there must be at least a quarter in which $\Delta \Xi_t$ falls below $2a$ standard deviations below historical rolling mean (serious drops). Here a serves as a criteria. Calvo et al. (2008) and Forbes and Warnock (2012) used $a = 1$. In this paper, we provided result of this algorithm for both $a = 1$ (harsh criteria) and $a = 0.5$ (loose criteria).

Result: We report the sudden stop (SS) episodes that we have identified using the algorithm above in Table 2, 3, and 4, which includes episodes of stops in portfolio investment flows, portfolio equity flows, and portfolio debt flows respectively. The boldfaced episodes are those identified by the Calvo criteria ($a = 1$), and the non-boldfaced ones were identified using our less strict definition of a stops ($a = 1/2$). Since portfolio investment is the sum of portfolio debt and portfolio equity investment, a stop in portfolio investment must be driven by a stop of either portfolio debts or portfolio equities, or both. By comparing the timing of episodes between the three tables, we can identify whether the drop in portfolio investment stems from debt or equity. This is noted as a superscript above each episode: a ‘d’ indicates a SS in portfolio investment occurs together with a SS in debt investment inflows, while an ‘e’ indicates association with a SS in equity investment inflows. Capitalized letters indicate they were major SS episodes identified by the Calvo criteria, while lowercase letters indicate that they are smaller SS events identified by our less conservative criteria.

Table 1: Number of Sudden Stop Episodes for Emerging Market in 2005-2015

	Debt	Equity	Debt → Equity	Equity → Debt
Calvo’s criteria ($a = 1$)	1	1	2	9
Our criteria ($a = 0.5$)	3	3	6	15

Finally, we also note the order at which SS happen: ‘de’ indicates that in this portfolio SS episode, the sell off in the debt market happens before equity sell off. Finally, we classify portfolio investment SS into 4 types: (1) a SS in portfolio investment associated with a SS in debt only, (2) a SS in portfolio investment which is associated with a SS in equity only, (3) a SS in portfolio investment which is driven by a SS in debt first, then a SS in equity

after, and (4) a SS in portfolio investment which is driven by a SS in equity first, then a SS in debt after.

We make a few observations:

Observation 1 (Extreme stops). *Extreme sudden stop events (those defined by Calvo) happened simultaneously across emerging markets during the 2008-2009 financial crisis, but not after 2011 in general.*

Observation 2 (Smaller stops). *Smaller stops (those defined by our paper) do happen in many emerging economies after 2011. Furthermore, SS episodes tend to happen more in the equity markets than in the debt markets.*

Judging from Table 3 and 4, it seems that the stops as defined by Calvo did not really happen in emerging market for both portfolio debt and portfolio equities. Therefore, despite having many great external risks (e.g. risk of higher interest rate in the US) and the associated fluctuations, the effects of these risks on emerging markets remain minor compared to historical standards. While there were significant sell offs of equities and debt securities in several emerging markets, these markets in general remain relatively sound. Smaller events did occur, however. We can see from table 3 and 4 that there are 13 portfolio equity SS episodes in 12 different countries from 2011-2015, but only 7 portfolio debt SS episodes.

Observation 3 (Orderly stops). *A portfolio equity SS tends to precede a portfolio debt SS rather than the opposite. In extreme SS events, this is especially true.*

From Table 1, we can see that regardless of the criteria, the number of SS episodes of the type “**Debt** → **Equity**” (i.e. capitals flow out of the bond market first) is more than “**Equity** → **Debt**” episodes. If we consider smaller scale stops, there are 15 Equity-then-Debt stops, but only 6 Debt-then-Equity stops. If we restrict ourselves to the conservative Calvo criteria, there are 9 serious SS in which capitals flow out of the stock market first, while only 2 in which capitals flow out of the bond market first. This implies that in risky time, EM’s stock market is more vulnerable in the near-term than the bond market.

Table 2: Sudden Stops in Inflows of Portfolio Investment

Country	Periods		
1 Armenia	2007Q4-2009Q1 ^{de}	2011Q3-2012Q3 ^{de}	
2 Brazil	2008Q4-2009Q4 ^{Ed}	2012Q1-2013Q2 ^{ed}	
3 China, Hong Kong		2012Q1-2012Q3 ^{ed}	
4 Colombia	2008Q3-2009Q4 ^{de}		
5 Costa Rica	2008Q4-2010Q2 ^D	2011Q2-2012Q1 ^d	
6 Croatia	2008Q3-2010Q1 ^{ed}		
7 Czech Republic	2009Q1-2010Q1 ^{Ed}	2012Q2-2013Q3 ^d	
8 Guatemala	2009Q2-2010Q2 ^d		
9 Hungary	2008Q3-2010Q2 ^{ED}		
10 India	2008Q3-2009Q4 ^{de}		
11 Israel	2008Q3-2009Q4 ^{de}	2011Q4-2013Q2 ^{ed}	
12 Jordan	2013Q1-2013Q4		
13 Kazakhstan	2008Q2-2010Q1 ^{de}		
14 Korea	2008Q2-2009Q4 ^{Ed}		
15 Latvia	2007Q3-2008Q1 ^{ed}		
	2009Q1-2010Q3 ^{ED}		
16 Lithuania	2008Q3-2009Q4 ^{eD}		
17 Macedonia		2011Q1-2012Q4 ^e	2013Q3-2014Q3 ^{7ed}
18 Mexico		2011Q3-2012Q3 ^e	
19 Peru	2008Q4-2010Q1 ^{E-D}		
20 Poland	2008Q4-2010Q1 ^{ED}		
21 Romania	2008Q4-2010Q1 ^e		
22 Venezuela	2008Q3-2009Q4 ^{ed}		

Data: IMF's International Financial Statistics Database; author's own calculations

Table 3: Sudden Stops in Inflows of Equity Securities

	Country	Periods	
1	Armenia	2009Q1-2010Q2	2012Q2-2013Q3
2	Belarus	2009Q2-2010Q4	
3	Brazil	2008Q4-2009Q4	2012Q1-2013Q2
4	Bulgaria		2012Q4-2013Q3
5	Chile		2011Q4-2012Q3
6	China, Hong Kong		2012Q1-2012Q3
7	Colombia	2009Q1-2010Q1	
8	Croatia	2008Q2-2010Q1	
9	Czech Republic	2008Q3-2010Q1	
10	Hungary	2008Q2-2010Q1	2012Q1-2011Q4
11	India	2008Q3-2009Q4	2012Q1-2013Q1
12	Israel	2008Q4-2009Q4	2011Q3-2013Q2
13	Kazakhstan	2008Q2-2010Q1	
14	Korea	2008Q1-2009Q4	
15	Latvia	2007Q1-2007Q3	
		2007Q4-2010Q2	
16	Lithuania	2007Q1-2010Q1	
17	Macedonia		2012Q1-2014Q1
18	Mexico		2011Q3-2012Q4
19	Peru	2008Q4-2010Q1	2011Q4-2012Q4
20	Poland	2008Q3-2010Q1	
21	Romania	2008Q3-2011Q2	2013Q3-2014Q1
22	Turkey	2008Q2-2009Q4	
23	Ukraine		2012Q2-2013Q1
24	Venezuela	2007Q1-2008Q3	

Data: IMF's International Financial Statistics Database; author's own calculations

Table 4: Sudden Stops in Inflows of Debt Securities

	Country	Periods	
1	Armenia	2007Q2-2009Q1	2011Q2-2012Q3
2	Brazil	2009Q1-2009Q4	2013Q4-2014Q2
3	China, Hong Kong		2012Q4-2014Q3
4	Colombia	2008Q3-2009Q4	
5	Costa Rica	2008Q4-2010Q2	2011Q2-2012Q1
6	Croatia	2008Q4-2010Q1	
7	Czech Republic	2009Q2-2010Q1	2012Q2-2013Q2
8	Guatemala	2009Q2-2010Q2	
9	Hungary	2008Q3-2010Q3	
10	India	2008Q1-2010Q1	
11	Israel	2007Q3-2010Q1	2012Q1-2013Q3
12	Kazakhstan	2008Q1-2009Q4	
13	Korea	2009Q1-2010Q1	
14	Latvia	2007Q4-2008Q1	
		2009Q1-2011Q2	
15	Lithuania	2008Q4-2009Q4	
16	Macedonia		2013Q3-2014Q3
17	Peru	2008Q4-2010Q1	
18	Poland	2008Q4-2010Q1	
19	Romania	2007Q1-2008Q1	
		2009Q1-2010Q1	
20	Turkey	2008Q1-2010Q1	
21	Venezuela	2008Q4-2009Q4	

Data: IMF's International Financial Statistics Database; author's own calculations

3.1.2 EM Currency Depreciation from 1994-2014

Methodology. We use a similar methodology to identify episodes of extreme currency depreciation in emerging markets. Our analysis is different from the literature in two ways. First, we analyze more current events (2011-2015), while the literature focuses mostly only until 2008. Secondly, we use the BIS' monthly historical data of effective exchange rate (EER) from January 1994 to November 2014. In this section, we aim to identify the episodes of currency depreciation of both emerging markets and advanced economies using BIS monthly historical data of effective exchange rate (EER) from January 1994 to November 2014. The data contains both real and nominal EER for 60 countries, including both advanced and emerging economies.⁶ The EER of a country is constructed as a weighted sum of multiple bilateral exchange rates between that country and other countries/regions, with weights determined by bilateral trade volumes. In particular, the effective exchange rate of country j at time t is calculated by the formula:

$$EER_t^j = \sum_i w_i BER_t^{ji}$$

where BER_t^{ji} is the bilateral exchange rate between j and i in period t , and weight w_i is determined by

$$w_i = \left(\frac{m_j}{x_j + m_j} \left(\frac{m_j^i}{m_j} \right) + \frac{x_j}{x_j + m_j} \left[\frac{x_j^i}{x_j} \frac{y_i}{y_i + \sum_h x_h^i} + \sum_{k \neq i} \left(\frac{x_j^k}{x_j} \frac{x_i^k}{y_k + \sum_h x_h^k} \right) \right] \right)$$

where x_j^i is economy j 's export to i , m_j^i is j 's import from i , x_j and m_j are total exports/imports of country j . Therefore, this construction allows us to factor in interdependency of countries through trade to fully evaluate the effect of fluctuations of a bilateral rate on the currency of any country.

To identify episodes of currency depreciation, we follow roughly the methodology employed in Forbes and Warnock (2012) as well as Calvo (1998). In particular, we calculate the 2-quarter (6-month) moving average for the nominal EER in order to smooth out the

⁶Please refer to our appendix A for more information about our samples.

random fluctuation in EER and focus more on trends:

$$\xi_t = \frac{\sum_{i=0}^5 EER_{t-i}}{6}$$

An **episode of depreciation** is defined to be a period of at least b consecutive months in which the currency depreciates for at least $a\%$ per month ($\frac{\xi_t - \xi_{t-1}}{\xi_{t-1}} < -a\%$). We will control the parameter a and b to compare and contrast the depreciation phenomenon post GFC compared to before GFC.

Table 5: Summary of currency depreciation episodes in emerging markets 1994-2014

	Avg. number of episodes per year		Avg. duration (months)	
	Pre-GFC	Post-GFC	Pre-GFC	Post-GFC
5%, 3 months (Sudden depreciation)	0.73	0.14	4.5	5
1%, 6 months (Slow, persistent depreciation)	2.67	0.86	7.3	8.3

Results. The major currency depreciation episodes according to different values of criteria a are listed in Table 6. To provide some summary statistics, Table 5 reports the number of EM currency depreciation episodes identified using the two sets of criteria, as well as the average duration. The sample was also divided into “Pre-GFC” (up until 2007Q4) and “Post-GFC” (from 2008Q1-2014Q4). We make a few observations:

Observation 4 (Fewer depreciation episodes in post-GFC). *On average, there are less currency depreciation episodes per annum in 2008-2014 than 1994-2008.*

There are 11 extreme depreciation episodes from 1994-2008, but only 1 after 2008. However, smaller depreciation episodes have appeared much more frequently after 2008 (11 episodes).

Observation 5. *On average, depreciation episodes have become longer and more persistent after 2008.*

An extreme depreciation episode prior to 2008 lasts for 4.5 months on average, while this duration has increased to 5 months after 2008. In terms of smaller depreciation events,

the average duration was 7.3 months before 2008, which has increased into 8.3 months after 2008.

Therefore, we can conclude that the pattern of currency depreciation episodes has somewhat changed after 2008: they appear less frequently after 2008, are less dramatic events, but are persistent and last longer on average than before 2008.

3.2 The decoupling of equity- and debt- financing

In this section, we document the relationship between the amount of debt-financing (i.e. debt securities issuance) and equity-financing of the countries in our sample using IMF's quarterly data on IIP (International Investment Position) Liabilities⁷ of 52 countries (34 advanced economies, and 18 EMs) over 2005-2014. The two time series we look at are **ILPE**⁸ and **ILPD**⁹ For each country, we calculate four measures:

- (1) Correlation of **ILPE** and **ILPD** using the entire 2005-2014 sample. (Column 1)
- (2) Correlation of **ILPE** and **ILPD** using only 2011-2014 data. (Column 2)
- (3) Slope of the linear trend line of debt-financing from 2011-2014. A plus sign presented indicates the country is generally issuing more debt securities, and vice versa.(Column 3)
- (4) Slope of the linear trend line of equity-financing from 2011-2014. A plus sign presented indicates the country is generally selling more equities, and vice versa. (Column 4)

The results for emerging markets are presented in Table 7 and advanced economies in Table 8. The first column $Cor(D, E)_{05-14}$ reports the correlation between portfolio debt- and equity- liabilities of emerging economies from 2005 to 2014. We summarize the results by making three observations:

Observation 6 (Debt and equity liabilities in normal time). *During normal time, the outstanding stock of debt liabilities and equity liabilities are highly correlated in both advanced economies and emerging markets.*

⁷We are looking specifically at gross inflows.

⁸International Liabilities Portfolio Equities

⁹International Liabilities Portfolio Debts

Table 6: Major Currency Depreciation Episodes from 1994-2014

Criteria	5%	3%	1%
Before 2008	Bulgaria 1996 Indonesia 1997-1998 Mexico 1995 Romania 1997 Russia 1994-1995, 1998- 1999 Turkey 2001 Venezuela 1996, 2002, 2010	Brazil 1999, 2002 Korea 1997 Romania 1995, 1998 Thailand 1997 Turkey 1995-1998,1999-2000	Brazil 2001, Chile 2001 Colombia 1995, 1997, 1998, 1999, 2002 Algeria 1994 Hungary 1994, 1995 Indonesia 2000, 2001 Israel 1998 Iceland 2000, 2006 Japan 1995 Mexico 1994, 1998, 2002 Malaysia 1997-1998 New Zealand 1996, 1998 Peru 1998 Philippines 1997, 2000, 2002 Poland 1994 Romania 2000-2003 Russia 1996, 2002 Singapore 1995 Turkey 2000-2002, 2006 Venezuela 2004-2005 South Africa 1996, 1998, 2001, 2006
After 2008	(None)	Argentina 2014 Iceland 2008 Korea 2008-2009 Venezuela 2013	Argentina 2002, 2009, 2012-2013 Austria 2008, 2013 Brazil 2008, 2012, 2013 Canada 2008 Chile 2008 Colombia 2008 UK 2008, 2009 Hungary 2008 Indonesia 2008, 2013 India 2008, 2013 Japan 2012 Mexico, New Zealand, Poland, Romania, Sweden 2008 Russia 2009 Turkey 2011, 2013 South Africa 2008, 2013

As we could see, besides a few exceptions, portfolio debt and portfolio equities are highly correlated. Most countries in the sample, emerging economies and advanced economies alike, have a debt liabilities vis-a-vis equity liabilities correlation between 0.6 and 1. This is somewhat expected, since generally, both equity investments and bond investments respond to EM's fundamentals or external shocks in the same way: a country with sound fundamentals attract both equities and debt investments from abroad, and a country with persistently bad fundamentals is perhaps not a good investment opportunity, making both debt- and equity-finance both virtually impossible. Similarly, low interest rates from advanced economies make emerging market investments more attractive, increasing capital flows into both the bond market and the stock market. For this reason, in normal time, external debt liabilities and equity liabilities are highly correlated with each other, and correlated with their sum - total portfolio liabilities. However, as soon as we restrict ourselves to 2011-2014 data only, the story is different:

Observation 7 (Debt and equity liabilities in risky time). *During period of moderate uncertainty (currency risk, interest rate risk, etc.), debt and equity liabilities are less correlated. In some case, these two variables move in opposite directions. This phenomenon is especially obvious in emerging markets. When debt and equity moves independently, debt generally increases while equity decreases.*

As we have discussed, the 2011-2015 period is rather abnormal with high level of uncertainty with regards to advanced economies' interest rates, money supply, as well as fluctuating fundamentals in emerging markets. As it has been documented, foreign investors post-GFC have been looking for high-yield investments from emerging markets, boosting the level of international portfolio liabilities of emerging markets. Therefore, fluctuating in outside options' value (foreign interest rate shocks) or EM domestic fundamentals affects investors' choice directly, causing them to act differently during this uncertain period compared to normal times.

Indeed, in the 2011-2014 periods, bond and equity inflows in many emerging economies start to move more independently, sometimes in opposite directions, which is contrary to the pattern observed in normal times. We call this phenomenon the **de-coupling** of portfolio debt inflows and portfolio equity inflows. In particular, we note from Table 7 that among

14 emerging markets for which we have sufficient quarterly data, 8 countries experienced a drastic drop in the correlation between bond- and equity- financing when we focus only in the time span 2011-2014. In normal time, bond and equities tend to move together (Brazil: 0.686, Chile: 0.914, Hong Kong: 0.6, India: 0.8), but during the post-2011 period, when there were much uncertainty stemming from both advanced economies and deteriorating fundamentals in the emerging markets, bond and equities switched to move less in sync, or even in opposite direction (Brazil: 0.322, Bulgaria: -0.617, Hong Kong: -0.025, Croatia: -0.71, etc.). This implies that during time of uncertainty, equities are less desirable, and debts seem attractive to investors who aim to re-balance their portfolios.

Table 7: Relationship between Portfolio Bond and Equity Movement in Emerging Economies during 2005-2014 (column 2) and 2011-2014 (column 3)

Country	$Cor(D, E)_{05-14}$	$Cor(D, E)_{11-14}$	Trend, debt	Trend, equity
1 Brazil	0.686	0.322	(+)	(-)
2 Bulgaria	0.226	-0.617	(+)	(-)
3 Chile	0.914	0.193	(+)	(+)
4 China, Mainland	0.955	0.937	(+)	(+)
Hong Kong	0.6	-0.025	(+)	(+)
5 Colombia	0.986	0.966	(+)	(+)
6 Croatia	-0.3	-0.71	(+)	(-)
7 Hungary	0.221	0.245	(+)	(-)
8 India	0.882	0.518	(+)	(+)
9 Mexico	0.787	0.802	(+)	(+)
10 Peru	0.63	-0.176	(+)	(-)
11 Philippines	-0.245			
12 Poland	0.838	0.854	(+)	(+)
13 Romania	0.588	0.358	(+)	(+)
14 Russian Federation	0.886			
15 Saudi Arabia	0.456			
16 Thailand	0.954			
17 Turkey	0.676	0.707	(+)	(+)
18 Venezuela	0.054	0.154	(+)	(+)

Data: IMF's International Financial Statistics Database; author's own calculations

Table 8: Relationship between Portfolio Bond and Equity Movement in Advanced Economies during 2005-2014 (column 2) and 2011-2014 (column 3)

	Country	$Cor(D, E_{05-14})$	$Cor(D, E)_{11-14}$	Trend, debt	Trend, equity
1	Australia	0.922	0.716	(+)	(+)
2	Austria	-0.009	0.88	(+)	(+)
3	Belgium	0.73	0.761	(+)	(+)
4	Canada	0.699	0.452	(+)	(+)
5	Cyprus	0.851	0.349	(-)	(+)
7	Czech	-0.269	-0.566	(+)	(-)
8	Denmark	0.661	0.818	(+)	(+)
9	Estonia	0.366	0.871	(+)	(+)
10	Finland	-0.499	0.619	(+)	(+)
11	France	0.114	0.982	(+)	(+)
12	Germany	0.567	0.391	(+)	(+)
13	Greece	0.531	-0.261	(-)	(+)
14	Iceland	0.092	0.874	(+)	(+)
15	Ireland	-0.464	-0.464	(-)	(+)
16	Israel	0.48	0.017	(-)	(+)
17	Italy	0.118	0.75	(+)	(+)
18	Japan	-0.15	-0.886	(-)	(+)
19	South Korea	0.629	0.914	(+)	(+)
20	Latvia	0.501	0.892	(+)	(+)
21	Lithuania	-0.295	-0.652	(+)	(-)
22	Luxembourg	0.777	0.796	(+)	(+)
23	Malta	-0.263	0.408	(+)	(-)
24	Netherlands	-0.294	0.191	(-)	(+)

Continued on next page

	Country	$Cor(D, E)_{05-14}$	$Cor(D, E)_{11-14}$	Trend, debt	Trend, equity
25	New Zealand	0.557	0.828	(+)	(+)
26	Norway	0.703			
27	Portugal	0.671	0.945	(-)	(-)
28	Slovak Republic	-0.283	-0.205	(+)	(-)
29	Slovenia	0.876	0.936	(+)	(+)
30	Spain	0.596	0.544	(-)	(+)
31	Sweden	0.678	0.965	(+)	(+)
32	Switzerland	0.544	0.954	(+)	(+)
33	UK	0.335	-0.352	(-)	(+)
34	US	0.853	0.959	(+)	(+)

Data: IMF's International Financial Statistics Database; author's own calculations

4 Effects of Capital Flows on Exchange Rate

To highlights further the different role of portfolio debt flows and portfolio equity flows during the 2011-2015 time period, we investigate in this section the relationship between these two types of flows and currency depreciation in emerging markets. We gather a panel data of 35 countries with quarterly data from I 2008 to I 2014 (25 quarters). The sample of countries that we use is adopted from Eichengreen and Gupta (2014), with a few changes in response to data availability.¹⁰ We then specify an entity fixed-effect model in order to determine which factors, especially which channels of flows, are most important in predicting the level of nominal exchange rate depreciation of the emerging economies.

Specification

Our various regression models take the general form:

$$L_{c,t} = \alpha_1 \cdot \Delta \text{FDI}_{c,t-1} + \alpha_2 \cdot \Delta \text{Port. Debt}_{c,t-1} + \alpha_3 \cdot \Delta \text{Port. Equity}_{c,t-1} + \alpha_4 \cdot \Delta \text{Credit Flow}_{c,t-1} \\ + \psi_c + \sum_i \beta_i \cdot \text{GF}_{t-1}^i + \sum_j \beta_j \cdot \text{LF}_{c,t-1}^j + \epsilon_{c,t}$$

where:

$L_{c,t}$: Dependent variable of country c in period t

$\Delta \text{FDI}_{c,t-1}$, $\Delta \text{Port. Debt}_{c,t-1}$, $\Delta \text{Port. Equity}_{c,t-1}$, $\Delta \text{Credit Flow}_{c,t-1}$:

(Percentage change of) four channels of capital inflows

Ψ_c : Country c 's fixed effects

GF^i : i -th global factor

LF^j : j -th local factor

In this specification, the dependent variable $L_{c,t}$ is either $\log(\text{NEER})$, the log-transformed nominal effective exchange rate, or $\log(\text{GDP})$ - growth rate of GDP.

¹⁰For example, since our regression requires quarterly data on the **decomposition** of portfolio flows, i.e. into debt and equity, several countries which only report the aggregate portfolio flows were dropped from the sample

Variables Selection

The independent variables can be considered to belong to three categories:

- Capital inflows variable: Recall the identity

$$\text{Capital inflow} = \text{FDI} + \underbrace{\text{Debt financing} + \text{Equity financing}}_{\text{Portfolio Investment (FPI)}} + \text{Credit flows}$$

Our RHS variables on flows include both levels and growth variables. By putting the (log-transformed) four variables into the right-hand side of the regression equation, we can see which variables played a more dominant role in determining the exchange rate.

- Global variables: There are many global variables that contribute to the instability of exchange rate in emerging markets. However, following the consensus in the current literature, including the VIX alone already gives the vast majority of explanatory power among global factors (Forbes and Warnock (2012), Rey (2013)). We also include the 1-year constant maturity US Treasury yield to, in conjunction with the lending rate of the EM, represent spread.
- Domestic variables: *PCPI* (inflation rate), *FILR* (domestic lending interest rate), *AIP* (industrial production index), *LUR* (recorded unemployment), and *RAXG* (gross foreign exchange reserve). Some of these variables will be dropped to increase coverage of data/number of countries included in our sample.

Model selection

Model (1), (2), and (3) include all the domestic macro variables available. Due to this inclusion, the number of countries represented in the panel were reduced to 4 due to data availability. Model (1) includes both level and growth of the flows variables, while (2) and (3) focus only on level/growth respectively. In (1)-(3), both global factors are included.

We then take turn dropping seemingly insignificant domestic variables in model (4)-(8) in order to increase coverage. Since models with log-transformed flows seem to do better

(or at least, equally good), we include only growth variables and not levels in these models.

Results and Discussion

Results are presented in Table 9 and Table 10 below. Models (1), (2), and (3) all fit relatively well (adjusted R^2 approximately 62% in all three models), though the difference between R^2 and adj- R^2 clearly indicates that we are over-fitting. When all domestic factors are included in the specification, the consistently significant variable is the level and growth of portfolio debt. Note that our for our nominal effective exchange rate index, a decrease in index means **depreciation**. Therefore, model (1)-(3) implies that portfolio debt puts downward pressure on the local currency, while portfolio equity growth supports the that local currency. This is quite the opposite of what we have found so far. However, it is worth noting that for the sake of including as many domestic fundamentals variables as we can, we have forsaken much of our data, and the sample now only includes 76 observations for 4 countries. Therefore, this result may not be representative for the entire sample.

To remedy the problem, we looked at specification (4) through (8) instead, in which only inflation rate, domestic lending interest rate, and total of foreign reserve is always present; the rest of our domestic fundamentals are included only alternately to include more data. Using this, we can have a roughly balanced panel of 21 countries. We look carefully at model (6) and (7) for two reasons: (6) includes the most number of observations and spans across most countries in our sample, while (7) seems like the best-fit model from the adjusted- R^2 values. As in previous sections, we summarize our results before discussing in length:

Result 1 (Debt and Equity). *The growth of portfolio debt and and portfolio equity have opposing effects on nominal effective exchange rate: positive growth in equity associates with local currency depreciation next period, while positive growth in debt helps appreciate the local currency next period.*

It is consistent in both models that the growth of FDI, equity, and credit flow are all significant variables, while portfolio debt is insignificant. In model (7), a 1% increase in the outstanding stock of equity makes the effective exchange rate decrease by -0.075% , while 1% increase in the stock of portfolio debt pushes exchange rate up by 0.011% . This result somewhat confirms our earlier findings and the theory we propose, that during risky

time, investors abandon emerging market stocks, while still willing to lend aggressively to the emerging market by purchasing their debt securities. In this section, even though we have lagged all independent variables by one quarter to reduce some endogeneity concerns (similar to Bruno and Shin (2013)), endogeneity is not completely eliminated since unmeasured determinants of exchange rate remains correlated with current capital flows, i.e. $Corr(\epsilon_{c,t}, \Delta\text{Credit/Debt/Equity Flow}_{c,t}) \neq 0$. Therefore, in the next section, we will estimate a VAR model to overcome this endogeneity concern.

We also want to note a few results that are not at the focus of this paper:

Result 2 (FDI and Credit Flows). *Both FDI and credit flows have a strong impact on EM's currency: a surge in FDI is likely succeeded by currency appreciation, while a surge in credit flow most likely results in currency depreciation.*

From column (6) and (7), we can see that both FDI growth and credit flow growth are significant in predicting currency depreciation. Furthermore, across most models, the coefficient in front of FDI is positive, and the coefficient of credit flow is negative. Across all models, these coefficients are not just statistically significant but also practically significant: a 10% increase in FDI would induce 3.5 – 3.9% appreciation of the currency, while a 10% increase in credit flow into an EM most likely associates with a 1.8 – 3.4% depreciation of that EM's local currency.

Result 3. *The VIX, US Treasury short-term yield, and inflation are important predictors of currency depreciation.*

These variables have very significant variables in most specification (except model (7), when domestic money supply is included). Higher inflation implies future exchange rate depreciation, though the economic significance seems low (coefficients are close to 0). US Treasury yield have large influence on EM's currencies: a 1% increase in US Treasury yield depreciates EM's currency by 0.52% on average (model (6)). The risk of foreign interest rate shock is indeed very high for emerging market, as we can see through investors' reaction during the Fed Taper Tantrum in summer 2013 at the end of 2014.

Table 9: Determinants of currency depreciation in emerging market 2010-2015

	(1)	(2)	(3)	(4)
<i>Capital Inflows</i>				
FDI	-0.001*	0.000		
	(0.000)	(0.000)		
FDI Growth	0.579*		0.140	0.393***
	(0.244)		(0.128)	(0.052)
Port. Equity	-0.001	0.000		
	(0.000)	(0.000)		
Port. Equity Growth	0.225*		0.188*	-0.073***
	(0.108)		(0.085)	(0.018)
Port. Debt	0.004***	0.002*		
	(0.001)	(0.001)		
Port. Debt Growth	-0.506***		-0.290**	0.008
	(0.102)		(0.097)	(0.008)
Credit Flow	-0.001	-0.000		
	(0.002)	(0.001)		
Credit Flow Growth	0.142		-0.242*	-0.192***
	(0.306)		(0.099)	(0.028)
<i>Global Factors:</i>				
1-year US Treasury Yield	0.348*	0.520***	0.210	0.420***
	(0.171)	(0.135)	(0.182)	(0.065)
VIX	0.005*	0.004*	0.002	0.004***
	(0.002)	(0.002)	(0.002)	(0.001)
<i>Domestic Factors:</i>				
Foreign Exchange Reserve	-0.000	0.001	0.001	0.000***
	(0.001)	(0.001)	(0.001)	(0.000)
Lending Interest Rate	0.003	0.001	0.006*	0.012***
	(0.003)	(0.003)	(0.003)	(0.002)
Inflation	-0.011**	-0.018***	-0.017***	-0.006***
	(0.003)	(0.004)	(0.004)	(0.001)
Industrial Production Index	0.003	0.004*	0.005*	
	(0.002)	(0.002)	(0.002)	
Broad Money	-0.000**	-0.000**	0.000	
	(0.000)	(0.000)	(0.000)	
Share Prices	0.001*	0.001	0.002**	
	(0.001)	(0.001)	(0.001)	
Unemployment Rate	-0.014	-0.018	-0.018	
	(0.013)	(0.014)	(0.014)	
R ²	0.863	0.788	0.800	0.373
Adj. R ²	0.625	0.612	0.621	0.342
Num. obs.	76	76	76	366

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Table 10: Determinants of currency depreciation in emerging market 2010-2015 (cont.)

	(5)	(6)	(7)	(8)
<i>Capital Inflows</i>				
FDI				
FDI Growth	0.202*** (0.056)	0.389*** (0.055)	0.352*** (0.093)	0.122* (0.049)
Port. Equity				
Port. Equity Growth	-0.024 (0.021)	-0.073*** (0.018)	-0.075** (0.026)	-0.019 (0.021)
Port. Debt				
Port. Debt Growth	-0.003 (0.008)	0.009 (0.008)	0.011 (0.010)	-0.011 (0.007)
Credit Flow				
Credit Flow Growth	-0.125*** (0.029)	-0.178*** (0.028)	-0.344*** (0.057)	-0.112*** (0.029)
<i>Global Factors:</i>				
1-year US Treasury Yield	0.378*** (0.060)	0.356*** (0.065)	0.200 (0.110)	0.355*** (0.060)
VIX	0.002** (0.001)	0.004*** (0.001)	0.003 (0.001)	
<i>Domestic Factors:</i>				
Foreign Exchange Reserve	0.000 (0.000)	0.000** (0.000)	0.001* (0.001)	0.000 (0.000)
Lending Interest Rate	0.009*** (0.002)	0.013*** (0.002)	0.009** (0.003)	0.010*** (0.002)
Inflation	-0.005** (0.002)	-0.006*** (0.001)	-0.007*** (0.002)	-0.004** (0.002)
Industrial Production Index	0.001** (0.001)			0.002*** (0.001)
Unemployment Rate		0.004 (0.004)		
Broad Money			-0.000** (0.000)	
R ²	0.288	0.371	0.498	0.264
Adj. R ²	0.261	0.339	0.446	0.241
Num. obs.	282	347	200	282

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

5 Estimating a VAR Model of Capital Flows

Models which aim to identify the determinants of capital inflows have been largely influenced by the concepts “push factors” and “pull factors” proposed by Reinhart et al. (1993). In particular, the term “push factor” refers to an external condition that induces inflows/outflows of capitals for the domestic emerging market, and includes variables such as the world risk-free interest rate (e.g. US Treasury bond yield), financial and economic conditions (boom or recessions) of advanced economies, advanced economies’ monetary policies, the VIX index, etc. On the other hand, “pull factors” refer to domestic conditions of the emerging market, such as level of financial liberalization, development of the bond market, domestic interest rate, inflation rate, current account deficit, foreign reserves, development of the banking system, etc. Most empirical literature so far has focused on identifying which of these factors dominate in a particular periods (Reinhart et al. (1993), Forbes and Warnock (2012), Bruno and Shin (2013)). In particular, the traditional specifications take the form:

$$y_j = \beta_0 + \sum_i \gamma^i GBL_j^i + \sum_k \beta^k DOM_j^k + \epsilon_j$$

where $\{GBL^i\}_i$ and $\{DOM^k\}_k$ are the lists of global and domestic factors, respectively. The dependent variable y_j is usually the level (or growth rate) of capital flows, exchange rate depreciation, level of reserves, or a composite index of those three criteria (Eichengreen and Gupta, 2014).

However, there are two improvements that can be done to the existing empirical literature:

- (1) Usually, only a standard OLS or its variations (e.g. fixed effects) is used. However, these variables interact rather actively in practice. For example, high level of domestic currency depreciation could lead to lower level of capital outflows, which reduces the outstanding stock of external liabilities¹¹; at the same time, capital outflows also put depreciating pressure on the local currency. This calls for the use of a vector autoregressive (VAR) model instead of standard OLS.

¹¹This is now a more serious issue, since bonds are increasingly denominated in local currency.

(2) In the spirit of our finding so far, there may be a great deal of interaction between different asset markets **within** one country due to foreign investors' portfolio rebalancing. When the stock market becomes unattractive investment (perhaps due to worsening fundamentals), foreign investors who are still actively looking for yields replace emerging market equities by emerging market debts instead. Therefore, this reinforces the need for a VAR-type regression in which the level of flows of each investment channel are determinants of each other.

However, since we are focusing on a very specific periods: 2010Q1 until 2014Q4 (20 quarters), running usual VAR on any one country cannot produce consistent estimates for the coefficients. Therefore, to make use of the panel data which we developed for the fixed-effects panel data in the previous section, we follow the methodology in Love and Zicchino (2006) to apply VAR on a panel data of capital flows, exchange rates, fundamentals and exogenous global factors. This so-called panel vector autoregressive (PVAR) method would allow us to overcome existing endogeneity problems and determine the relationships between capital flows and the push-/pull- factors as in traditional literature, taking into account the potential relationship between different channel of flows itself.

5.1 Methodology

Specification

We specify a p^{th} -order panel vector autoregressive (PVAR) model as following:

$$y_{ct} = \sum_{i=1}^p \Phi_i y_{c,t-p} + \sum_{j=1} \Psi_j D_{c,t-1}^j + \sum_{j=1} \Lambda_j G_{t-1}^j + f_c + \epsilon_{ct}$$

or, in matrix notation:

$$y_{ct} = \Phi' Y_{c,t,p} + \underbrace{\Psi' D_{c,t-1} + \Lambda' G_{t-1} + f_c}_{\text{exogeneous}} + \epsilon_{ct}$$

where y_{ct} is a vector of endogenous variables (K in total), $y_{c,t-p}$ is a vector of p^{th} -lags of the endogenous variables, and $Y_{c,t-1} = [y_{c,t-1} \quad y_{c,t-2} \quad \dots \quad y_{c,t-p}]^T$. We have

$$D_{c,t-1}^j = [d_{c,t-1}^j \quad d_{c,t-1}^j \quad \dots \quad d_{c,t-1}^j]^T$$

is a $K \times 1$ vector of repeated value of a domestic variable (pull-factors) d^j that is present in all the VAR's component regression. Similarly, we have

$$G_{t-1}^j = [g_{c,t-1}^j \quad g_{c,t-1}^j \quad \cdots \quad g_{c,t-1}^j]^T$$

is a $K \times 1$ vector of repeated values of a global variable (push-factors). Note that this variable is independent of the country being considered, hence without subscript c . To arrive at the matrix notation, we have denoted:

$$Y_{c,t,p} = \begin{bmatrix} y_{c,t-1} \\ y_{c,t-2} \\ \cdots \\ y_{c,t-p} \end{bmatrix} \quad D_{c,t-1} = \begin{bmatrix} D_{c,t-1}^1 \\ D_{c,t-1}^2 \\ \cdots \\ D_{c,t-1}^m \end{bmatrix} \quad G_{t-1} = \begin{bmatrix} G_{t-1}^1 \\ G_{t-1}^2 \\ \cdots \\ G_{t-1}^m \end{bmatrix}$$

The vector of endogenous variables being considered in this specification y_{ct} includes $neer = \ln(NEER)$ (log-transformed nominal effective exchange rate), levels of four types of inflows (FDI, portfolio debt, portfolio equity, and credit flow). Then, f_c is a vector of (again, repeated values of) the country-specific fixed effects. The inclusion of this country fixed effects helps take into account country-specific fundamental differences (e.g. political stability, geographical location, etc.) that is not time-variant. Finally, ϵ_{ct} is a mean-zero spherical error term.

5.2 Theory of PVAR

We briefly explain the theory behind the PVAR estimation procedure employed by Love and Zicchino (2006).

Dealing with Fixed-Effects: Helmert Procedure

When dealing with a fixed-effects panel data, the standard procedure is to time-demean the data to eliminate the entity fixed-effects. However, since our model includes p-lags of the endogenous variables, the fixed effects are correlated with these variables through the lags. Therefore, Love and Zicchino (2006) employs the Helmert procedure to forward-time-

demean the data:

$$y_{ct}^H = y_{ct} - \frac{1}{T-t+1} \sum_{s=t}^T y_{cs}$$

After this procedure, one can employ GMM as usual to estimate the coefficients of the model without the fixed effects.

Impulse Response Function

Assume the model we are considering involve y_t - log exchange rate, x_t - portfolio debt, and z_t - portfolio equities, a simple version of our model without exogenous variables includes takes the form:

$$x_t = \alpha_1 + \beta_{12}y_t + \beta_{13}z_t + \gamma_{11}x_{t-1} + \gamma_{12}y_{t-1} + \gamma_{13}z_{t-1} + \epsilon_{1t} \quad (1)$$

$$y_t = \alpha_2 + \beta_{21}x_t + \beta_{23}z_t + \gamma_{21}x_{t-1} + \gamma_{22}y_{t-1} + \gamma_{23}z_{t-1} + \epsilon_{2t} \quad (2)$$

$$z_t = \alpha_3 + \beta_{31}x_t + \beta_{32}y_t + \gamma_{31}x_{t-1} + \gamma_{32}y_{t-1} + \gamma_{33}z_{t-1} + \epsilon_{3t} \quad (3)$$

This can be re-arrange into:

$$\Xi X_t = \alpha + \Gamma X_{t-1} + \epsilon_t \quad (4)$$

where $X_t = [x_t \ y_t \ z_t]^T$, $\alpha = [\alpha_1 \ \alpha_2 \ \alpha_3]$, $\Gamma(i, j) = \gamma_{ij}$, $\epsilon_t = [\epsilon_{1t} \ \epsilon_{2t} \ \epsilon_{3t}]'$, and:

$$\Xi = \begin{bmatrix} 1 & -\beta_{12} & -\beta_{13} \\ -\beta_{21} & 1 & -\beta_{23} \\ -\beta_{31} & -\beta_{32} & 1 \end{bmatrix}$$

Multiplying both sides by Ξ^{-1} yields

$$X_t = \tilde{\alpha} + \tilde{\Gamma} X_{t-1} + \tilde{\epsilon}_t$$

where $\tilde{\alpha} = \Xi^{-1}\alpha$, $\tilde{\Gamma} = \Xi^{-1}\Gamma$, and $\tilde{\epsilon}_t = \Xi^{-1}\epsilon_t$. This so-called “reduced-form” allows us to estimate the coefficients that cannot be estimate directly from the structural model 4. The impulse response function, i.e. how would one variable react to a one-standard deviation

shock of another variable, can then be estimated as usual:

$$X_t = \mu + \sum_{i=0}^{\infty} \tilde{\Gamma}^i \tilde{\epsilon}_{t-i} = \mu + \sum_{i=0}^{\infty} \Phi^i \epsilon_{t-i}$$

Since, again, $\tilde{\epsilon}_{t-i}$ is only a composite function of ϵ_{t-i} . Note that this generates only the impulse response function. To generate the error bands for PVAR, Love and Zicchino (2006) runs Monte Carlo simulation for a fixed number of repetitions to find the 95% confidence interval for forecasts of the future.

5.3 Results

All results are presented using variables' code instead of label. We provide them here as a point of reference:

- *lnneer*: log-transformed nominal effective exchange rate.
- *ild_bp6*: level of outstanding FDI.
- *iloln_bp6*: level of outstanding loans (credit flows).
- *ilpd_bp6*: level of outstanding portfolio debt.
- *ilpe_bp6*: level of outstanding portfolio equity.
- *vix*: the VIX index.
- *tyr*: 1-year constant maturity US Treasury yield.

5.3.1 Model without global factors

We first discuss the estimated impulse response functions (IRFs) for our baseline model with FDI, debt, equity, credit flows, logged nominal effective exchange rate as endogenous variables. The IRFs are presented in figure 7. We first focus on the endogenous response between portfolio debt and equity (row 3 and 4 of figure 7).

Result 4. *A negative shock to the debt market induces a negative shock to the equity market, and the two variables co-move for two quarters ahead. Contrarily, a negative shock to the equity market induces positive growth in portfolio debt (substitution effect).*

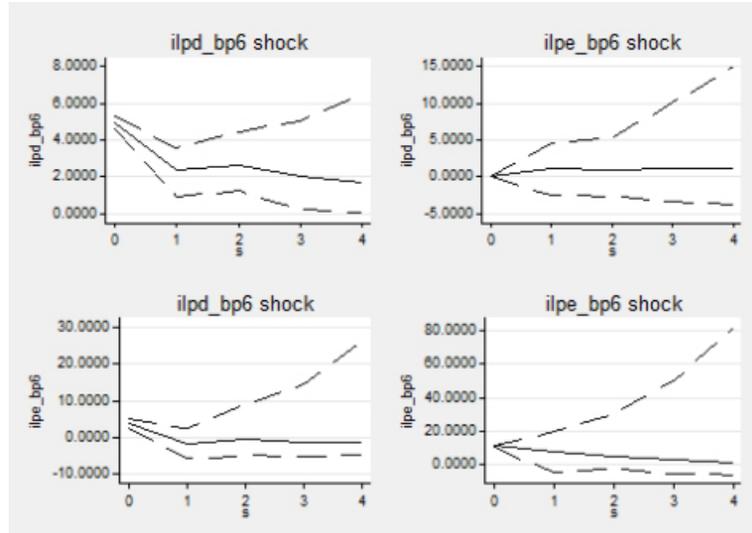


Figure 3: Endogenous responses between portfolio debt and equity

Figure 3 is an enlarged portion of debt and equity IRFs already provided in figure 7. The first column shows that a one-standard deviation shock to the debt market causes equity to co-move for the next four quarters. The second column shows that a one-standard deviation shock to the equity market causes EM debt holding to increase, instead of decreasing. This is consistent with the story we have put forward so far: when EM's return on equities are low (perhaps due to bad domestic conditions), investors are ready to dump emerging market equities (or, force its price to drop very low). This causes the outstanding portfolio equity recorded in the data to drop. However, while dumping equities, investors could still find EM's debt attractive - provided low prospect of default. Therefore, investors who desperately look for high yield abroad substitute EM equities for EM debts, causing the two variables to move in opposite directions. In fact, we can observe the opposite responses of portfolio debt and portfolio equity when subject to other types of shock as well:

Result 5. *A negative shock to FDI or credit flows can also generate opposite movements for debt and equity.*

As shown in column 1 of figure 7, a sudden drop in FDI, which could again be because of bad economic conditions, induces capital outflows in both debt and equity market in the next period. However, starting in the second period, portfolio debt recovers and increases, while portfolio equity falls more dramatically. This is because the deterioration of the equity

market in the first period induces positive response in portfolio debt in subsequent quarters in the same manner that we discussed in the previous paragraph: foreign investors want to substitute EM equities for EM debts.

5.3.2 Model with global factors

In our second model, we include the VIX index and US Treasury yield into our model in order to fully appreciate the effect of external shocks on EMs' debt and equity market. The impulse response functions for this model are provided in figure 8. We first note that an exchange rate shock (last column, figure 8) produces relatively flat response in the level of portfolio of debt, but does worsen the equity market significantly. Because VIX and US Treasury yield is put in as endogenous variables in this model, an exchange rate shock increases market volatility (VIX) and lowers US Treasury yield, which is what we expect to happen as more people demand safe assets.

Result 6 (Debt-equity movements). *Our previous result still holds: a shock to the debt market generates downward co-movement in both markets, but a negative shock to the equity market generates opposite movements: debt increases while equity decreases.*

Therefore, our story of debt-equity rebalancing during a period of negative shocks to the equity market remains robust in this model. Indeed, the EM bond market seems very healthy in response to shock: a negative VIX or exchange rate shock produces extremely flat response in portfolio debt. A negative treasury yield shock (which increases spread) of course draws more capital to the EM, thereby bidding up outstanding level of portfolio debt. What is more surprising is that the debt market also benefits (short-term) from a shock in portfolio equity through the portfolio rebalancing mechanism.

5.3.3 Robustness

We test the robustness of our model in two ways:

- Try other number of lags: so far we have always used 2 lags. We also estimated two one 1-lag and one 3-lag model in order to see if our results still hold.

The impulse response functions for this experiment are provided in figure 10 (3-lag) and figure 11 (1-lag). We found that the 1-lag model is too simple to capture any

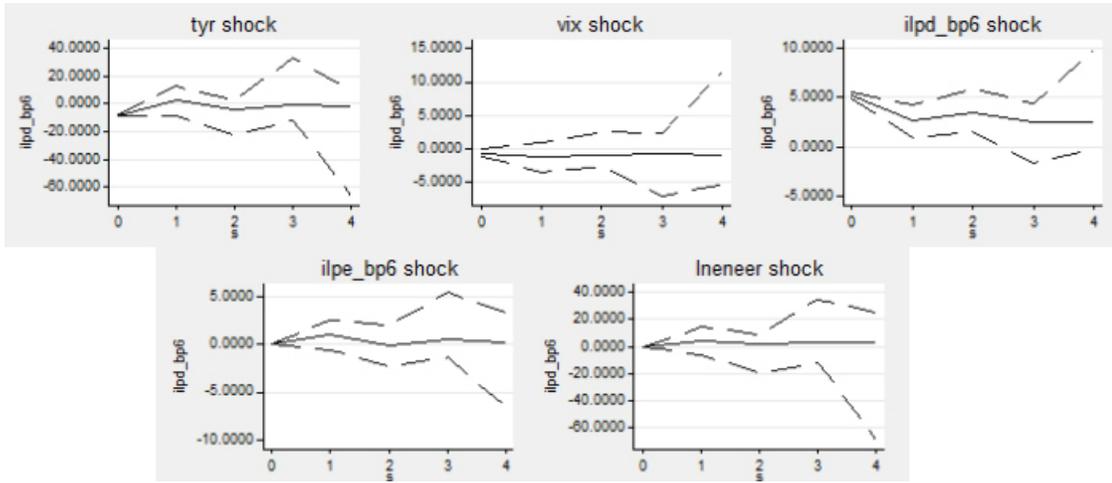


Figure 4: Response of EM portfolio debt in a model with global factors

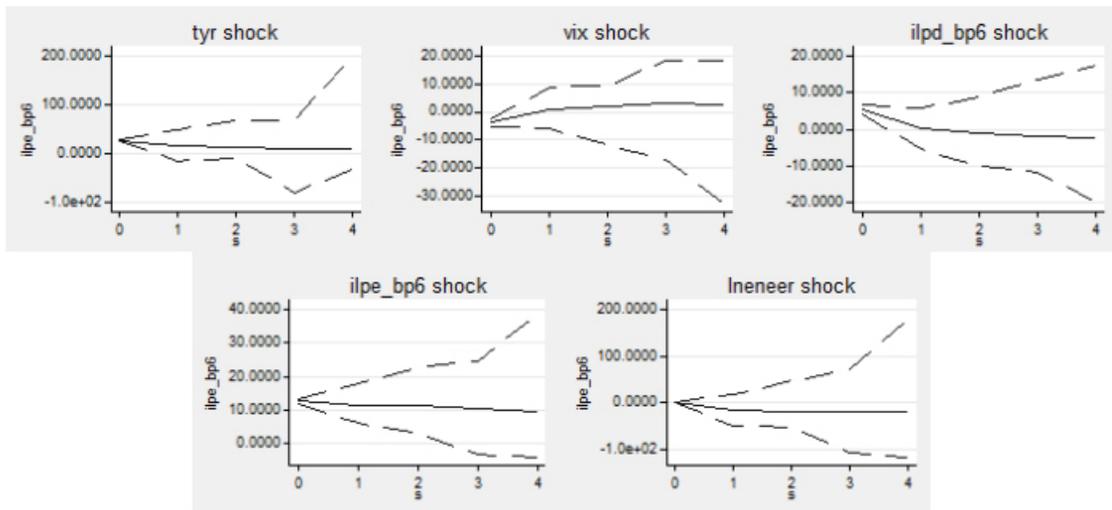


Figure 5: Response of EM portfolio equity in a model with global factors

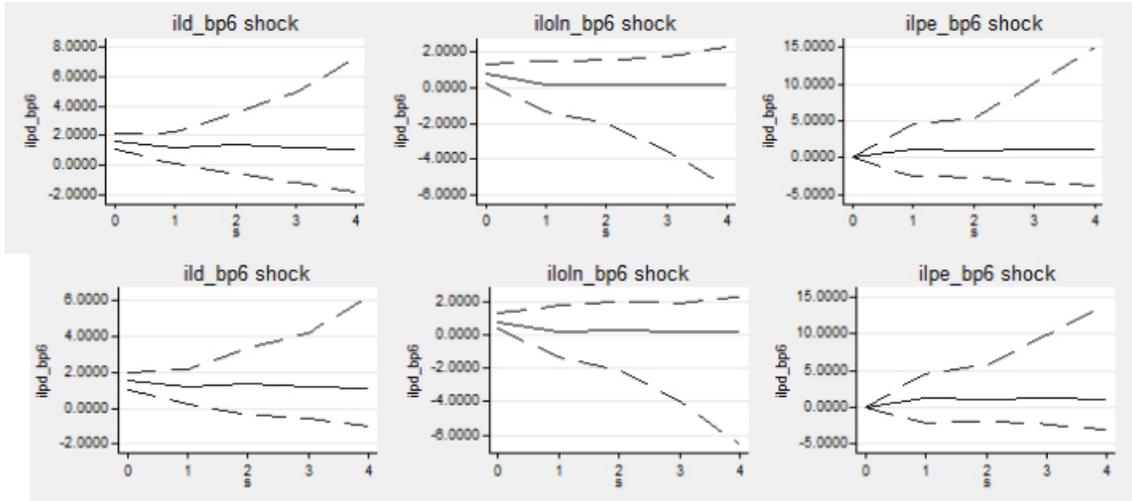


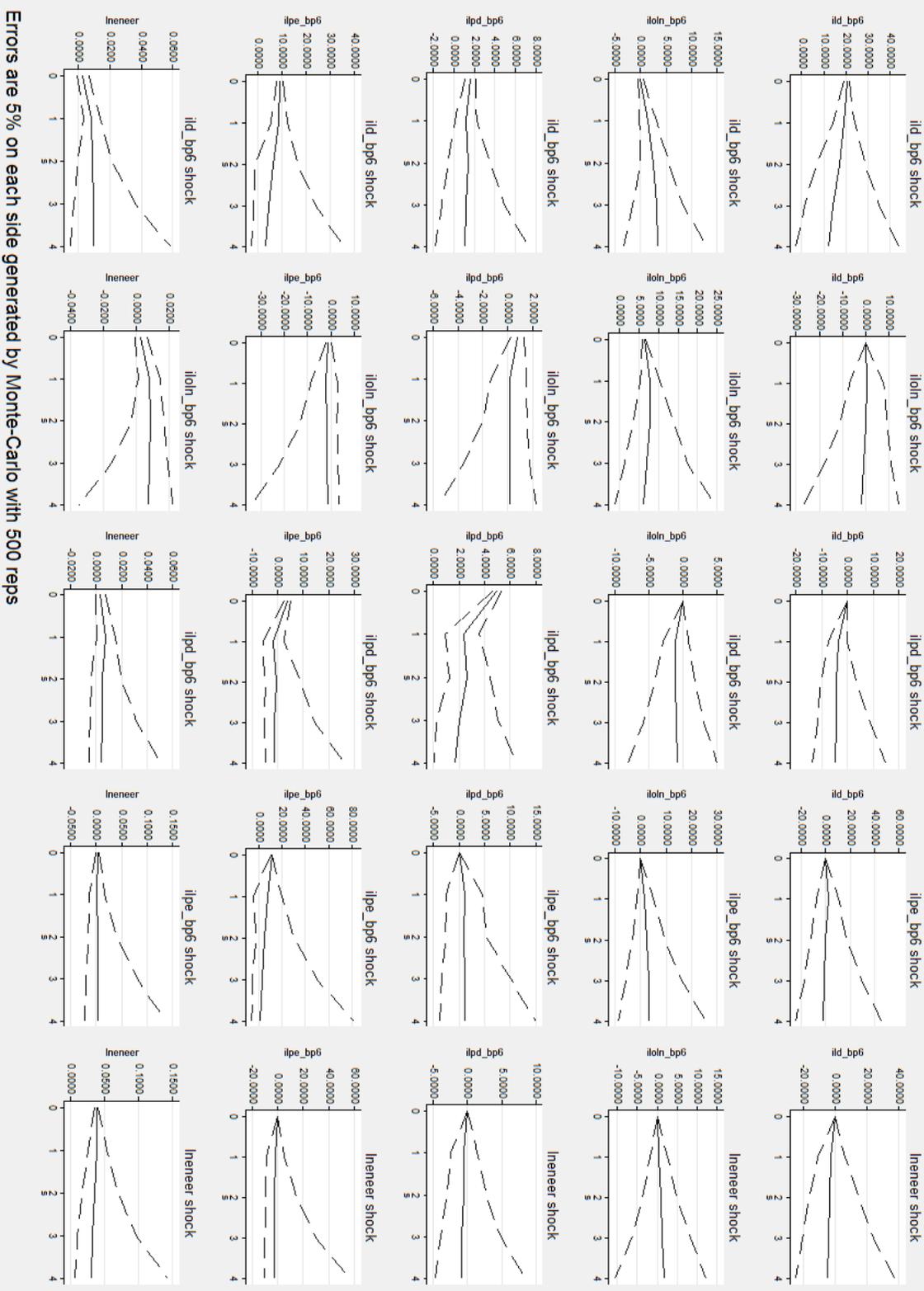
Figure 6: Comparing IRF of portfolio debt among models with exogenous/endogenous exchange rate

dynamics at all. As a result, the impulse response functions appear to be extremely flat and do not provide any useful insights. The 3-lag model, on the other hand, still preserves the same behaviors of endogenous response of portfolio debt and equity to each other's shocks. That is, result 5 and 6 are extremely robust: portfolio debt shock generates co-movement in both debt and equity, while a portfolio equity shock induces outstanding debt and equity to move in opposite directions.

- Re-ordering: Since the order of endogenous variables matters the PVAR estimate method of Love and Zicchino (2006), we try to rearrange the term *lnneer* (log exchange rate) from the leftmost (most exogenous) to rightmost (most endogenous) to see if that affects our results at all.

Figure 9 provides an alternative specification in which exchange rate is considered more exogenous. One can compare to see that the two specifications yield almost the same result, and all of our observations so far remain intact. We provide this comparison in figure is the impulse response function of portfolio debt subject to a shock of other capital flow channels. The difference is really subtle and insignificant.

2 lag VAR of ild_bp6 $iloin_bp6$ $ilpd_bp6$ $ilpe_bp6$ $lneneer$



Errors are 5% on each side generated by Monte-Carlo with 500 reps

Figure 7: Impulse response function for 2-lag baseline model

Endogenous variables: VIX, US Treasury yield, portfolio debt, portfolio equity, and log nominal exchange rate. Columns (left to right): FDI shock, credit flow shock, portfolio debt shock, portfolio equity shock, nominal effective exchange rate (NEER) shock. Rows (top to bottom): IRF of FDI, credit flow, portfolio debt, portfolio equity, NEER.

Impulse-responses for 2 lag VAR of tyr vix ilpd ilpe ilpee Ineener

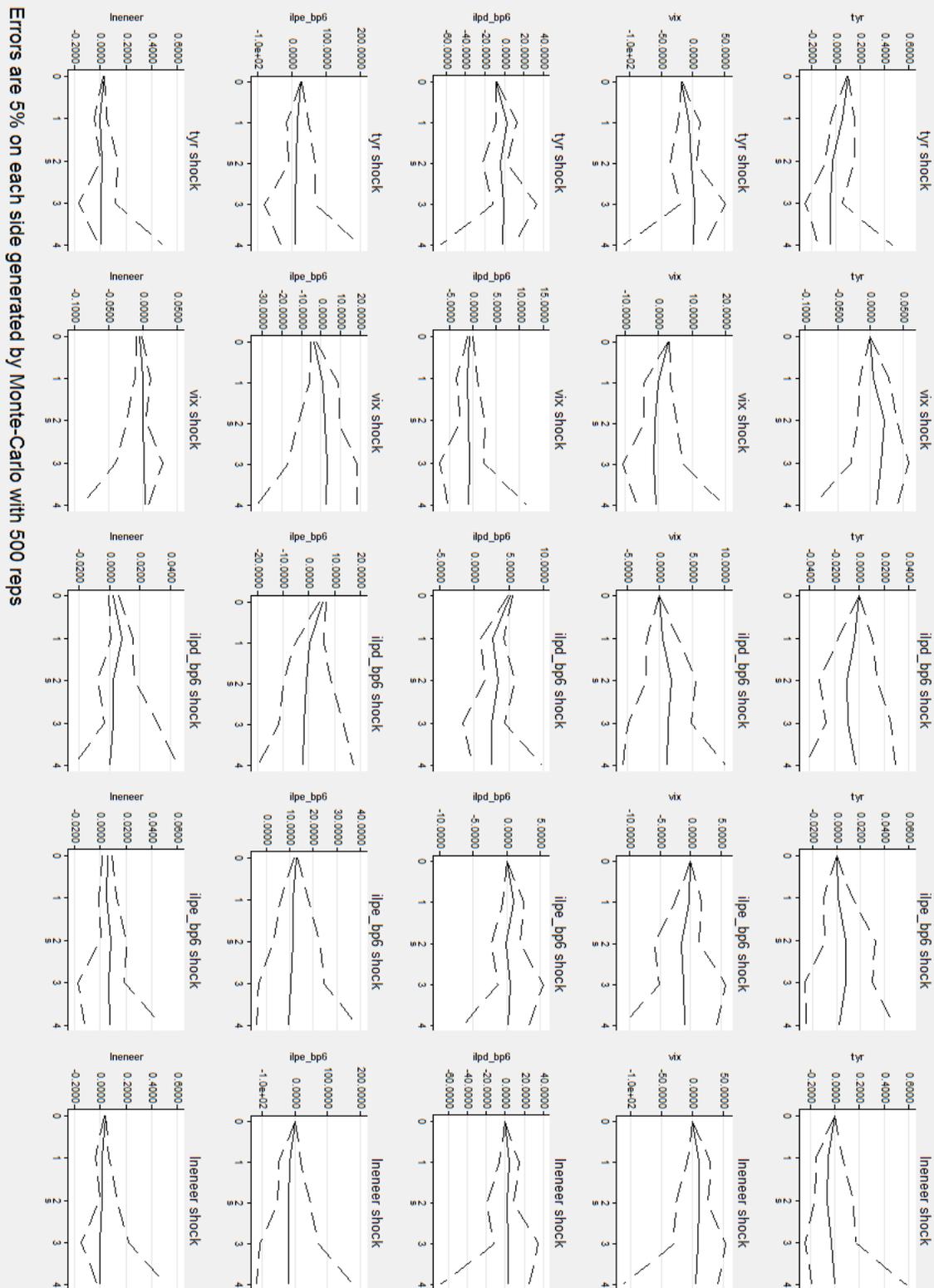


Figure 8: Impulse response function for 2-lag model with all flow channels
 Endogenous variables: FDI, credit flow, portfolio debt, portfolio equity, and log nominal exchange rate.

2 lag VAR of Ineneer iid_bpp6 iloln_bpp6 ilpd_bpp6 ilpe_bpp6

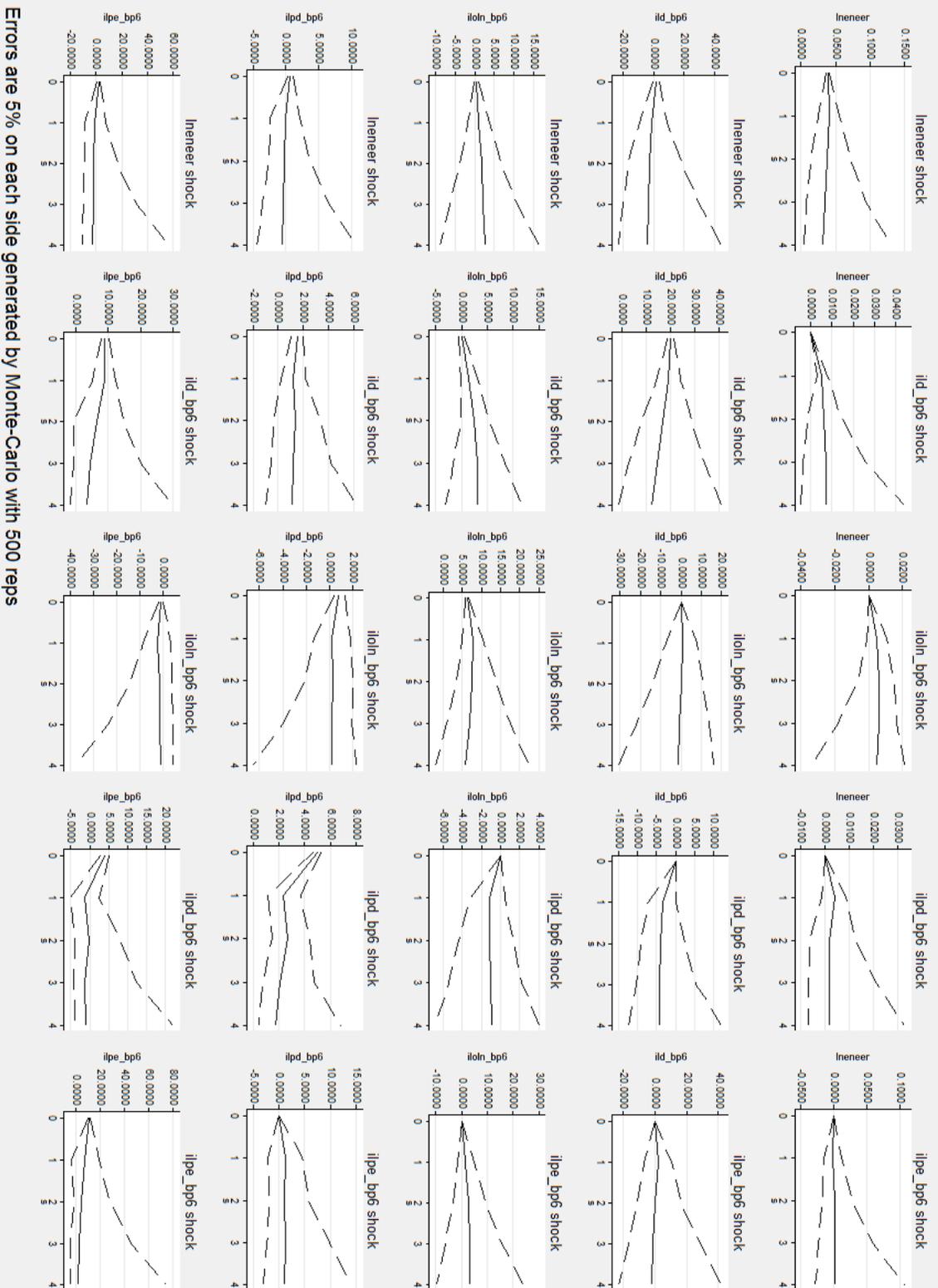
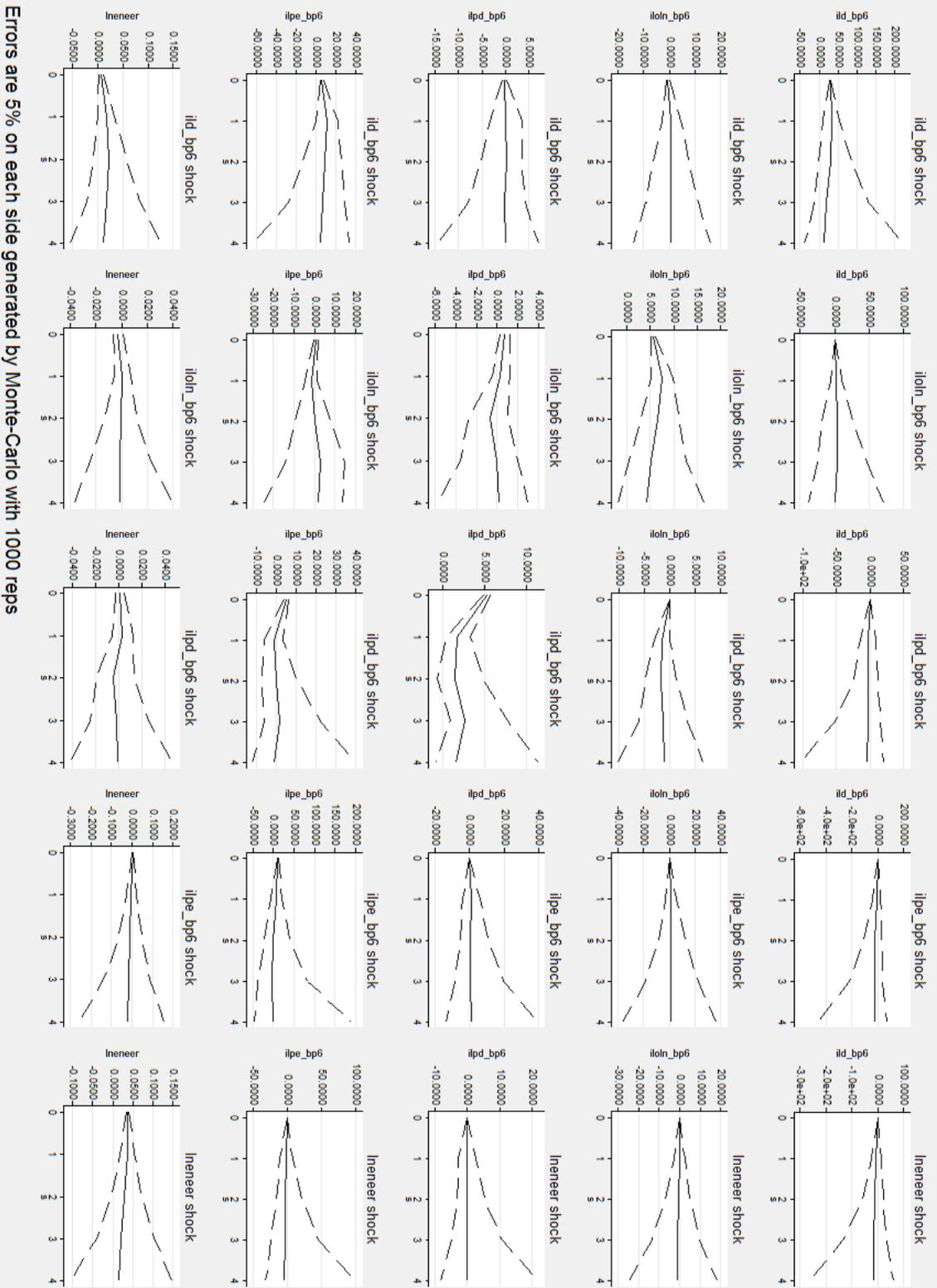


Figure 9: Impulse response function for 2-lag model with all flow channels, re-ordered Endogenous variables: FDI, credit flow, portfolio debt, portfolio equity, and log nominal exchange rate.

3 lag VAR of iid_bp6 iloin_bp6 ilpd_bp6 ilpe_bp6 Ineneer



Errors are 5% on each side generated by Monte-Carlo with 1000 reps

Figure 10: Impulse response function for 3-lag model with all flow channels, re-ordered
 Endogenous variables: FDI, credit flow, portfolio debt, portfolio equity, and log nominal exchange rate.

1 lag VAR of iid_bp6 iloin_bp6 ilpd_bp6 ilpe_bp6 Ineener

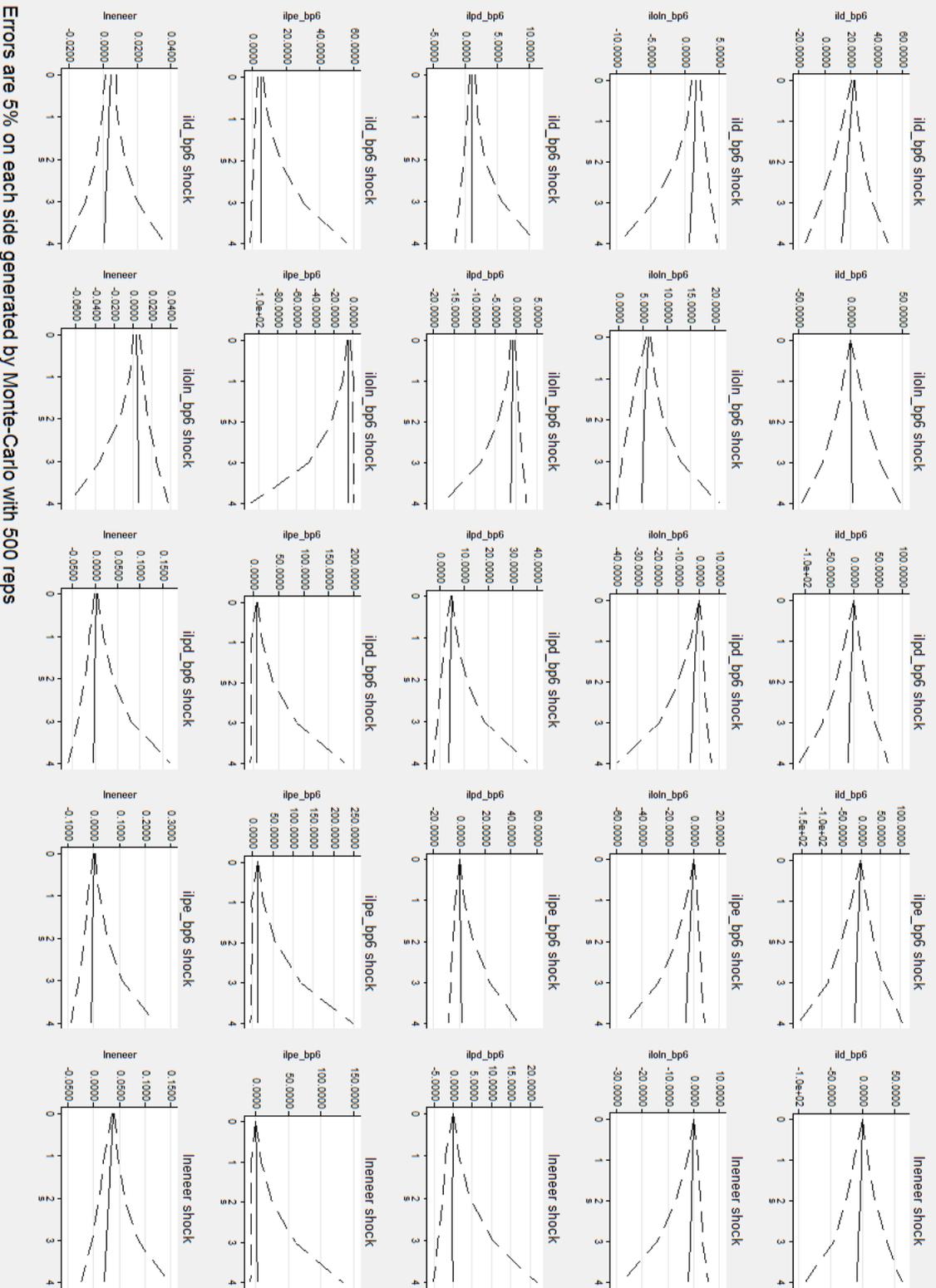


Figure 11: Impulse response function for 1-lag model with all flow channels, re-ordered
 Endogenous variables: FDI, credit flow, portfolio debt, portfolio equity, and log nominal exchange rate.

6 RBC-type Sudden Stop Model with Portfolio Rebalancing

6.1 The Environment

The world economy has two countries: an advanced economy which acts as foreign investor, and a domestic firm-owning household emerging market. The emerging market owns a Lucas tree which produces output d_t in period t , of which only a fraction $\xi \in [0, 1]$ is tradable; and the remaining $(1 - \xi)d_t$ can only be consumed domestically. The output d_t follows an AR(1) process: $d_t = \rho d_{t-1} + \epsilon_t$, where $\epsilon_t \sim \mathcal{N}(0, 1)$, and $|\rho| < 1$.

The Emerging Market

The emerging market consists of a representative household who maximizes its lifetime expected utility

$$\mathbb{E}_0 \sum_{t=0}^{\infty} u(c_t, n_t)$$

where c_t is the consumption of tradable good in period t , and n_t the consumption of the non-tradable good. We also impose Inada conditions: $\lim_{c_t \rightarrow 0} u_1(c_t, \cdot) = \infty$ and $\lim_{n_t \rightarrow 0} u_2(\cdot, n_t) = \infty$. Since n_t , the consumption of non-tradable good, has to come from holding the Lucas tree, from the Inada condition, it will never be the case that the emerging market will sell the entire tree to foreigners.

The financial market of emerging market is imperfect, hence they could only finance by borrowing from foreign investors in the advanced economy, or selling their shares of the Lucas tree. Denote by b_t the face value of outstanding bond to be paid in period t , and $s_t \in (0, 1)$ its share to period t output d_t of a domestic Lucas. In this model, the bond is a one-period risk-less non-contingent bond that is issued only to foreigners. The budget constraint of the emerging market is:

$$c_t + q_t b_{t+1} + v_t s_{t+1} = (v_t + \xi d_t) s_t + b_t \tag{5}$$

and

$$n_t = (1 - \xi) d_t s_t$$

In our model, firm borrows and sells equity entirely in local currency, hence not vulnerable

to currency risk directly. However, as currency risk affects foreign investors' decision, this risk will still affect the emerging market's optimal allocation in equilibrium. The only risk that firm faces is the uncertainty of output from the Lucas tree.

The emerging market also faces a borrowing constraint:

$$q_t b_{t+1} \geq -\kappa v_t s_{t+1} \quad (6)$$

This constraint, which stipulates that borrowing at time t cannot exceed a fraction of the liquidation value of all its equity at the end of the period, is standard in the sudden stop literature. $\kappa \in [0, 1]$ represents the quality of law enforcement and quality of the bond market in the emerging market: higher κ ensures that lenders can seize more of the emerging market's asset when they default. Note that default does not occur in this model, so this constraint arises naturally from the willingness of lenders to lend risk-free.¹²

To sum up, the sequence problem of the EM is: taking the sequence of prices $\{q_t, v_t\}_{t=0}^{\infty}$ as given, the EM chooses a sequence of consumption, debt issuance, and equity holding $\{c_t, b_t, s_t\}_{t=0}^{\infty}$ to maximize

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(c_t, n_t) \quad (7)$$

subject to

$$c_t + q_t b_{t+1} + v_t s_{t+1} = (v_t + \xi d_t) s_t + b_t \quad t = 0, 1, \dots \quad (8)$$

$$n_t = (1 - \xi) d_t s_t \quad t = 0, 1, \dots \quad (9)$$

$$q_t b_{t+1} \geq -\kappa v_t s_{t+1} \quad t = 0, 1, \dots \quad (10)$$

$$0 \geq s_t \geq 1 \quad t = 0, 1, \dots \quad (11)$$

$$b_0, s_0 \text{ is given} \quad (12)$$

Foreign Investor

Foreign investor is an advanced economy, which consists of a risk-neutral representative agent. Each period, the foreign investor receives a constant amount of endowment y . Let

¹²This constraint is similar to the collateral constraint in credit cycle model in Kiyotaki and Moore (1997) or Bernanke et al. (1998). Please see Arellano and Mendoza (2002) for a more thorough discussion.

$\{\varphi_t\}_{t=0}^{\infty}$ denote the stream of exogeneous exchange rate of the EM's currency vis-a-vis the foreign currency. We assume that the exchange rate is depreciating constantly at rate η :

$$\frac{\varphi_{t+1}}{\varphi_t} = \eta > 1$$

Besides investing in the emerging market, the foreign investor could also borrow and lend at world interest rate $1 + r^* = \frac{1}{q^*}$ (q^* is the price of the risk-free world bond). Denote by a_t the amount of outside option bond held by the foreign investor in period t , the budget constraint for the foreign investor is:

$$c_t + \frac{q_t b_{t+1}^i + v_t s_{t+1}^i}{\varphi_t} + q^* a_{t+1}^i = y + \frac{b_{t+1}^i + (v_{t+1} + \xi d_{t+1}) s_{t+1}^i}{\varphi_t} + d_t^i$$

Therefore, each period, foreign investor faces currency risk. Since both bonds and equities are denominated in EM's local currency, a foreign investor who purchases portfolio (b_{t+1}^i, s_{t+1}^i) has to pay

$$\frac{q_t b_{t+1}^i + v_t s_{t+1}^i}{\varphi_t}$$

to receive an income next period that is worth

$$\frac{b_{t+1}^i + (v_{t+1} + d_{t+1}) s_{t+1}^i}{\varphi_{t+1}}$$

A sudden depreciation of the local currency $\varphi_{t+1} \gg \varphi_t$ may make the investment unprofitable.

Note that even though the dividend payment each period to foreign investor is $d_t s_t^i$, a fraction $(1 - \xi)$ is non-tradable, and will be assumed to be thrown away. Therefore, real dividend to foreign investor is only $\xi d_t s_t^i$.

6.1.1 Recursive Formulation

Denote by $X \equiv (B, S, \varphi, d)$ the vector of state variables, where (B, S) is the outstanding bond and equities held by the foreign investor. φ is the current exchange rate, and d is the current realized output of the emerging market's Lucas tree.

Foreign investors' Bellman equation is:

$$V^i(b^i, s^i, a^i, d) = \max_{c^i, b^{i'}, s^{i'}, a^{i'}} \left\{ c^i + \beta \mathbb{E} \left[V^i(b^{i'}, s^{i'}, a^{i'}; d') \mid d \right] \right\} \quad (13)$$

subject to

$$c^i + \frac{q(X)b^{i'} + v(X)s^{i'}}{\varphi} + q^* a^{i'} = y + \frac{(v(X) + \xi d)s^i + b^i}{\varphi} + a^i \quad (14)$$

Let $V(b, s; X)$ denote the maximum value of the EM with initial debt/equity holding (b, s) and current Lucas tree output d . Taking prices $q(X)$ and $v(X)$ as given, the value function of the EM solves:

$$V(b, s; X) = \max_{c, b', s'} \left\{ u(c, (1 - \xi)ds) + \beta \mathbb{E} \left[V(b', s'; X') \mid d \right] \right\} \quad (15)$$

subject to

$$c + q(X)b' + v(X)s' = (v(X) + \xi d)s + b \quad (16)$$

$$q(X)b' \geq -\kappa v(X)s' \quad (17)$$

$$s' \in [0, 1] \quad (18)$$

6.1.2 Recursive Competitive Equilibrium

A Recursive Competitive Equilibrium (RCE) for this model is policy functions $g_c(b, s; X)$, $g_b(b, s; X)$, $g_s(b, s; X)$, $g_c^i(b, s; X)$, $g_b^i(b, s; X)$, $g_s^i(b, s; X)$, $g_a^i(b, s, X)$; and associated value functions $V(b, s; X)$, $V^i(b, s; X)$; bond price $q(X)$ and equity price $v(X)$; and laws of motion for $B'(X)$, $S'(X)$ such that for all $(b, s) \in \mathcal{B} \times \mathcal{S}$:

- Given prices $q(X)$ and $v(X)$, and law of motion $B'(X)$, $S'(X)$, then policy functions $g_c(b, s; X)$, $g_b(b, s; X)$, $g_s(b, s; X)$, and $V(b, s; X)$ solve EM's problem.
- Given prices $q(X)$ and $v(X)$, and law of motion $B'(X)$, $S'(X)$, then policy functions $g_c^i(b, s, a; X)$, $g_b^i(b, s, a; X)$, $g_s^i(b, s, a; X)$, $g_a^i(b, s, a; X)$ and $V^i(b, s, a; X)$ solve investor i 's problem.
- Markets clear:

- Bond market: $g_b(b, s; X) + g_b^i(b^i, s^i, a^i; X) = 0$.
- Equity market: $g_s(b, s; X) + g_s^i(b^i, s^i, a^i; X) = 1$.

- Laws of motion: $B'(X) = g_b^i(X)$, $S'(X) = g_s^i(X)$, $\varphi' = \varphi - \Psi(X)$.

6.2 Solving The Model

Since foreign investors are risk-neutral and there is no default in this model, we can pin down the prices in this model:

Theorem 6.1 (Asset Prices of Emerging Market). *The prices of emerging market bond and equity is dependent solely on its currency depreciation and the realization of the Lucas tree output, and independent of the outstanding debt/equity holding:*

$$q(b, s, d) = \frac{q^*}{\eta} \quad \forall (b, s, d)$$

and

$$v(b, s, d) = v(d) = \frac{\beta\xi\rho}{\eta - \beta\xi\rho}d \quad \forall (b, s, d)$$

Proof. For all $X = (b, s; d)$, the first-order conditions for emerging market bond and safe assets of foreign investors are $q^* = \beta$ and

$$\frac{q(X)}{\varphi} = \beta\mathbb{E}\left[\frac{1}{\varphi'}\right] \Rightarrow q(X) = \beta\mathbb{E}\left[\frac{\varphi}{\varphi'}\right] = \frac{q^*}{\eta}$$

Optimal condition for equity holding implies

$$v(X) = \varphi\beta\mathbb{E}\left[\frac{v(X') + \xi d'}{\varphi'} \middle| d\right] = \frac{\beta}{\eta}\mathbb{E}\left[v(X') + \xi d' \middle| d\right]$$

For convenience, we rewrite this condition in sequential form: for all t :

$$v_t = \frac{\beta}{\eta}\mathbb{E}_t[v_{t+1} + \xi d_{t+1}]$$

Iterate forward on v_t gives:

$$v_t = \sum_{s=1}^{\infty} \left(\frac{\beta\xi}{\eta}\right)^s \mathbb{E}_t[d_{t+s}] + \lim_{s \rightarrow \infty} \left(\frac{\beta}{\eta}\right)^s \mathbb{E}_t[v_{t+s}]$$

Using law of iterated expectation and the fact that $\mathbb{E}_t[d_{t+1}] = \rho d_t$ for all $t \geq 0$, we have $\mathbb{E}_t[d_{t+s}] = \rho^s d_t$. Furthermore, since $\beta < 1$, $\eta > 1$, $\lim_{s \rightarrow \infty} (\beta\eta^{-1})^s = 0$. Therefore, we also

impose the no-bubble condition that $\lim_{s \rightarrow \infty} \left(\frac{\beta}{\eta}\right)^s \mathbb{E}_t[v_{t+s}] = 0$. That leaves us with

$$v_t = \sum_{s=1}^{\infty} \left(\frac{\beta\xi\rho}{\eta}\right)^s d_t = \frac{\beta\xi\rho}{\eta} \frac{1}{1 - \frac{\beta\xi\rho}{\eta}} d_t = \frac{\beta\xi\rho}{\eta - \beta\xi\rho} d_t$$

□

Therefore, regardless of current portfolio, the emerging market can issue any amount of debt (or lend) at price $q = \frac{q^*}{\eta}$ and sell any amount of equities at price $v(d) = \frac{\beta\xi\rho}{\eta - \beta\xi\rho} d$. Note the effect of currency depreciation on borrowing: the higher the rate of expected depreciation $\eta = \mathbb{E}[\varphi_{t+1}/\varphi_t]$, the lower the price of bond and equities (more costly to borrow). This is expected, since foreign investors have to discount for currency risk that they are bearing. Also, the more tradable the Lucas tree output is (higher ξ), the higher its value $v(d)$. Finally, the more persistent the Lucas tree output (higher ρ), the lower its price.

With these prices, we can derive the optimal conditions for the risk-averse emerging market:

$$q = \beta \mathbb{E} \left[\frac{u_1(c', (1 - \xi)d's')}{u_1(c, (1 - \xi)ds)} \middle| d \right] + \frac{\mu_b}{u_1(c, (1 - \xi)ds)} \quad (19)$$

$$v(d)[u_1(c, (1 - \xi)ds) - \kappa\mu_b] = \beta \mathbb{E} \left[(v(d') + \xi d')u_1(c', n') + (1 - \xi)d'u_2(c', n') \middle| d \right] - \mu_1 \quad (20)$$

where $c' = g_c(b', s', d')$ - the optimal consumption next period, and μ_b, μ_1 are the multiplier on the borrowing constraint and equity constraint respectively. If $\mu_b > 0$, then $qb' = -\kappa v(d)s'$, and if $\mu_1 > 0$, then $s' = 1$.

Ignoring the multipliers of the collateral and equity constraints, we note that equation 19 is the intertemporal choice of consumption of tradable good (c versus c'), while equation 20 gives the EM the static choice between consumption of tradable and non-tradable good (c' versus n'). These are the two forces that drive EM's choice at any given period.

6.3 Discussion of Dynamics

This model provides a framework of portfolio choice which could explain why EM debt could still rise while their equities are not worth much any more due to the realization of

the bad states of the world. Note that because of the existence of tradable and non-tradable portions of the Lucas fruit, the EM values the tree more than foreign investors. Therefore, even if the EM has access to safe assets (i.e. saving in the world capital markets through foreign investors) in absence of currency risk,¹³ they would still have an incentive to hold on to the tree to balance out consumption between tradable and non-tradable good.

To fix ideas, we rewrite the first-order equations using Cobb-Douglas utility $u(c, n) = \frac{1}{2} \log(c) + \frac{1}{2} \log(n)$:

$$q = \beta \mathbb{E} \left[\frac{c}{c'} \middle| d \right] + 2c\mu_b \quad (21)$$

$$Ad = \frac{\beta \mathbb{E} \left[(A + \xi) d' \frac{1}{c'} \middle| d \right] + \frac{1}{2s'} - \mu_1}{\frac{1}{2c} - \kappa\mu_b} \quad (22)$$

In a state of bad low realization of d , EM is inclined to borrow to increase consumption, due to the consumption smoothing equation 21. Therefore, b' increases, and c increases. However, equation 22 provides a force for EM to increase their holding of the Lucas tree in order to smooth out non-tradable consumption as well. In this scenario, therefore, we will see both debt rising and equity flowing back to emerging market, and this will be consistent with the data.

6.4 Approximation Methods

There are multiple ways to solve for the value functions and decision rules of this model. To the best of our knowledge, closed-form solutions of this model do not seem to exist. However, we could approximate the solutions using two methods:

- Second-order approximation: We can follow Coeurdacier et al. (2011) to define and find a risky steady state (c^*, b^*, s^*) , then the solutions can be written as a linear (or quadratic) function of gaps away from steady state. Then, we can use a first or second-order approximation of the solution as in Devereux and Sutherland (2010). However, as noted by Mendoza (2010), solutions RBC models with collateral constraint that

¹³Note that without currency risk, the interest rate of risk-free borrowing/saving in the emerging market is simply the world rate discounted by depreciation rate. However, if currency risk is presence, then borrowing/saving through foreign investors is no longer risk-free.

binds occasionally are rather complex and may not be well approximated by first- or second-order approximation.

- Alternatively, we could use the Endogenous Gridpoints Method (EGM) to iterate over the two Euler equations 21 and 22. We propose here an iteration idea:
 - Guess the *conditional* next period consumption $c'(b, s, d, d')$, that is the optimal consumption next period of this week's state variables are (b, s, d) , and next week's state variables $(b'(b, s, d), s'(b, s, d), d')$.
 - Once we guessed optimal $c'(d')$ given any (b, s, d) , we can use equations 21 and 22 to calculate optimal $c(b, s, d)$ and $s'(b, s, d)$. Then, use the budget constraint to calculate the optimal bond holding rule $b'(b, s, d)$.
 - Interpolate and update the new rule $c'(b, s, d, d') = c(b'(b, s, d), s'(b, s, d), d')$.
 - Repeat the steps above until convergence.

7 Conclusion

This paper identifies capital sudden stop episodes in emerging markets from 2005-2014 and tries to explain why capital sudden stops did not happen in EMs during this period, and why the reversal of capital surge in emerging markets is much less damaging now than it was more than a decade ago. It is indeed puzzling, since 2011-2014 was a risky period with much uncertainty. We attribute this anti-climatic outcome to another phenomenon that we also document in this paper, the “de-coupling of portfolio debt and equity”. Through a large sample of both advanced economies and EMs, we document that while the portfolio debt and portfolio equity tend to co-move during normal times, they turn to move in opposite directions. This phenomenon suggests that investors do not treat all EM assets equally, and that foreign investors might have very different behaviors in the debt market and bond market. We put forth the idea of “portfolio rebalancing,” in which investors who are discouraged by low equity dividends look for investment opportunities elsewhere, and find the high yield EM’s bond very attractive. If this is the case, then we have explained the robust growth of debt securities in emerging market despite all risks and uncertainties. To test our theory, we estimated a VAR model on a panel data of 21 countries using new econometric methodology developed by Love and Zicchino (2006) and confirmed that there was an endogenous relation between a country’s outstanding portfolio debt and its level of portfolio equity. Results from PVAR estimation told us that a negative shock to the stock market triggers positive **growth** in the debt market in subsequent quarters, which confirms our theory of portfolio rebalancing. Finally, we provide a theoretical framework, an extension of Mendoza (2010), to have a sudden stop model with portfolio choice, since we believe the current sudden stop models, which contain only 1 type of asset (usually a risk-free bond), cannot explain fully what happened in practice in 2011-2015.

There are various ways to extend our line of research. First, we could develop algorithm to numerically solve the theoretical model put forth in section 6. Knowing exactly the decision rules of the EM representative agent may shed light on our understanding of capital inflows in EM - i.e. what and when will it happen, and particularly, in which market. Developing such an algorithm would also benefit other parts of the literature, since RBC

models with portfolio choice at the moment is currently not yet solved in the literature. Furthermore, we could extend the model to include risk-averse investors as well. Our paper has assumed risk-neutral investors in order to pin down asset prices in the economy, however that comes as a cost. Since we would like to know how foreign investors actively manage their portfolio, replacing risk-neutral investors assumption with risk-averse agents is necessary to confirm our theory of portfolio rebalancing. Endogenizing exchange rate would also enrich the model, and we suspect we could derive thresholds in which sudden stops in capital also associate with a currency crisis.

A Data Sources and Sample Descriptions

Sample for capital flows SS analysis

Eichengreen and Gupta (2014) sample: 57 countries. Albania, Argentina, Armenia, Azerbaijan, Belarus, Bosnia & Herzegovina, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Croatia, Czech, Dominican Rep, Egypt, Ghana, Guatemala, Hungary, Hong Kong, India, Indonesia, Ireland, Israel, Jamaica, Jordan, Kazakhstan, Kenya, Korea, Latvia, Lebanon, Lithuania, Macedonia, Malaysia, Mauritius, Mexico, Morocco, Pakistan, Paraguay, Peru, Philippines, Poland, Romania, Russia, Serbia, Singapore, South Africa, Sri Lanka, Tanzania, Thailand, Tunisia, Turkey, Ukraine, Uruguay, Venezuela, Vietnam.

Sample for currency depreciation SS analysis

- Advanced economies: Australia, Austria, Belgium, Canada, Switzerland, Cyprus, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, UK, Greece, Hong Kong, Ireland, Israel, Iceland, Italy, Japan, South Korea, Latvia, Luxembourg, Malta, Netherlands, Norway, New Zealand, Portugal, Sweden, Singapore, Slovenia, Slovakia, US.
- Emerging market: United Arab Emirates, Argentina, Bulgaria, Brazil, Chile, China, Croatia, Colombia, Algeria, Hungary, Indonesia, India, Lithuania, Mexico, Malaysia, Peru, Philippines, Poland, Romania, Russia, Saudi Arabia, Thailand, Turkey, Taiwan, Venezuela.

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PLEDGE

This paper represents my own work in accordance with University regulations.

VU THANH CHAU