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Three Essays on International Credit Market and Monetary Policy

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THREE ESSAYS ON INTERNATIONAL CREDIT MARKET AND MONETARY POLICY

by

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ABSTRACT

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My dissertation studies the behavior of international credit flow and the associated monetary policy spillover effect. In the first chapter, I am interested in decomposing the long-run variations and the short-run variations of US dollar denominated credit in emerging market economies. This paper uses a multivariate correlated unobserved component model to study the dynamic relationship among dollar credit in emerging market economies, US interest rates and the dollar index. The results from this model suggest that the transitory shocks to dollar credit in emerging market economies are highly negatively correlated with the transitory shocks to the US interest rate and the transitory shocks to the dollar index. The estimate of the cyclical component of dollar credit well captures the recent boom and bust phase in emerging market.

The rise in non-financial corporate overseas debt issuance has been playing a critical role in international capital flow activities. The second chapter of my dissertation examines the determinants of corporate overseas bond issuance in 32 countries during 1993-2015. The results suggest that the compression in risk premium has encouraged the corporates in emerging markets to borrow from international bond markets. This effect is more prevalent in countries with tighter international capital control policies, so that corporates outside financial regulation serve as surrogate financial intermediaries at the border. These incentives suggest a potential systematic shift in international financial risk transmission through corporate fixed-income markets and a possible external shock channeled through the monetary policy spillover effect.

The third chapter investigates further into the relative strengths of the global, regional, and country-idiosyncratic factors in driving debt dollarization in global financial market. Using a dynamic factor model, we decompose the fluctuations in the dollar debt growth of 12 countries into a global factor, a developed economy factor, an emerging market factor, and country-specific factors. We find that, since 2009, the global factor of the dollar debt growth has been increasing dramatically. It is the global factor that plays the dominant role in explaining the dollar debt growth of these countries.

To

my grandparents,

my parents,

and my uncle's family

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LIST OF ABBREVIATIONS

AR - Autoregressive

BIS - Bank of International Settlements

CA - Current Account

DFM - Dynamic Factor Model

EAC - East African Community

EM - Emerging Market

EME - Emerging Market Economies

EMU - European Monetary Union

FED - Federal Reserve System

GDP - Gross Domestic Product

HP - Hodrick and Prescott Filter

IMF - International Monetary Fund

MLE - Maximum Likelihood Method

OECD - Organization for Economic Cooperation and Development

QE - Quantitative Easing

SRTSM - Shadow Rate Term Structure Model

T-Bill - Treasury Bill

UC - Unobserved Component

VIX - CBOE Volatility Index

ZLB - Zero Lower Bound

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Chapter 1

Introduction

As the financial markets are becoming more integrated globally, we observe an increase in various cross-border financial activities. The international credit market has become an important component for borrowers and lenders around the world. While an integrated credit market helps promote risk sharing at the global scope, the cyclical variations in credit lending, some of which are driven by global factors (e.g. US monetary policy shocks), could potentially create domestic monetary and financial instability in the short run. It becomes even more challenging to stabilize the domestic economy when an external shock is playing a bigger role from the policy maker perspective. Moreover, some capital control policies, without proper design, may distort the credit market and push financial risk outside the traditional regulatory framework. For instance, a tighter regulation on international banking activities after Great Recession may explain the blizzard phenomenon that non-financial firms act as surrogate financial intermediaries to participate in the international corporate bond market.

In my dissertation, I try to explain the variation in the international credit flow and discuss the effect of the relevant public policies on the credit market. The first chapter of my dissertation is to untangle the short-run and long-run variations in the dollar credit in EMEs. Among the existing literature, there have been many works that try to understand the relationship between international credit and domestic credit or the relationship between international credit and major economy monetary policy. As discussed above, without differentiating the long-run and short-run variations of international credit, it is difficult to tease apart the opposite effects of variations in the data series and identify the clean linkage between the short-run variations and the business cycles of other macroeconomic variables. Therefore in this chapter, I try to decompose the short-run and

long-run variations using a correlated multivariate unobserved component model. The results from this model suggest that the transitory shocks to dollar credit in emerging market economies are highly negatively correlated with the transitory shocks to the US interest rate and the transitory shocks to the dollar index. The estimate of the cyclical component of the dollar credit in emerging market from our model captures the recent boom and bust phase in this market and compares favorably to a univariate trend-cycle decomposition benchmark.

The second chapter of my dissertation digs further into the international credit market by understanding the rising overseas corporate bond issuance behavior. After 2009, non-financial firms in EMEs suddenly increase overseas bond issuance dramatically. They behave like financial intermediaries in the international bond market to facilitate the cross-border lending activities. A few related questions should be asked: Why do non-financial firms increase overseas bond issuance? What are the associated financial risks in this behavior? In this chapter, I carefully examine these questions using a panel dataset that consists 32 countries during 1993-2015. The results suggest that the compression in risk premium, due to advanced economy stimulative monetary policy, has encouraged the corporates in emerging markets to borrow from international bond markets. This effect is more prevalent in countries where policy makers impose tighter international capital control, so that corporates outside financial regulation serve as surrogate financial intermediaries at the border. Besides, corporates hold short-term assets in domestic currency as collateral for outstanding overseas debt, in expecting domestic currency appreciation, a behavior often phased as price arbitrage or carry trade position. These incentives suggest a potential systematic shift in international financial risk transmission through corporate fixed-income markets and a possible external shock channeled through the monetary policy spillover effect.

The third chapter investigates the debt dollarization in global financial market. Using a dynamic factor model, we decompose the fluctuations in the dollar debt growth of 12 countries into a global factor, a developed economy factor, an emerging market factor, and country-specific factors. We find that, it is the global factor that plays the dominant

role in explaining the dollar debt growth of these countries. Furthermore, since 2009, the global factor of the dollar debt growth has been increasing dramatically, suggesting that the global liquidity transmission is closely related to the US monetary policy spillover effect. Our results also show that the estimated level of global factor is negatively correlated with VIX implying lower uncertainty in financial market tends to be associated with higher level of global debt dollarization.

Chapter 2

The Rise of Dollar Credit in Emerging Market Economies and US Monetary Policy

2.1 Introduction

The surge of dollar credit in the emerging market economies (EMEs henceforth) has drawn close attention from the international financial market participants and the policymakers due to its potential role in the monetary and financial stability of the global economy. The data from the Bank of International Settlements (BIS) shows that the outstanding US dollar credit to non-bank borrowers in the EMEs has risen from 1.69 trillion dollar in 2008Q4 to 3.25 trillion dollar in 2015Q4. The cyclical nature of EME dollar credit[1] could also amplify the overall credit condition in the domestic economy and increase the vulnerability of these the EMEs in dealing with negative economic shocks. For example, during the expansionary phase, the dollar credit floods into the EMEs, which raises the challenge to stabilize the domestic monetary base. In the contractionary phase, the dramatic outflow of dollar credit also creates difficulty to stabilize the exchange rate and asset prices (Avdjiev et al., 2012). This was very evident during the 'taper tantrum' of 2013. On the other hand, however, it has also been argued that the increasing role of

[1]EME dollar credit in this paper refers to the outstanding dollar credit to non-bank borrowers in emerging market economies. It is composed of credit extended by all lenders: banks and non-bank creditors, from foreign and domestic sources. Specifically, it is composed of loans extended by banks and purchases of debt securities by both banks and by non-banks (as proxied by issues of debt securities). Based on the guide to use BIS global liquidity indicators, emerging market economies refers to the countries including Argentina, Brazil, Chile, China, the Czech Republic, Hong Kong, Hungary, India, Indonesia, Korea, Poland, Russia, South Africa, Thailand, Turkey, Malaysia, Mexico, Saudi Arabia, and Singapore.

dollar credit in the EMEs may signify a more integrated global financial market and a greater degree of risk sharing across different countries.

The growing academic interest in the literature on examining the dollar credit in the EMEs has also coincided with the recent emphasis on the role of US monetary policy in boosting global liquidity. Global liquidity refers to the global factor that drives cross-border spillover in financial conditions and credit growth. Shin (2013) proposes two phases of global liquidity after the Millennium. The first phase of global liquidity transmission (2002-2008) is more associated in form of bank loans through global banking system. The international bond market gradually took over the share of bank loans in the second phase of global liquidity transmission starting in 2009. Since then, the large scale of bond purchases as a result of of Quantitative Easing (QE) programs had led to the portfolio re-balancing effect[2] in the international bond market. A few papers and policy studies have provided narrative evidence (Borio, et al. 2011; McCauley, et al., 2015) in support of the hypothesis that the abundance of global liquidity was one of the causes of the boom of the dollar credit in the EMEs.

Although much attention has been given to the rise of dollar credit and its apparent relationship with US monetary policy and the valuation of the US dollar, not much work has been done to systematically disentangle the short-run and the long-run relationships among these variables. It is perfectly plausible to think that the short-run relationship between dollar credit in emerging markets and the stance of monetary policy in the US may be very different from its long-run relationship. The long-run dollar credit in the emerging market may be driven more by its long-run absorptive capacity instead of the short-run increase in liquidity or the weakness of the US dollar. Therefore, it is very important to decompose the overall EME dollar credit and isolate the cyclical variations from its long-term trend, by taking into account the information on US interest rate and the dollar valuation. In addition to estimating the short-run and the long-run correlation between the shocks to each series, this approach will also yield us a quantitative estimate

[2]The portfolio re-balancing effect in this context means when the Fed purchases bonds from the investors, the investors need to purchase additional bonds from somewhere else, for instance, emerging market economies, if they want to maintain the original weights on different asset classes.

of how big the cyclical component in dollar credit was at different points in time during the last few years.

To examine the long-run and short-run relationship among these variables, we propose to use a correlated multivariate unobserved component (UC hereafter) model which is a multivariate counterpart of the correlated univariate UC model as outlined in Morley, Nelson and Zivot (2003).[3] This model allows us to decompose the movements in dollar credit, interest rate and dollar index[4] into a slow-moving trend component and a cyclical component simultaneously. The slow-moving trend captures the long-run evolution of these variables and the cyclical component captures the short-run movements. This model allows us to not only estimate the permanent and transitory movements, but also provides us a measure of correlation of the long-run movements and the short-run movements among dollar credit, interest rate and dollar index.[5] For example, if the recent narrative about the role of exceptionally low interest rate in boosting EME dollar credit is correct, then we would observe a negative correlation between the shock to the transitory component of dollar credit and the shock to transitory component of the US interest rate. To take into account the zero lower bound problem associated with the federal funds rate and the short-term interest rate in the recent time period, we use the shadow interest rate as proposed by Wu and Xia (2016) as a proxy for US monetary policy stance. The shadow interest rate takes into account the impact of unconventional monetary policy on interest rate and unlike the federal funds rate, is allowed to fall below zero.

To understand the intuition behind the structure of our model, one could think of the credit activities in the EMEs as a form of international investment. From the investors' perspective, the return of lending dollar in the EMEs depends on the interest rate paid from these credit instruments. The US interest rate, the risk-free rate in the international credit market, is a major factor in pricing the interest rates on the international bank

[3]Multivariate correlated unobserved component model has also been applied in other context. See for example, Sinclair (2009), Morley (2007), Bhatt and Kishor (2016) among others.

[4]Dollar index refers to the broad trade-weighted US dollar index. This variable is a proxy of the dollar valuation against other currencies.

[5]It should be noted at the outset that we are interested in understanding the role of external forces in dollar credit growth. Domestic factors like GDP growth may also affect the movements in dollar credit growth in the EMEs. In our set up, the dynamic behavior of trend and cycle should be able to capture some of these effects.

loans and the corporate bond yields. From the EME borrowers' perspective, the dollar valuation in the currency market is also critical in determining their real external debt burden, besides the US monetary policy rate. The expectation of domestic currency appreciation will lower the expected external debt burden in the future and vice versa. To summarize, we can think of this three-variable dynamic system as the application of interest rate parity in international credit activities.

We find interesting and economically meaningful results from the estimated multivariate correlated unobserved component model. The maximum likelihood estimates of our correlated multivariate UC model suggest that there is a strong negative correlation between the transitory shock to dollar credit and the transitory shock to the US interest rates. This suggests that a temporary decline in interest rate below its long-run level is associated with an increase in dollar credit above its long-run level. We also find a very high negative correlation between the transitory shocks to dollar credit and the transitory shocks to the dollar index, implying an appreciation of US dollar is associated with a decline in dollar credit in the EMEs in the short-run. These results support the anecdotal and narrative evidence on the strong relationship between dollar credit and the US interest rates and also between dollar credit and the strength of the US dollar. We also find that the trend-cycle decomposition of EME dollar credit from our multivariate correlated unobserved component model captures the recent boom and bust behavior and compares favorably to a univariate trend-cycle decomposition benchmark. In particular, our results suggest that the dollar credit before the taper tantrum was 10% above its long-run trend in the emerging market economies.

The rest of the paper is structured as follows. The second section provides a literature review about global liquidity transmission and discusses the associated monetary policy spillover effect. The third section introduces the data used in this study and the setup of the correlated multivariate UC model. The fourth section interprets and presents the results from the model. The last section concludes the paper.

2.2 Literature Review

The literature on dollar credit in the EMEs is nascent. Few papers have tried to address this issue from different perspectives. In understanding the phenomenon that dollar credit outside the US behaves differently from the US domestic dollar credit, Borio, McCauley and McGuire (2011) take a look at the recent behavior of international credit and associate it with the overall credit conditions. Their descriptive analysis reveals the fact that US dollar credit in some countries has been outgrowing the overall credit during the credit booms. A formal analysis later on from Avdjiev, McCauley and McGuire (2012) regresses the cross-sectional change in credit-to-GDP ratio on the change in international credit during the credit boom phase (2002-2008) and regresses the credit growth in the EMEs on the change in international credit during the credit bust phase (2008-2011). Their results suggest that international credit amplifies the overall credit cycles in the EMEs. While in these studies, the authors often use the share of international credit in the overall credit to measure the cyclical variation of international credit, it is worthwhile to recognize that the trend of international credit and the trend of the overall credit can be driven by different underlying factors, therefore they do not need to share the common trend in the numerator and denominator. For instance, the long-term trend of international credit could be explained by the integration of international financial market, but the long-term trend of the overall credit condition may respond more to the domestic economic fundamentals. Thus without isolating the long-term trend from these two credit series, it is very difficult to perform a clean analysis about the cyclical comovement between the international credit and the overall credit condition.

Since the recent global financial crisis of 2008-2009, the outstanding US dollar credit to the non-bank borrowers in the EMEs has roughly doubled within the past seven years. The commentators associate this surge to US monetary policy spillover, mainly because of the ultra low interest rates in the US. He and McCauley (2013) survey a number of studies on the transmission of monetary policy of the major advanced economies to East Asia and conclude that policy rates, bond yields and exchange rates are three price channels in the transmission process. McCauley, McGuire and Suchko (2015) also link the US monetary

policy, leverage and flow into bond funds to explain the dollar credit extended to non-US borrowers. In this paper, since our goal is to understand the behavior of the overall dollar credit condition, regardless of the credit instruments, we focus on the two price channels—interest rate and currency appreciation/depreciation, an analytical framework which can be interpreted as based upon international interest rate parity theory. [6]

It should be pointed out that we focus on *EME dollar credit*, a subject we believe to be ideal to study the monetary policy spillover effect in global liquidity transmission. This is because, the composition of bank loan and bond issuance depends on country-specific contexts, for instance, the regulatory emphasis of capital control. Tighter regulation on international banking practice could push the domestic borrowers to issue bonds overseas and vice versa (Caballero et al., 2015). Since our goal is to understand the trend and cycle of the dollar credit in emerging market economies, we purposely ignore the credit breakdown based on types of financial instruments. Furthermore, we choose to study EME dollar credit, instead of Euro, Yen or other currency credit, is because different currency credit could be sensitive to different monetary policy rates and dollar credit dominates other currencies in the currency breakdown of international credit (Borio, et al., 2011). The last but not the least, we work with the dollar credit in the EMEs, because the dollar credit outside US may respond to factors in different ways when it comes to the EMEs compared to other advanced economies. (Borio, et al. 2011; McCauley, et al., 2015)

2.3 Data and Empirical Model

2.3.1 Data Description

Our sample period spans from the first quarter of 2000 to the last quarter of 2015. The sample period is based on data availability. Measuring dollar credit can be a challenging exercise. Fortunately, the Bank of International Settlements (BIS) website provides global

[6] See the empirical model section for details.

liquidity indicators to measure the ease of financing in global financial markets. [7] Among various global credit aggregates, we use the US dollar credit to non-bank sector in the EMEs in this study. This measure aggregates all the maturities of credit instruments. The original data is measured in trillions of US dollar and we take the natural log of this series and use the log-transformed series in the model estimation.

The second variable in our exercise is US interest rate that proxies the stance of US monetary policy. The ideal candidate would have been the federal funds rate if there was not a zero lower bound (ZLB) problem. The ZLB issue arises during and after the Great Recession, as the Fed quickly lowered the federal funds rate close to zero and also implemented the unconventional monetary policies, including large-scale purchases of financial assets from private financial corporations. These unconventional monetary policies helped inject more liquidity into the market than implied by the federal funds rate, which basically had no room to be lowered further. The overall monetary policy stance thus can not simply be captured by the variations in the federal funds rate itself.

To take this ZLB problem into account, Wu and Xia (2016) proposed to use the shadow interest rate to provide a comprehensive measure to summarize the overall stance of monetary policy while the federal funds rate stuck at the ZLB environment. The shadow interest rate measure originated from the idea in Black (1995) to price the interest rate as an option. Wu and Xia (2016) conducted an analytical approximation for the forward rate in the Shadow Rate Term Structure Model (SRTSM), by linearizing the state-space model representation of the three-factor SRTSM. Then they used the estimated parameters and decomposed three unobserved factors to compute the shadow interest rate. The likelihood ratio test could not reject the hypothesis that the parameters relating the shadow interest rate to key macroeconomic variables under the ZLB environment are the same as those that related the federal funds rate to those variables before the Great Recession. Because of its intuitive appeal, Wu and Xia (2016) shadow interest rate measure has been gaining widespread attention. [8]

[7] The term global liquidity is used by the BIS to mean the ease of financing in global financial markets. BIS publishes measures of global liquidity indicators. See *https* : *//www.bis.org/statistics/gli.htm?m* for details.

[8] Federal Reserve Bank of Atlanta posts Wu and Xia shadow federal funds rate on the website: *https* :

Because of the above mentioned reasons, we use the shadow interest rate proposed by Wu and Xia (2016) as a proxy for the Fed's overall monetary policy stance. The reason we choose to use this measure in our benchmark estimation over some alternative measures, for instance, the longer-term interest rates which suffer less from the ZLB issue, is because the term premium in the long-term interest rates could potentially contaminate the monetary policy stance. Nevertheless, we still perform a robustness test with 1-year treasury bill rate, given the fact that our dollar credit measure aggregates all the credit instruments regardless of their term to maturity. The third variable in our exercise is the US dollar exchange rate in the global currency market. We use the broad trade-weighted US dollar index to measure the dollar valuation in the currency market. The larger the index, the stronger the US dollar is, or equivalently, the more US dollar appreciates, and vice versa.

2.3.1 Empirical Model

In this paper, we use a trivariate unobserved component model to model the dynamics in EME dollar credit (Y_t), interest rate (I_t) and dollar index (D_t). This model is multivariate extension of the model proposed by Morley, Nelson and Zivot (2003). To understand the intuition behind the structure of our model, one could think of the credit activities in the EMEs as a form of international investment. From the investors' perspective, the return of lending dollar in the EMEs depends on the interest rate paid from these credit instruments. The US monetary policy rate, the risk-free rate in the international credit market, is a major factor in pricing the interest rates on the international bank loans and the corporate bond yields. From the EME borrowers' perspective, the dollar valuation in the currency market is also critical in determining their real external debt burden, besides the US monetary policy rate. The expectation of domestic currency appreciation will lower the expected external debt burden in the future and vice versa. To summarize, we can think of this three-variable dynamic system as the application of interest rate parity in international credit activities. Moreover, the interest rate parity

$//www.frbatlanta.org/cqer/research/shadow_rate.aspx?panel = 1$

has to hold in both the short-run and the long-run market equilibrium. Therefore, the dynamics of interest rate and exchange rate will provide useful information in explaining the dynamics of dollar credit in the EMEs.[9] Our model takes the following form:

EME Dollar Credit:

$$Y_t = \tau_{yt} + c_{yt} \tag{1}$$

$$\tau_{yt} = \mu_y + \tau_{yt-1} + \eta_{yt}, \eta_{yt} \sim iidN(0, \sigma^2_{\eta y}) \tag{2}$$

$$c_{yt} = \phi_{1y} c_{yt-1} + \phi_{2y} c_{yt-2} + \varepsilon_{yt}, \varepsilon_{yt} \sim iidN(0, \sigma^2_{\varepsilon y}) \tag{3}$$

Interest Rate:

$$I_t = \tau_{it} + c_{it} \tag{4}$$

$$\tau_{it} = \mu_i + \tau_{it-1} + \eta_{it}, \eta_{it} \sim iidN(0, \sigma^2_{\eta i}) \tag{5}$$

$$c_{it} = \phi_{1i} c_{it-1} + \phi_{2i} c_{it-2} + \varepsilon_{it}, \varepsilon_{it} \sim iidN(0, \sigma^2_{\varepsilon i}) \tag{6}$$

Dollar Index:

$$D_t = \tau_{dt} + c_{dt} \tag{7}$$

$$\tau_{dt} = \mu_d + \tau_{dt-1} + \eta_{dt}, \eta_{dt} \sim iidN(0, \sigma^2_{\eta d}) \tag{8}$$

$$c_{dt} = \phi_{1d} c_{dt-1} + \phi_{2d} c_{dt-2} + \varepsilon_{dt}, \varepsilon_{dt} \sim iidN(0, \sigma^2_{\varepsilon d}) \tag{9}$$

Each series is decomposed into a stochastic trend component ($\tau_{jt}, i = Y, I or D$) and a cyclical component ($c_{jt}, i = Y, I or D$) implying an I(1) process for all the variables. The non-stationarity of these variables are confirmed by the unit root tests where we do not reject the null of unit root for all the variables.[10] We also do not impose the common trend restriction, i.e., all three variables have their own trend and cycle components and these components are allowed to have a certain degree of correlation based on the economic intuition we will discuss later. In fact, we do test for cointegration among these three

[9] It can be argued that a more realistic model should also include more variables.This is a valid criticism. However, the objective of this paper is to understand the dynamic relationship between US monetary policy and dollar credit in the EMEs, therefore, in the interest of parsimony we focus on these three variables.

[10] The detailed results are not reported here for brevity. They are available upon request.

variables and do not find evidence to support this for the sample period under study.

Secondly, we specify the dynamics of trend and cycle components. The cyclical component in each series is assumed to follow an AR (2) process. This assumption captures the auto correlation structures as observed in the correlogram and provides rich dynamics in the data series to enable us to identify all the parameters under the state-space model framework (Morley, Nelson and Zivot, 2003). The trend components are assumed to follow a random walk process with a drift, and as mentioned above, we do not impose a common trend among these three variables.[11]

Thirdly, we assume the shocks to the trend and cycle components follow a white noise process, but allow for non-zero cross-correlation across series. The shocks to the trend components ($\eta_{jt}, i = Y, I, or D$) have a long-run effect on the trend because the trend is assumed to follow a random walk process. The shocks to the cyclical component ($\varepsilon_{jt}, i = Y, I or D$) have a short-run effect on the cycle because the cycle follows a stationary autoregressive process with two lags. The shocks to each trend component are allowed to be correlated across each other, so are the shocks to the cyclical components. However, we impose the zero correlation between the shocks to the trend component and the shocks to the cycle component within and between series. That is to say, we assume that the shocks that generate a long-run effect are different from the shocks that generate a short-run effect. This assumption for example, isolates the monetary policy shocks, which often are considered neutral in the long term, from the productivity shocks, which has a persistent effect in the real economy.

Below is the correlated multivariate unobserved component model setup based on the previous discussion. It should be pointed out that, in the variance-covariance matrix of the shocks to the trend and cycle, $\sigma_{\eta y \eta i}$, $\sigma_{\eta y \eta d}$, and $\sigma_{\eta i \eta d}$ are the pairwise covariance of the shocks to the trend of EME dollar credit, monetary policy rate and dollar index. $\sigma_{\varepsilon y \varepsilon i}$, $\sigma_{\varepsilon y \varepsilon d}$, and $\sigma_{\varepsilon i \varepsilon d}$ are the pairwise covariance of the shocks to the cycle of EME dollar credit, monetary policy rate and dollar index. The estimates of correlation coefficients,

[11] We also explore the random walk model with drift to capture the potential shocks in the percentage changes in additional to the shocks to the levels for stochastic trend. The results do not show evidence in support of this model..

instead of covariances, will be reported in Table 1. We estimate the model using the classical maximum likelihood via the Kalman filter. [12]

Measurement Equation:

$$\begin{bmatrix} Y_t \\ I_t \\ D_t \end{bmatrix} = \begin{bmatrix} 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 \end{bmatrix} \begin{bmatrix} \tau_{yt} \\ c_{yt} \\ c_{yt-1} \\ \tau_{it} \\ c_{it} \\ c_{it-1} \\ \tau_{dt} \\ c_{dt} \\ c_{dt-1} \end{bmatrix}$$

Transition Equation:

$$\begin{bmatrix} \tau_{yt} \\ c_{yt} \\ c_{yt-1} \\ \tau_{it} \\ c_{it} \\ c_{it-1} \\ \tau_{dt} \\ c_{dt} \\ c_{dt-1} \end{bmatrix} = \begin{bmatrix} \mu_y \\ 0 \\ 0 \\ \mu_i \\ 0 \\ 0 \\ \mu_d \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \phi_{1y} & \phi_{2y} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \phi_{1i} & \phi_{2i} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \phi_{1d} & \phi_{2d} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} \tau_{yt-1} \\ c_{yt-1} \\ c_{yt-2} \\ \tau_{it-1} \\ c_{it-1} \\ c_{it-2} \\ \tau_{dt-1} \\ c_{dt-1} \\ c_{dt-2} \end{bmatrix} + \begin{bmatrix} \eta_{yt} \\ \varepsilon_{yt} \\ 0 \\ \eta_{it} \\ \varepsilon_{it} \\ 0 \\ \eta_{dt} \\ \varepsilon_{dt} \\ 0 \end{bmatrix}$$

[12] See Kim and Nelson (2000) for the details of the estimation procedure.

Variance-Covariance Matrix of the Shocks to Trend and Cycle:

$$Q = \begin{bmatrix} \sigma^2_{\eta y} & 0 & 0 & \sigma_{\eta y \eta i} & 0 & 0 & \sigma_{\eta y \eta d} & 0 & 0 \\ 0 & \sigma^2_{\varepsilon y} & 0 & 0 & \sigma_{\varepsilon y \varepsilon i} & 0 & 0 & \sigma_{\varepsilon y \varepsilon d} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \sigma_{\eta y \eta i} & 0 & 0 & \sigma^2_{\eta i} & 0 & 0 & \sigma_{\eta i \eta d} & 0 & 0 \\ 0 & \sigma_{\varepsilon y \varepsilon i} & 0 & 0 & \sigma^2_{\varepsilon i} & 0 & 0 & \sigma_{\varepsilon i \varepsilon d} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \sigma_{\eta y \eta d} & 0 & 0 & \sigma_{\eta i \eta d} & 0 & 0 & \sigma^2_{\eta d} & 0 & 0 \\ 0 & \sigma_{\varepsilon y \varepsilon d} & 0 & 0 & \sigma_{\varepsilon i \varepsilon d} & 0 & 0 & \sigma^2_{\varepsilon d} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

2.4 Results and Interpretation

We present the results of this model in the next three subsections. In the first subsection, we discuss the parameter estimates and also provide interpretation for the correlation of the shocks to the trend and cycle among the three variables. In the second subsection, we discuss the evolution of the estimated trend and cycle of each series and examine whether the trend and cycle components capture the long-run trend and the cyclical variation during the sample period. In the third subsection, we look at both the long-term and short-term comovement among these three variables.

2.4.1 Dynamic Relationship among EME dollar Credit, US Interest Rate and the Dollar Index

Table 1 provides the maximum likelihood estimates of all the parameters. The corresponding standard errors are in the parentheses. The results suggest that the cyclical shocks dominate the variation in the overall EME dollar credit. The standard deviation

of the shocks in the trend of EME dollar credit is 0.014[13], smaller compared to the standard deviation of the shocks in the cycle, 0.017. Additionally, for the shadow interest rate, the standard deviation of the shocks in the trend is 0.274, almost twice as large as the standard deviation of the shocks in the cycle. The results seem to suggest that variations in slow moving component in the shadow interest rate is dominant. However, the variations in cyclical component are also significant. For the dollar index, the standard deviation of shocks to the trend and cycle components are 0.015 and 0.016 respectively, implying similar importance of transitory and permanent variation in dollar index. As far as the estimated parameters of the cyclical components are concerned, we find that the cyclical component of all the variables are persistent implying a shock to the cycle, though transient, persists for a while.

The correlation analysis of the shocks to the *cycles* among these variables suggests that the cyclical variation among EME dollar credit, monetary policy rate and dollar credit are strongly correlated. The correlation coefficient between the transitory shock to dollar credit and the transitory shock to US interest rate is -0.97. The correlation coefficient between the transitory shock to EME dollar credit and the transitory shock to dollar index is -0.94. And the correlation coefficient between the transitory shock to US interest rate and the the transitory shock to dollar index is 0.99. The standard errors of these estimated parameters confirm that these correlation coefficients are significantly different from zero.

The strong negative correlation between the transitory shock to US interest rate and the transitory shock to dollar credit in the EMEs suggests that, a temporary decrease in US interest rate below its long-run trend leads to a temporary increase in EME dollar credit as it lowers the cost of borrowing. In addition to the lower cost, the transitory decline in interest rate may also reflect temporary abundance of liquidity as witnessed during the QE programs. The negative correlation between transitory shock to dollar index and transitory shock to dollar credit in the EMEs is also very intuitive. An increase

[13]The unit of measurement here is log trillion of US dollars for the EME dollar credit series. The unit of measurement for US shadow interest rate is percentage point and the unit of measurement for dollar index is the log transformation of the original index.

in dollar index implies an appreciation of dollar index above its long-run trend and these movements make the dollar financing activities in the EMEs less appealing temporarily.

We can motivate the strong positive correlation between the transitory shock to US interest rate and the transitory shock to US dollar index by considering an open economy's short-run equilibrium model. At the initial output level and given the sticky price level in the short-run, an increase in US money supply pushes down the US interest rate. Since the US monetary change is temporary and does not affect the expected future exchange rate, so to preserve interest rate parity, the exchange rate must depreciate immediately to create the expectation that the US dollar will appreciate in the future. Therefore, in the short run, a negative transitory shock to US monetary policy rate is predicted to associate with a negative transitory shock to US dollar index, which is exactly what we identify in our model estimation.

The correlation analysis of the shocks to the *trends* among these variables confirm our earlier finding that these three variables do not share a common trend and hence, are not cointegrated.[14]The correlation coefficient between the permanent shocks to EME dollar credit and the permanent shocks to US interest rate is 0.67. The correlation coefficient between the permanent shock to US interest rate and the permanent shocks to dollar index is -0.68. The standard errors of these estimated parameters confirm that these correlation coefficients are significantly different from zero. The correlation coefficient between the permanent shock to EME dollar credit and the permanent shock to dollar index is insignificant and low. Therefore, it is not likely that these variables share the common trend, which supports the conjecture that we need to decompose the trend and cycle components from the series to understand the business cycles of these variables.

The negative correlation between the permanent shock to US interest rate and the permanent shock to dollar index seems puzzling at the first glance. However, it can be explained using the forward looking behavior of these variables. If an unexpected permanent increase in interest rate provide the signal that inflation is expected to go up in future, then nominal exchange rate may respond instantaneously in response to this

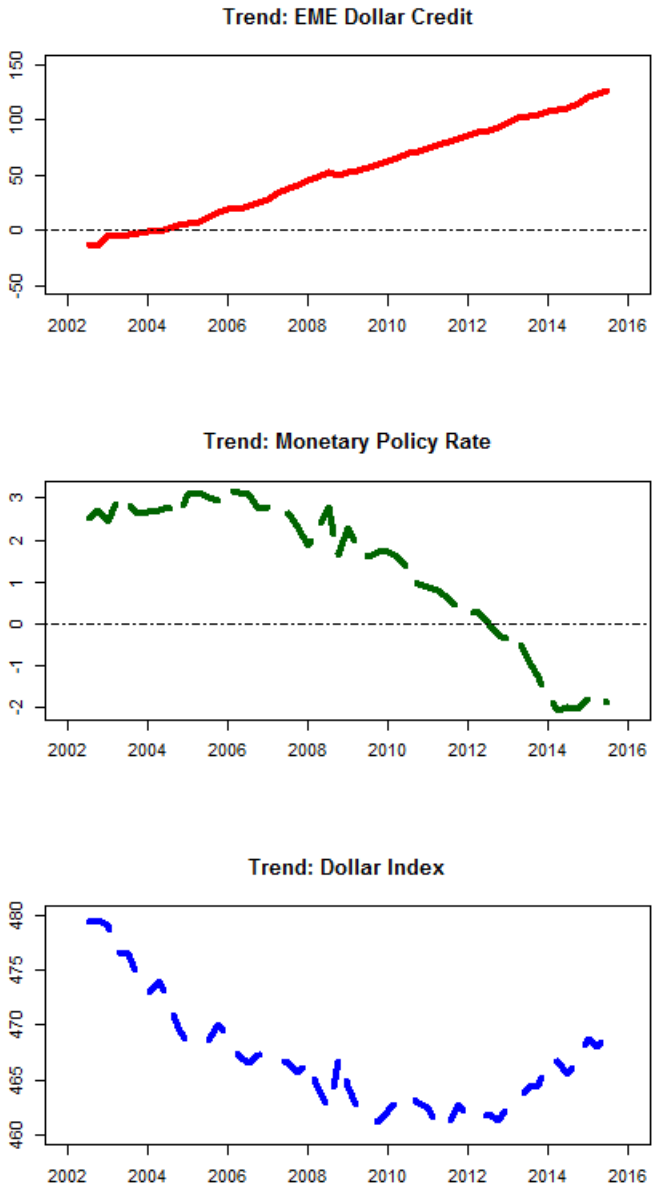
[14]In extreme case of cointegration, we will observe perfect correlation in the trend shock of these variables.

Table 1: Maximum Likelihood Estimates: A Correlated Multivariate UC Model

Description	Parameter	Estimate (Standard Error)
Log likelihood value	llv	295.8723
	EME dollar credit	
S.D. of permanent shocks to the EME dollar credit	$\sigma_{\eta y}$	0.0139 (0.0041)
S.D. of temporary shocks to the EME dollar credit	$\sigma_{\varepsilon y}$	0.0168 (0.0033)
the EME dollar credit drift	μ_y	0.0274 (0.0025)
EME dollar credit 1st AR parameter	ϕ_{1y}	1.3851 (0.1399)
EME dollar credit 2nd AR parameter	ϕ_{2y}	-0.4770 (0.1251)
	shadow interest rate	
S.D. of permanent shocks to shadow interest rate	$\sigma_{\eta i}$	0.2738 (0.0312)
S.D. of temporary shocks to shadow interest rate	$\sigma_{\varepsilon i}$	0.1549 (0.0327)
Shadow interest rate drift	μ_i	-0.0792 (0.0481)
Shadow interest rate 1st AR parameter	ϕ_{1i}	1.9072 (0.0355)
Shadow interest rate 2nd AR parameter	ϕ_{2i}	-0.9462 (0.0363)
	US dollar index	
S.D. of permanent shocks to US dollar index	$\sigma_{\eta d}$	0.0148 (0.0029)
S.D. of temporary shocks to US dollar index	$\sigma_{\varepsilon d}$	0.0158 (0.0027)
US dollar index drift	μ_d	-0.0026 (0.0021)
US dollar index 1st AR parameter	ϕ_{1d}	1.3585 (0.1144)
US dollar index 2nd AR parameter	ϕ_{2d}	-0.5726 (0.0980)
	Cross-series correlations	
Correlation: Permanent dollar credit/ Permanent interest rate	$\rho_{\eta y \eta i}$	0.6669 (0.2118)
Correlation: Permanent dollar credit/ Permanent dollar index	$\rho_{\eta y \eta d}$	0.0842 (0.3396)
Correlation: Permanent interest rate/ Permanent dollar index	$\rho_{\eta i \eta d}$	-0.6864 (0.2532)
Correlation: Transitory dollar credit/ Transitory interest rate	$\rho_{\varepsilon y \varepsilon i}$	-0.9719 (0.1157)
Correlation: Transitory dollar credit/ Transitory dollar index	$\rho_{\varepsilon y \varepsilon d}$	-0.9406 (0.2205)
Correlation: Transitory interest rate/ Transitory dollar index	$\rho_{\varepsilon i \varepsilon d}$	0.9941 (0.0372)

Figure 1: Trends from Correlated Multivariate Unobserved Component Model

The figures below report the trend components of EME dollar credit, shadow interest rate and dollar index. The dollar credit in the EMEs is measured in log trillions of USD and multiplied by 100. The shadow interest rate is measured in percentage points. The log of US dollar index has been multiplied by 100.



news about higher than expected inflation. Similarly, the forward-looking behavior can explain the positive correlation between permanent shock to interest rate and permanent shock to dollar credit. An unexpected permanent increase in interest rate may provide information about higher than expected inflation, which in turn may lead to a depreciation of the dollar as argued before. This will be associated with an unexpected permanent increase in dollar credit in emerging market economies. Overall, the results from the correlation analysis clearly suggests value in examining the short-run and the long-run relationships separately. The results suggest that fundamentals seem to matter more in the long-run, whereas the short-run boom may be associated with temporary phases of monetary policy as well as movements in dollar index.

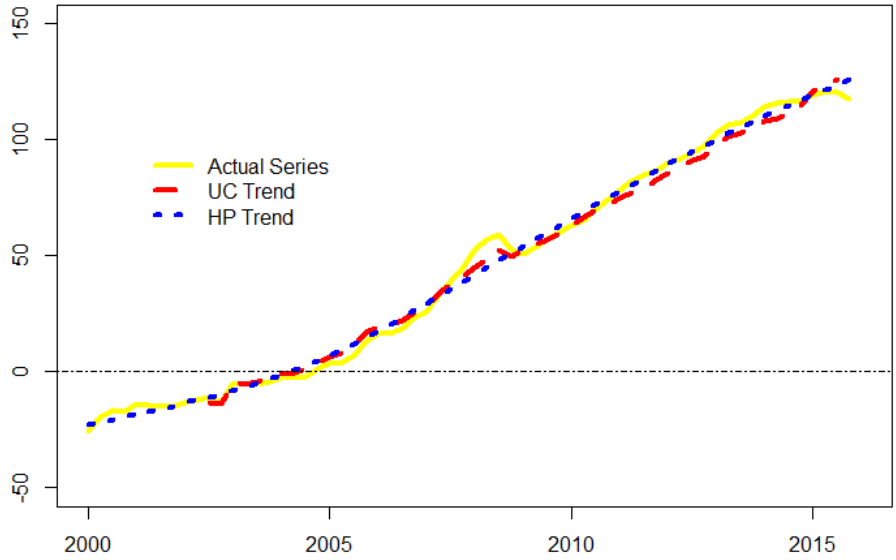
2.4.2 Trend-Cycle Decomposition

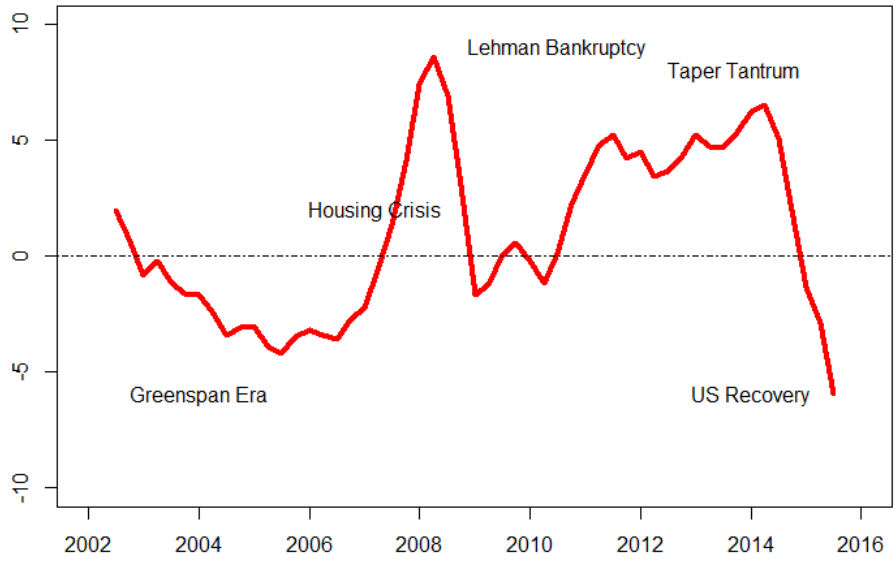
In this subsection, we decompose the trend and cycle of EME dollar credit, interest rate and dollar index using the correlated multivariate unobserved component model. The stochastic *trend* in the multivariate UC model captures the long-run evolution in EME dollar credit and also reflects the effect of recent global financial crisis (Figure 2). In the long-run, there is an increasing trend in EME dollar credit, due to the global financial integration. There was a downward shift in the trend during the financial crisis. The effect of this negative shock on the trend of EME dollar credit persisted for few years.

The *cyclical* component from our multivariate UC model captures the evolution of the dollar credit and its dynamic relationship with US interest rate and the dollar index really well (Figure 2). During the initial part of our sample, the dollar credit cycle was negative implying lower than potential credit in these countries. After the collapse of Bear Stearns, emerging market economies provided a sanctuary for the international capital, mainly because the investor community assumed that the EMEs are decoupled from the developed markets.In the third quarter of 2008, Lehman Brother filed bankruptcy that led to financial panic. These events were associated with a global contraction in credit lending, which brought the dollar credit back down to its long-term trend. During

Figure 2: Trend/Cycle Decomposition from Correlated Multivariate UC Model

This figure reports the trend component and the cyclical component of EME dollar credit. The dollar credit in the EMEs is measured in log trillions of USD and multiplied by 100. The UC trend is the trend component of EME dollar credit decomposed using the correlated multivariate unobserved component (UC) model. The HP trend is the trend component of EME dollar credit decomposed using Hodrick and Prescott (HP) filter.





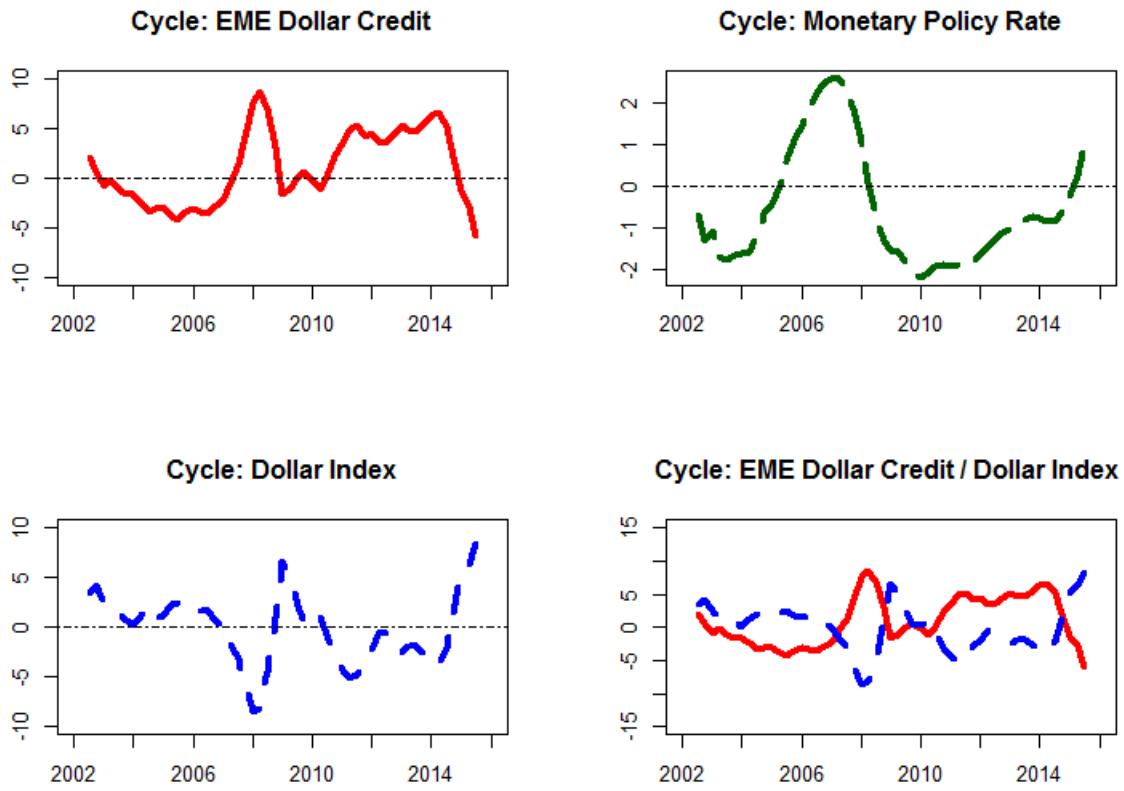
this time period, the Federal Reserve lowered the policy rate significantly and dumped liquidity into the financial market through several runs of the QE programs. The portfolio re-balancing effect quickly directed the investors to the credit market in the EMEs to chase for yield. Shin (2013) denotes the year 2009 as the beginning of the second phase of global liquidity, because of the rapid capital flow into the EMEs in the form of non-financial firm bond issuance. Our cyclical component from the multivariate UC model indicates the expansionary cycle of EME dollar credit during 2009-2014, a phenomenon widely observed and agreed upon among the financial market observers and researchers. Starting from 2015, the persistent recovery of US economy and the slowdown in the EMEs overturned the dollar credit flow and created the concern about the instability of the EME financial markets and the feedback loops between the EMEs and advanced economies.

2.4.3 Co-movement among the Cyclical Components

The estimated cyclical components from our model are displayed in Figure 3. Both the qualitative and quantitative measures of the cycles are consistent with intuition and they follow the dynamics of dollar credit, interest rates and dollar index very well. We observe that cyclical variation in dollar index is strongly negatively associated with the cyclical variation of EME dollar credit. Before 2008 financial crisis, when dollar was relatively strong, the overall EME dollar credit was increasing but was still below its trend, consistent with the idea that stronger dollar works against capital inflow in the EMEs. The correlation between the cyclical components of EME dollar credit and the dollar index suggests that the weak dollar could potentially contribute to the surge in the credit flow into the EMEs. When the financial crisis hit the US economy, the dollar depreciated and the investors with dollar assets were looking for higher yields in alternative asset classes. During this recessionary phase in the US, EME dollar credit witnessed an expansionary period during the 2009-2014 sample period. The negative correlation between cyclical components of EME dollar credit and the dollar index also suggests that the strong dollar could potentially slow down the credit flow into the EMEs. Since 2015, the recovery of the

Figure 3: Cycles in the Correlated Multivariate Unobserved Component Model

This figure reports the cyclical components of the three variables EME dollar credit, shadow interest rate and the dollar index. The dollar credit in the EMEs is measured in log trillions of USD and multiplied by 100. The shadow interest rate is measured in percentage points. The US dollar index is in logs and has been multiplied by 100.



US economy has played a role in strengthening of the US dollar and as a result financial markets started anticipating a hike in the interest rates. EME dollar credit seemed to have entered a contractionary phase during this time period. Note that the overall EME dollar credit could still increase due to the underlying increasing trend. The dollar index is also relevant for the market participants to estimate the overall return when US policy rate hits the zero-lower bound. The risk of international carry trade, a typical cyclical investment behavior, mainly comes from the exchange rate risk under this environment. Therefore, it is not surprising that the dollar index can provide useful information in understanding the EME dollar credit conditions.

The plot of the cyclical component of interest rate suggests that interest rates were

slightly above its long-run trend prior to the great recession. In the earlier part of the sample, the results suggest that the interest rate were below its trend suggesting an accommodative stance of monetary policy. This is consistent with the arguments proposed in the literature that has argued that the interest rates were too low in the pre-financial crisis period (Taylor, 2007). The unconventional monetary policy tools utilized by the Federal Reserve during the great recession led to a decline in the interest rate below its long-run average in our model during and after the great recession. This period was also associated with surge in dollar credit above its long-run trend as shown in Figure 3. The plot also shows that interest rate started moving towards its long-run trend at the beginning of 2015 and this is also associated with the decline in the cyclical component of dollar credit.

2.5 Robustness Check

In this section, we check the robustness of our results by substituting Wu and Xia (2016) shadow interest rate with other proxies for the stance of monetary policy. We also compare the estimated trend-cycle from our approach with univariate trend-cycle decomposition using different methods.

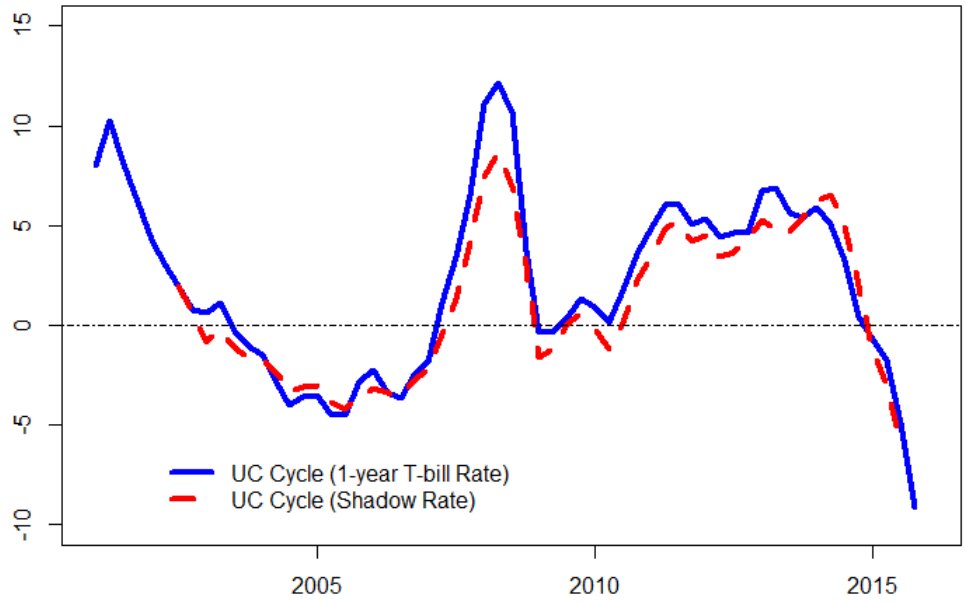
2.5.1 An Alternative Interest Rate Measure

As explained earlier, there are several possible proxies that can capture the stance of monetary policy. We use shadow interest rate because it does not suffer from ZLB problem, and is also not contaminated by term premium . The shorter term interest rates, for instance, federal funds rate or three-month treasury bill rate, suffer seriously from the ZLB issue during post-2008 sample period. While the longer term interest rates raise less concern from this problem, they are more easy to be contaminated by the variation in the term premium. Since our EME dollar credit measure aggregates all the credit instruments, regardless of the term to maturity, by taking the middle ground, we use one-year Treasury bill rate in the model to check the robustness of our result. The

results from this exercise is shown in Figure 4. The plot clearly shows the robustness of our estimation to the use of 1-year interest rate as a measure of monetary policy stance, as the estimated cycle closely resembles the one with the shadow rate as a measure of monetary policy stance.

Figure 4: The Cyclical Component from Correlated Multivariate UC Model

This figure reports the cyclical component of EME dollar credit. The dollar credit in the EMEs is measured in log trillions of USD and multiplied by 100. The UC cycle (Shadow Rate) is the cyclical component of EME dollar credit decomposed using the shadow interest rate as the measure of US monetary policy stance in the correlated multivariate unobserved component (UC) model. The UC cycle (1-year T-bill Rate) is the cyclical component of EME dollar credit decomposed using the one-year treasury bill rate as the measure of US monetary policy stance in the same UC model setup.



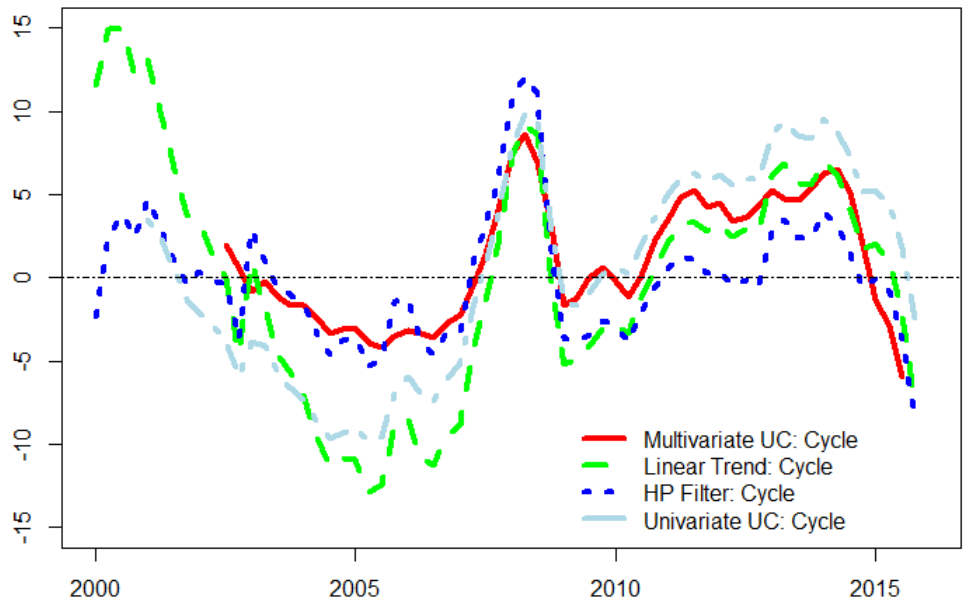
2.5.2 Comparison with Univariate Trend-Cycle Decomposition

In addition to the estimation of the correlation between shocks to the permanent and transitory component, the use of multivariate model in theory should also provide us a superior measure of trend and cycle as compared to the univariate model. To examine this hypothesis, we also perform trend-cycle decomposition using the univariate models (Figure 5). The univariate models include a linear trend model, a HP filter model and a

univariate UC model. The linear trend model decomposes the EME dollar credit series into a linear-trend component and a cycle component. The HP filter method uses an algorithm to smooth the original data series to estimate the trend component and the difference between them is the cyclical component. The parameter value λ is set at 1600 as suggested by Hodrick and Prescott for the quarterly data. The univariate UC model only uses the series of EME dollar credit to decompose a stochastic trend component and a cyclical component with the same specification as in the multivariate UC model.

Figure 5: Comparing EME Dollar Credit Cycles

This figure reports cyclical components of EME dollar credit based on alternate decompositions.



The results presented above clearly demonstrates that the estimate of trend and cycles obtained from the the multivariate UC model is better able to capture the dynamics of these three variables. The linear trend model, assuming a constant slope in the trend component, is not appropriate since it assumes no shock to the trend. The recent crisis is considered as the most severe financial crisis after the Great Depression (1929-1933) and we observe a clearly big negative shock to EME dollar credit series which the linear trend model is unable to capture. Other univariate models, without assuming a linear trend,

fail to generate realistic trend and cycle series by ignoring the relationship between EME dollar credit and its price channels. The HP cycle seems to mimic the counterpart from multivariate UC model very well before the crisis but diverge afterwards. The cycle from the univariate UC model, instead, is close to the multivariate counterpart after the crisis. Taking into account all the historical events as mentioned in the cycle interpretation, the outflow of dollar credit slowed down before the crisis, due to the domestic boom, but the magnitude of the negative cycle did not seem to be as large as suggested by the univariate UC model. The HP cycle fails to capture the credit boom since 2009, while it performed reasonably well before the crisis. Overall, it is clear from the analysis presented above that there is valuable pay-off in utilizing information from other variables that are useful in explaining EME dollar credit if one is interested in extracting its permanent and transitory component.

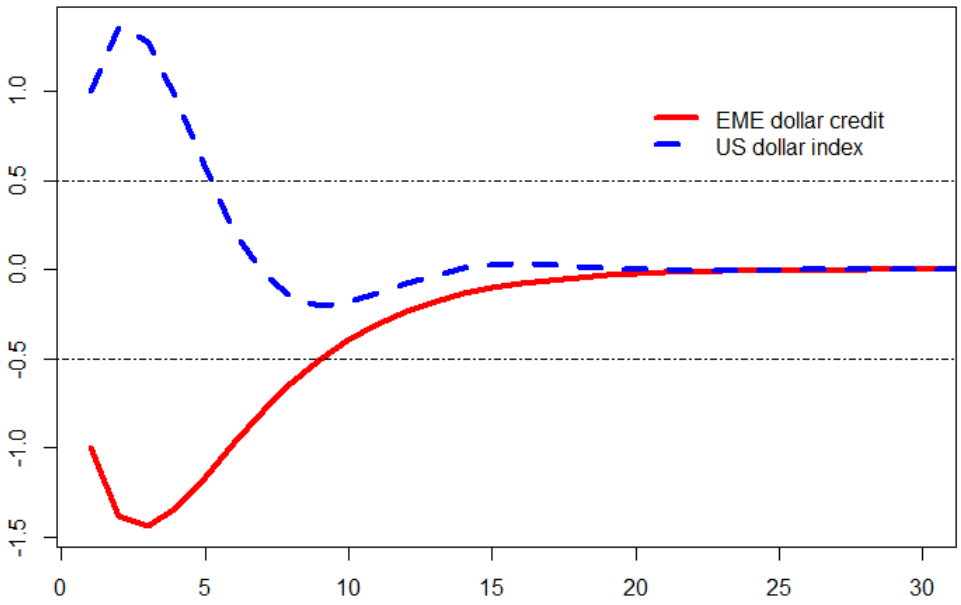
2.6 The Effects of US Monetary Policy Shocks

With global financial integration and dollar as international currency, US monetary policy plays a critical role in global liquidity transmission. Both the Fed and the EME authorities are concerned about the dynamic impact of US monetary policy changes on the international financial system. It would be an interesting exercise, therefore, to examine the dynamic impact of monetary policy shock on dollar credit in the EMEs using our multivariate unobserved component model.

Figure 6 plots the impulse responses of EME dollar credit and US dollar index when there is a transitory Fed interest rate hike. Based on our model, the cyclical variation of the three variables are correlated through the contemporary shocks in the error terms. Given a positive transitory shock to US monetary policy, we would expect a negative contemporaneous transitory shock to EME dollar credit and a positive contemporaneous transitory shock to dollar index. The effects of the transitory shock would not disappear immediately after the current period because of the persistent nature of the cyclical components as it depends on the lagged values. From our impulse response analysis,

Figure 6: Impact of a Transitory Increase in Interest Rate

This figure reports the impulse response functions of EME dollar credit and the dollar index to to a temporary increase in US interest rates



we find a hump shaped response of US dollar index and a U-shaped response of dollar credit to a contractionary monetary policy shock. The transitory nature of the shock suggests that these effects slowly disappear over time. The results suggest that the US dollar index and EME dollar credit do not move to the new equilibrium immediately after the transitory shock to US monetary policy. From policy maker perspective, the US interest rate hike above it long-run trend would strengthen US dollar and induce dollar credit outflow for several months. Although the effect eventually disappears, however, the transition process may come with international financial instability. On one hand, the process creates the challenges in the balance of payment for the EME authorities. They need to equip with enough official reserves to manage the rapid outflow of capital and stabilize the foreign exchange rate. On the other hand, the appreciation of US dollar and the outflow of dollar credit leave the EME borrowers pressured to pay back the dollar-denominated debt.

In order to be prepared for the transmission of international financial risk, in this case through the rise in US interest rate above its trend, policy makers should adopt both macro- and micro-prudential policies to deal with the monetary policy spillover effect. Traditional macro-prudential policies focus on the soundness of financial corporations, however, after 2009, non-financial firms engage heavily in the carry trade activities and serve as surrogate financial intermediaries. The associated financial risks create new challenges to the existing regulatory framework. For example, Hoffman (2014) provides evidence that the very low world funding interest rates are associated with a rise in volatile capital flows and asset market bubbles in fast-growing emerging markets. Furthermore, although the integration of financial markets promote risk sharing in the long run, in the short run, the external liquidity shocks and the interconnectivity of financial markets make the international financial risk transmission easier and faster. In other words, the global financial system may become more fragile in the short run, due to the externalities in the market.[15] Internalizing the costs and benefits require macro-prudential policy and international coordination.

2.7 Conclusions

In this paper, we use a correlated multivariate unobserved component model to examine the hypothesis about the role of ultra low US interest rates in the dollar credit boom in the emerging market economies. In doing so, we also decompose the movements in dollar credit in emerging markets, US interest rate and the dollar index into a permanent and transitory component. The correlations among the cyclical components support the idea that the rise of dollar credit in the EMEs is associated with US interest rate and the US dollar index below its long-run trend. The estimated permanent and transitory component from our model captures the dynamic features of EME dollar credit series and performs better than univariate benchmarks in capturing the boom and the boost during the last few years. The strong cyclical correlations among dollar credit in the EMEs, US

[15]Leijonhufvud (2007) suggests that the structural features inherent in today's financial markets that directly contribute to the instability in EM capital flows.

interest rate and the dollar index suggest that the policymakers may need to take into account the US monetary policy spillover effect on domestic credit conditions of the EMEs, by observing the stance of the US monetary policy and the behavior of the US dollar in the foreign exchange market. Macro-prudential policies and international coordination may be justified and needed, along with micro-prudential policies, as a consequence of global liquidity transmission and the implied international financial instability.

Chapter 3

Corporate Overseas Debt Issuance in the Context of Global Liquidity Transmission

3.1 Introduction

The recent surge in non-financial corporate[16] (hereafter "corporate") overseas debt issuance after 2007-2009 financial crisis has started drawing attention from macroeconomic researchers, as it plays a critical role in the conduct of international capital flow activities in the emerging markets. This surge in the overseas debt issuance is also referred to as the second phase of global liquidity (Shin, 2013).The first phase (2003-2007) of global liquidity is associated with a rapid increase in cross-border international bank loans. The international banks lose the market share to international bond markets in the cross-border activities substantially after the global financial crisis, partly because of the strengthened financial system regulation. This fall in cross-border lending by international banks was followed by a rise in the overseas debt issuance of the non-financial corporate sector. The relative importance of corporate overseas debt issuance can be gauged from the fact that more than half of the net "external" financing of emerging economies in 2012 took place through the issuance of international debt securities (Turner, 2014).

Given its importance for the stability of the global financial system, it is important to understand the behavior and determinants of corporate overseas debt issuance. The

[16]In this paper, we are interested in non-financial corporate overseas debt issuance behavior. In finance literature, non-financial corporates normally are referred as corporates. Financial corporates are required to be specified explicitly to indicate the difference between these two types of subjects. We follow the norm to use corporates to refer non-financial corporates hereafter in this paper.

purpose of this paper is to fill this gap in the literature. In particular, we want to examine three hypotheses related to the overseas debt issuance of these corporate firms. First, is there an evidence of price arbitrage on the part of these firms? Traditionally, a textbook-version corporate only issues bonds overseas because of foreign currency exposures. Think about the case when an exporting firm expects to receive a payment in foreign currency. This firm should issue foreign currency liability to match the foreign currency asset, in order to hedge foreign currency exposure. This behavior is considered as a typical corporate risk management practice to help this company focus on the main operating activities. In other words, they are not supposed to be interested in doing price arbitrage in foreign exchange markets. Nevertheless, in recent years, many studies suggest that corporate firms, especially large firms in emerging markets, may behave like financial intermediaries in overseas debt issuance activities. [Black and Munro (2010), Bruno and Shin (2015), Caballero et al (2015), Shin and Zhao (2013)]. Secondly, we also examine whether the firms get around capital control measures enacted by the countries and act more like a financial intermediary. This hypothesis is motivated by the recent behavior of the firms in the emerging markets where we observe a surge in debt issuance even in the presence of capital controls. Thirdly, we also examine the recent debate about the transmission of the U.S monetary policy to the global financial system by examining the link between overseas debt issuance and risk premium. To examine these hypotheses, we utilize a recently developed database on international debt securities by the Bank of International Settlement and perform a panel study of 32 countries for the 1993-2015 sample period.

Overall our results are consistent with the idea that non-financial firms in emerging economies have been acting like financial intermediaries. Firstly, we find evidence in support of price arbitrage hypothesis in case of emerging economies where we find significant negative impact of level and volatility of exchange rate on changes in overseas debt issuance. This implies that the corporate firms issue debt overseas in expecting that domestic currency will appreciate against the US dollar. We also find that capital control on bond market are positively correlated with corporate overseas debt issuance in emerg-

ing economies whereas this relationship has opposite pattern in the advanced economies. This difference in response to capital control across border reflects that corporate firms in emerging markets have strong incentive to walk around capital control to tap into international bond market, whereas corporate firms in advanced economies typically follow the regulation to reduce cross-border financial activities. We also find strong evidence between a measure of risk premium in the U.S. and overseas debt issuance in emerging economies implying that overall credit conditions in the U.S. do play a significant role. For advanced economies, however, we don't find a significant relationship between risk premium and debt issuance by its corporate firms implying that the non-financial firms in the advanced economies do behave very differently than the firms in the emerging market economies.

The remainder of this paper is structured as follows. Section 2 reviews the literature on international debt securities. Section 3 presents our conceptual framework and econometric methodology followed by a discussion. In section 4 and 5 we interpret and check the robustness of the results. Section 5 concludes the paper.

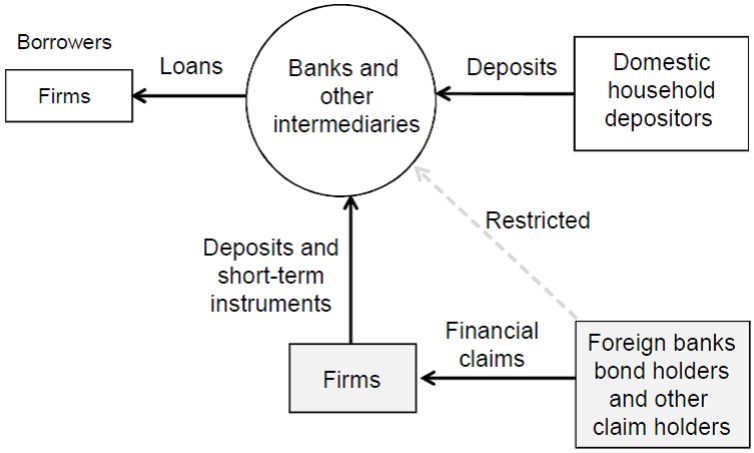
3.2 Literature Review

The surge in corporate overseas debt issuance plays an important role in the second phase of global liquidity. Turner (2014) suggests that declining in term premium in 10-year US treasuries may have implication on greater sensitivity to global long-term interest rates in emerging economy bond markets. McCauley et al (2014) also suggests that term premium compression in US treasuries has significantly stimulate offshore dollar-denominated bond issuance. Shin (2013) points out, furthermore, the transmission of financial condition across borders has taken the form of 'reaching for yield'. The compositional shift in asset managers' portfolios increases the demand for emerging market corporate bonds, which leads to the decline of risk premium for these debt securities. Meanwhile, the issuances of international debt securities explode in response to the compression in risk premium and the declining capital cost in overseas bond market. Chung

et al (2014) identify a positive relationship between domestic money growth and capital flow to the non-bank sector in emerging markets. Large corporates borrow money overseas and hold short-term instruments in home country, such as deposits and other liquid assets. This behavior essentially enables small corporates to borrow money overseas and weakens the independence of monetary policy aiming at domestic liquidity control.
These papers describe the paths in monetary policy spillover and the role of corporates in global liquidity transmission in the context of strict regulation imposed on international banking system. We borrow Figure 1 from Shin and Zhao (2013) to visualize the role of corporate debt issuance in global liquidity transmission. In the first phase of global liquidity, domestic household depositors and international investors (mostly international banks) supply liquidity to domestic financial system to finance the final corporate borrower production projects. However, in the second phase of global liquidity, domestic large corporates, rise to serve as surrogate intermediaries to facilitate liquidity transmission into domestic financial system, presumably due to the restriction on direct lending from international banks. The large corporates headquartered in emerging markets may use their overseas subsidiaries to issue bonds in international financial markets and receive the proceeds through intra-company transactions (The subsidiaries can pay for operation costs for the headquarters, for instance). In this way, the proceeds flowing into emerging markets are treated as a form of foreign direct investment and do not appear in the residency-based external debt positions. This conjecture worries policy makers about the effectiveness of capital control policies at the border and the creation of systematic risks outside traditional international financial regulation framework.

Under this backdrop, researchers investigate the determinants of corporate debt issuance behavior by exploiting micro evidence from firm-level overseas debt issuance and financial accounting information. Black and Munro (2010) examines the onshore/offshore bond issuance decision by non-government residents of five Asia-Pacific countries. Price arbitrage is identified as the most important motivator to issue offshore, for both financial and non-financial corporates. Market completeness and liquidity are also estimated to drive issuance decisions, i.e. firms seeks for more complete financial markets to issue

Figure 7: Transmission of Global Liquidity across Borders

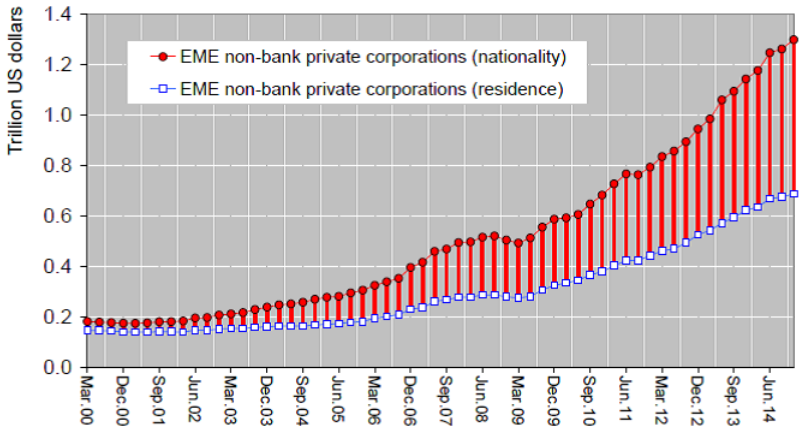


Shin and Zhao (2013)

larger-size, longer-maturity bond at a lower capital cost. Nevertheless, this study uses residency-based international bond issuance data, which may not be able to capture the real volume of cross-border issuance, especially given the fact that non-financial firms use intra-company transactions to avoid capital regulation across border. As depicted by Bruno and Shin (2015), the difference widen significantly between nationality-based and residency-based amount of external debt outstanding: the nationality-based external debt position reaches roughly twice as much as the residency-based measures in 2014. (Figure 2) Shin and Zhao (2013) use firm-level financial accounting information based on consolidated balance sheet and debt issuance data to further investigate the role of corporates as surrogate financial intermediaries. Their results also suggest that corporates in emerging markets behave like financial intermediaries in the sense that the correlation between financial assets and financial liabilities has a positive sign, which is supposed to be an accounting feature for financial corporates instead of non-financial corporates. [17]

[17]This argument is based on Pecking Order Theory (Myers, 1984) in corporate finance literature. See Shin and Zhao (2013) for details.

Figure 8: Corporate Overseas Debt Issuance in Emerging Markets



Bruno and Shin (2015)

Two recent micro studies, instead, focus on testing carry trade hypothesis. Both papers support the positive correlation between corporate overseas debt issuance and firm cash holding, which essentially indicates a carry trade position. Bruno and Shin (2015), furthermore, point out this phenomenon is more prevalent for emerging market firms during favorable carry trade periods. Caballero et al (2015) suggests that there is evidence for carry trade activities in countries with higher levels of capital controls. In our paper, we also find that corporate overseas debt issuance behaviors are positively correlated with capital controls at the border, especially in emerging markets where overall capital control levels are much higher than in advanced economies.

To summarize, the literature provides some evidence to support the idea that corporates dramatically increase overseas debt issuance to conduct price arbitrage and serve as surrogate financial intermediaries to facilitate capital flow across borders in emerging markets or countries with strict capital controls. Put it differently, corporates may step into the vacuum whereas financial sectors are blocked by international capital control regulation. This paper, from our knowledge, is the first paper using macro nationality-based corporate overseas debt issuance data, to tackle several hypotheses in the literature and to explain the determinants of corporate overseas debt issuance behavior.

3.3 Empirical Models

3.3.1 Price Arbitrage VS. Risk Management

To test the hypotheses mentioned above, we build three empirical models to study the determinants of corporate overseas debt issuance behavior. In first model, we try to test price arbitrage hypothesis against risk management hypothesis based on the contradictive implication in response to exchange rate variables from these two hypotheses. If corporates behave more like price arbitragers, they will issue less debt when domestic currency depreciates/ when the exchange rate is volatile. Whereas, if corporates behave like what textbook suggests, they will issue more debt when domestic currency depreciates because when domestic currency depreciates, export increases so as the foreign currency exposure. In order to hedge the foreign currency exposure, they should issue more debt securities. In addition, when exchange rate is more volatile, corporates are expected to have stronger incentive to hedge larger portion of foreign currency asset exposure. In our model, the exchange rate is computed based on direct quote against US dollar, which means the exchange rate number is interpreted as the amount of domestic currency one US dollar can purchase. Therefore, an increase in the exchange rate number implies depreciation of domestic currency.

To be explicit, if price arbitrage hypothesis dominates risk management hypothesis, then we would expect that $\beta_1 > 0$ and $\beta_2 > 0$; if the other way around, then $\beta_1 < 0$ and $\beta_2 < 0$. Besides exchange rate and exchange rate volatility, we also control for relevant economic fundamentals. In this case, we control for both domestic real GDP growth rate and current account balance. In the most complete specification, we also control for government foreign exchange market intervention, by adding the growth rate of official reserve. This specification allows us to see the impact of exchange rate and exchange rate volatility on corporate overseas net debt issuance while government intervention is in place.

$$
\begin{aligned}
Net\_Debt\_Issuance_{it} = \beta_0 &+ \beta_1 Exchange\_Volatility_{it-1} + \beta_2 Exchange\_Rate_{it-1} \\
&+ \beta_3 Real\_GDP\_Growth_{it-1} + \beta_4 CA\_Balance_{it-1} \\
&+ \beta_5 Foreign\_Reserve\_Growth_{it-1} + \gamma_t + \delta_i + \varepsilon_{it}
\end{aligned} \tag{10}
$$

3.3.2 The Effectiveness of Capital Control Policies

In the second model, we are interested to study the effect of capital control on corporate overseas debt issuance. The capital control policies imposed by governments are designed to control for the amount of international capital flow across borders. Therefore, if the capital control policies were effective and well-designed, we would expect the reduction of all types of international capital flow, implying the reduction of corporate debt issuance. If, instead, we found the effect of capital control was the rise in corporate debt issuance, then the effectiveness of capital control policies could be in doubt. Explicitly speaking, the capital control policies may impose a binding constraint on financial sectors, whereas the corporates may gain comparative advantage to take the role as financial intermediaries. As explained previously, corporates are able to use intra-company transactions to avoid the international capital control regulation.

Thereupon, the positive sign of capital control coefficient suggests the lack of effectiveness of capital control on corporates, whereas the negative sign indicates the effectiveness of capital control on both financial and non-financial sectors. As you may have noticed, we do not control both exchange rate variables and capital control variables simultaneously in one specification. This is due to the fact that capital control policies and exchange rate stability are strongly dependent on each other. According to international monetary policy trilemma, if the government imposes capital control at the border, then the country will gain the ability to stabilize the exchange rate and the independence of domestic monetary policy. If, instead, the government is willing to let exchange rate float according

to market forces, then the capital are free to flow across borders and monetary authorities still maintain the independence of domestic monetary policies. Hence, the bottom line is, we are not able to identify the clean effect of capital control and exchange rate variables separately, by putting both of them into one specification.

$$\begin{aligned} Net\_Debt\_Issuance_{it} = \beta_0 + \beta_1 Capital\_Control_{it-1} + \beta_2 Real\_GDP\_Growth_{it-1} \\ + \beta_3 CA\_Balance_{it-1} + \gamma_t + \delta_i + \varepsilon_{it} \end{aligned} \tag{11}$$

3.3.3 Advanced Economy Monetary Policy Spillovers: An Indirect Test based on Corporate Risk Premium

As explained in the introduction, there may exist advanced economy monetary policy transmission effect. In this study, we perform an indirect test based on the effect of corporate risk premium. If β_1 is negative, which suggests a decrease in risk premium will increase corporate debt issuance, provides a piece of supportive evidence in the process of monetary policy spillovers. We test this hypothesis by adding back all the variables in the previous regressions and are able to show that risk premium indeed causes the rise in corporate overseas debt issuance.

$$\begin{aligned} Net\_Debt\_Issuance_{it} = \beta_0 + \beta_1 Risk\_Premium_{it-1} + \beta_2 Real\_GDP\_Growth_{it-1} \\ + \beta_3 CA\_Balance_{it-1} + \beta_4 Exchange\_Volatility_{it-1} + \beta_5 Exchange\_Rate_{it-1} \\ + \beta_6 Capital\_Control_{it-1} + \gamma_t + \delta_i + \varepsilon_{it} \end{aligned} \tag{12}$$

We control for both country fixed effect and year fixed effect in panel regressions in all the model estimations. The standard errors we report in our paper are Driscoll and Kraay (1998) robust standard errors. Driscoll and Kraay (1998) propose a nonparamet-

ric covariance matrix estimator that produces heteroscedasticity- and autocorrelation-consistent standard errors that are robust to general forms of spatial and temporal dependence. Because the nonparametric technique of estimating standard errors place no restrictions on the limiting behavior of the number of panels, the size of cross-sectional dimension in finite sample does not constitute a constraint on feasibility. These features make Driscoll and Kraay (1998) standard error the most suitable candidate in our models. Our sample includes 32 countries and quarterly data observations spanning across 1993-2015. Clearly, we have limited cross-sectional dimensions but relatively large time series dimensions. Since our conjectures are mostly based on the stylized fact in emerging markets, we split the sample countries into emerging market subsample (20 countries) and advanced economy subsample (12 countries).

3.4 Data Description

Our sample includes 32 countries[18] during the period 1993Q3-2015Q1. The key variable we are interested in, net debt issuance based on nationality of corporate issuers, is from Bank of International Settlement (BIS) website. Luckily, we are also able to find a dataset, just available recently, about capital control measures in various financial markets, constructed based on IMF annual reports. This dataset allows us to disentangle the effect of the capital control policies in each financial sector on corporate overseas debt issuance separately. Table 2 lists all the data sources we use in this study.

Table 2: Data Sources

Variable	Data Source
Net Debt Issuance (Millions of USD)	Bank for International Settlements (BIS): http://www.bis.org
Exchange Rate (Quarterly Average)	OANDA: http://www.oanda.com
Exchange Rate Volatility	OANDA: http://www.oanda.com
GDP Growth Rate (%)	FRED: https://fredqa.stlouisfed.org; IFS: http://www.imf.org
Current Account Balance (Millions of USD)	IFS: http://www.imf.org
Foreign Reserve Growth Rate (%)	IFS: http://www.imf.org
Risk Premium (Junk Spread) (%)	FRED: https://fredqa.stlouisfed.org
Capital Control Measures (range: [0,100])	NBER: http://www.nber.org/data/international-finance/

[18]The 32 countries we use in this study are based on data availability. These countries are Argentina, Australia, Brazil, Canada, Chile, China, Czech Republic, Denmark, Hong Kong, Hungary, Iceland, India, Indonesia, Israel, Jamaica, Japan,Korea, Malaysia, Mexico, New Zealand, Norway, Peru, Philippines, Poland, Russia, Singapore, South Africa, Sweden, Switzerland, Thailand, Turkey, UK.

The variables used in this paper are constructed as described below.

Net Debt Issuance: We remove the seasonality in the international debt security amount outstanding, which are issued by non-financial corporates and categorized based on nationality of issuers. Then first difference these series to get net debt issuance in millions of US dollars for each country.

Exchange Rate:measured in direct quote, i.e. in domestic currency per unit of US dollar. We take the average of the daily closing rate in the quarter to serve as quarterly average exchange rate.

Exchange Rate Standard Deviation: The standard deviation of exchange rate within the quarter based on the daily closing rate.

Exchange Rate Volatility: $= (ExchangeRateStandardDeviation/ExchangeRate) * 100$. It can be interpreted as percentage deviation from the quarterly average. This measure of exchange rate volatility gets rid of unit of measures, therefore is comparable across currencies.

Real GDP Growth Rate: We take log difference of seasonality-adjusted real GDP to get the quarterly GDP growth rate.

Current Account Balance: We remove seasonality in current account balance data and convert series to be measured in millions of US dollars.

Foreign Reserve Growth Rate: We take log difference of official reserve assets which are measured in US dollars.

Risk Premium: We use BAA corporate bond rate minus 10-year Treasury bond rate to measure risk premium in corporate bonds.

Capital Control Measures: We use international capital control indexes on the money market/ bond market/ equity market/ real estate market/ foreign direct investment separately. These measures are continuous variables ranging from 0 to 100. This variable is only available between 1995 and 2013.

Table 3: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Net Debt Issuance (Millions of USD)	358.199	2077.493	-22934.971	23020.229	2720
Exchange Rate	356.624	1599.789	0.014	10000	2738
Exchange Rate Standard Deviation	2.82	35.909	0	1151.724	2738
Exchange Rate Volatility	1.7	1.956	0	48.979	2738
Real GDP Growth	0.88	1.816	-12.074	42.294	2637
Current Account Balance (Millions of USD)	2127.202	11555.506	-39157.066	108339.003	2603
Foreign Reserve Growth	2.743	10.293	-95.652	85.048	2815
BAA minus 10 Treasury Bond Yield	2.406	0.794	1.37	5.58	2855
Capital Control: Money Market	38.035	38.612	0	100	2432
Capital Control: Bond Market	36.397	39.083	0	100	2176
Capital Control: Real Estate Market	47.862	36.247	0	100	2432
Capital Control: Direct Investment	41.612	40.304	0	100	2432
Capital Control: Equity Market	37.87	39.116	0	100	2432

3.5 Results and Interpretation

3.5.1 Price Arbitrage Hypothesis VS. Risk Management Hypothesis

Price arbitrage hypothesis implies that domestic currency depreciation and volatile exchange rate against US dollar has a negative impact on corporate overseas net debt issuance. Whereas, risk management hypothesis suggests that domestic currency depreciation will stimulate export and create larger currency exposure position needed to be hedged by issuing overseas liabilities, and the more volatile the exchange rate against US dollar, the stronger the incentive for corporates to hedge the exposures. These ideas implies a positive impact on overseas debt issuance from domestic currency depreciation and exchange rate fluctuation, from the risk management perspective.

Table 4 reports the results from the first model that tests price arbitrage against risk management hypothesis. In all specifications, as the exchange rate increases, i.e. domestic currency depreciates, corporate overseas debt issuance will decrease; as exchange rate becomes more volatile, the less the corporate will issue debt securities overseas. This result is in line with price arbitrage hypothesis. The corporates issue debt overseas in expecting that domestic currency will appreciate against US dollar. From model specifications (1) to (4), we add real GDP growth and current account balance to control for the economic fundamentals. Interestingly, current account balance is insignificant

in explaining corporate overseas debt issuance, which confirms the result that corporate overseas debt issuance does not strongly associate with hedging foreign currency receivable exposure. In the last column, by adding the growth rate of official reserve, a proxy for government foreign exchange market intervention, we find that government intervention stabilizes corporate debt issuance by mitigating the effect of exchange rate volatility, while the exchange rate variables still play a significant role in explaining the corporate overseas debt issuance behavior.

Table 5 reports the same regressions using advanced economy subsample. No significant impacts are found for exchange rate and exchange rate volatility, which suggests that corporates in advanced economies are not sensitive to exchange rate variables in overseas bond issuance activities. Together with insignificant effect from current account balance, we could not support either of the hypothesis in advanced economies. Our conjecture is that corporates in advanced economies could issue bonds overseas in domestic currency so that these firms are less sensitive to exchange rate variables. Another interpretation could be, if countries fall into more flexible exchange rate regimes, there is less opportunity to conduct price arbitrage in the foreign exchange markets. Most emerging markets impose much stronger capital control at the border to stabilize the exchange rate and maintain monetary policy independence. Thereupon, the exchange rates in emerging markets may not reflect market expectation about the 'true' exchange rate against US dollar. It will take much longer time to arbitrage away these zero-risk opportunities because capitals need to find a way to walk around the capital control regulation at the border. Whereas, in advanced economies, domestic financial markets are well integrated into international financial markets and the overall capital control levels are much lower at the border for these counties. Corporates headquartered in advanced economies presumably on average face a smaller interest rate gap at the border, due to financial market integration. Moreover, they do not have comparative advantage, compared to financial corporates, to rise as financial intermediaries because of less regulation at the border. Overall, there is no evidence to support the price arbitrage hypothesis for the corporates in advanced economies.

Table 4: Price Arbitrage/Risk Management Hypothesis: Emerging Markets

This table is to test the two hypotheses based on the contradictive implication on exchange rate and exchange rate volatility. The dependent variable is corporate net overseas debt issuance within the quarter. Exchange rate is measured using direct quote, i.e. the amount of domestic currency per unit of US dollar can purchase. Therefore an increase in exchange rate is equivalent to domestic currency depreciation. Exchange rate volatility is measured as the percentage deviation from the quarterly average of exchange rate. Price arbitrage hypothesis predicts both coefficients of exchange rate and its volatility are negative, whereas the risk management hypothesis predict the opposite. Driscoll and Kraay (1998) robust standard errors are reported in all estimations.

	(1)	(2)	(3)	(4)	(5)
	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance
Exchange Rate Volatility (t-1)	-13.19**	-14.37**	-18.47**	-19.72**	-15.84**
	(-2.11)	(-2.20)	(-2.72)	(-2.64)	(-2.18)
Exchange Rate (t-1)		-0.0281**	-0.0651*	-0.0584*	-0.0558*
		(-2.38)	(-1.99)	(-1.95)	(-1.86)
Real GDP Growth (t-1)			-16.94	-18.34	-18.63
			(-0.95)	(-1.06)	(-1.08)
Current Account Balance (t-1)				0.00430	0.00409
				(1.60)	(1.52)
Official Reserve Growth (t-1)					3.331
					(1.32)
Constant	515.7***	530.6***	227.3***	1001.2***	1003.3***
	(18.19)	(18.31)	(2.91)	(12.04)	(12.09)
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	1629	1629	1564	1469	1469

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Price Arbitrage/ Risk Management Hypothesis: Advanced Economies

This table is to test the two hypotheses based on the contradictive implication on exchange rate and exchange rate volatility. The dependent variable is corporate net overseas debt issuance within the quarter. Exchange rate is measured using direct quote, i.e. the amount of domestic currency per unit of US dollar can purchase. Therefore an increase in exchange rate is equivalent to domestic currency depreciation. Exchange rate volatility is measured as the percentage deviation from the quarterly average of exchange rate. Price arbitrage hypothesis predicts both coefficients of exchange rate and its volatility are negative, whereas the risk management hypothesis predict the opposite. Driscoll and Kraay (1998) robust standard errors are reported in all estimations.

	(1)	(2)	(3)	(4)	(5)
	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance
Exchange Rate Volatility (t-1)	-130.4	-129.6	-124.8	-154.2	-155.6
	(-1.32)	(-1.33)	(-1.26)	(-1.61)	(-1.61)
Exchange Rate (t-1)		-5.985	-3.817	-3.915	-4.399
		(-0.40)	(-0.25)	(-0.26)	(-0.29)
Real GDP Growth (t-1)			-8.865	2.147	4.960
			(-0.19)	(0.04)	(0.10)
Current Account Balance (t-1)				-0.0108	-0.0107
				(-0.47)	(-0.47)
Official Reserve Growth (t-1)					-6.018
					(-0.99)
Constant	-386.2**	-275.0	-317.5	53.21	74.85
	(-2.44)	(-0.87)	(-1.01)	(0.13)	(0.18)
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	1011	1011	1003	949	949

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To summarize, the results from the first model support the conjecture that price arbitrage incentive dominates corporates overseas debt issuance behavior in emerging markets. This assessment is in line with the micro evidence from Black and Munro (2010), which concludes that price arbitrage is the most important incentive for corporates to issue bonds overseas, although the evidence for financial corporates is even more prevalent. On the other hand, there is no such evidence found among the counterparts in advanced economies. Shin and Zhao (2013) suggests that corporates in advanced economies behave more like textbook-version corporates.

3.5.2 The Effectiveness of Capital Control in Emerging Markets

Typically we would expect a reduction in cross-border activities from all market participants when facing a strengthened international regulation. This intuition implies a negative impact of capital control on corporate debt issuance overseas. Table 6 reports the effect of capital control on corporate debt issuance in emerging markets. Surprisingly, we find that capital control on bond market are positively correlated with corporate overseas debt issuance. This result suggests that corporates may exercise their comparative advantage as surrogate financial intermediaries, while financial sectors face strict regulation at the border. This result, together with Caballero et al (2015), illustrates the importance of corporate overseas debt issuance as surrogate financial service in countries where strict international capital flow regulation is in place.

Using advanced economy data in the same specifications (Table 7), we see the opposite pattern: capital controls in financial markets are negatively correlated with corporate overseas debt issuance. This difference in response to capital control across border reflects that corporates in emerging markets have strong incentive to walk around capital control to tap into international bond market, whereas corporates in advanced economies typically follow the regulation to reduce cross-border financial activities. Especially among our sample countries, many advanced economies have international financial centers in their home countries or they are by themselves financial centers (e.g. Hong Kong and Singapore). Corporates in these countries do not have strong incentive to issue bonds

overseas, when they face more strict capital control at the border.

Table 6: The Effectiveness of Capital Control: Emerging Markets

The table is to study the effect of capital control on corporate overseas debt issuance behavior. The dependent variable is corporate net overseas debt issuance within the quarter. In all specifications, we control for economic fundamentals, i.e. current account balance and the real GDP growth rate. In each specification, we add one capital control index on a specific financial sector, in order to test which capital control policy plays a role in explaining corporate overseas debt issuance. Driscoll and Kraay (1998) robust standard errors are reported in all estimations.

	(1) Net Debt Issuance	(2) Net Debt Issuance	(3) Net Debt Issuance	(4) Net Debt Issuance	(5) Net Debt Issuance
Real GDP Growth (t-1)	-12.22	-19.01	-12.44	-11.75	-13.32
	(-0.64)	(-0.93)	(-0.66)	(-0.61)	(-0.70)
Current Account Balance (t-1)	0.00584*	0.00671**	0.00599**	0.00582**	0.00525*
	(2.05)	(2.37)	(2.16)	(2.24)	(1.88)
Capital Control: Money Market (t-1)	0.672				
	(0.53)				
Capital Control: Bond Market (t-1)		2.797***			
		(3.15)			
Capital Control: Equity Market (t-1)			1.777		
			(1.60)		
Capital Control: Real Estate Market (t-1)				0.310	
				(0.22)	
Capital Control: Direct Investment (t-1)					2.679
					(1.53)
Constant	32.75	120.8	-50.10	57.22	-118.9
	(0.40)	(1.62)	(-0.61)	(0.65)	(-0.91)
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	1392	1276	1392	1392	1392

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: The Effectiveness of Capital Control: Advanced Economies

The table is to study the effect of capital control on corporate overseas debt issuance behavior. The dependent variable is corporate net overseas debt issuance within the quarter. In all specifications, we control for economic fundamentals, i.e. current account balance and the real GDP growth rate. In each specification, we add one capital control index on a specific financial sector each time, in order to test which capital control policy plays a role in explaining corporate overseas debt issuance. Driscoll and Kraay (1998) robust standard errors are reported in all estimations.

	(1) Net Debt Issuance	(2) Net Debt Issuance	(3) Net Debt Issuance	(4) Net Debt Issuance	(5) Net Debt Issuance
Real GDP Growth (t-1)	12.18	30.35	13.52	20.41	16.76
	(0.22)	(0.53)	(0.25)	(0.38)	(0.31)
Current Account Balance (t-1)	0.00851	-0.00363	0.00764	0.00631	0.00567
	(0.34)	(-0.17)	(0.30)	(0.25)	(0.22)
Capital Control: Money Market (t-1)	-12.15***				
	(-3.19)				
Capital Control: Bond Market (t-1)		-5.617*			
		(-1.97)			
Capital Control: Equity Market (t-1)			-9.425**		
			(-3.02)		
Capital Control: Real Estate Market (t-1)				1.096	
				(0.37)	
Capital Control: Direct Investment (t-1)					-7.657
					(-1.14)
Constant	-1167.1***	-761.0***	-1188.4***	-1279.9***	-1106.9***
	(-4.75)	(-3.31)	(-4.84)	(-4.82)	(-4.08)
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	871	799	871	871	871

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

3.5.3 Advanced Economy Monetary Policy Transmission and an Indirect Test Based on Risk Premium

There exists a common sense that compression in corporate risk premium originates from expansionary monetary policy in advanced economies, among researchers and market participants. To test monetary policy spillover effect, one of the key factors in the spillover chain is the response of corporate overseas debt issuance from compression in risk premium. In the third model, we test this broad hypothesis by providing some supportive evidence from the impact of risk premium on corporate overseas debt issuance behavior. Table 8 provides strong evidence to support that corporates issue more bonds overseas in response to compression in risk premium in emerging market economies.

No significant effect in advance economies (Table 9) suggests that corporates in these countries do have different incentive in conducting cross-border activities, compared to the emerging market counterparts. In advanced economies, domestic financial markets are well connected in the international financial market. Compression in risk premium in international bond market also imply compression in risk premium in domestic bond market. Therefore, these firms have no strong incentive to go abroad to issue bonds, whereas the corporates in emerging markets face a segregation between domestic bond market and international bond market.

These results offer some support to the idea of advance economy monetary policy spillover effect. Although the less integration of emerging markets in international financial system, monetary policy in advanced economies do push international investors to crack through border barriers to chase for yield; and meanwhile market participants in emerging markets also try to walk around the regulation to arbitrage the return across the borders. This phenomenon raises the concern about the relevant liquidity measures for policy makers, even for those policy makers in countries where impose tight capital regulation at the borders. They may also need to put an eye on the global liquidity measure, as it helps explain anomalies in domestic liquidity supply. (Chung et al, 2014)

In the most complete regression estimation, we include all the three sets of variables together with real economic fundamentals. The effect of exchange rate variables disap-

pears. This result may imply that the effect of capital control can dominate the effect of exchange rate variables because they are strongly interdependent and it is hard to tease apart the marginal effect if we try to regress them simultaneously in one estimation. Without controlling for capital control policies, we found the consistent results as in previous model specifications.

Table 8: Monetary Policy Transmission: An Indirect Test (Emerging Market)

This table performs an indirect test on advanced economy monetary policy spillover effect based upon corporate risk premium. The dependent variable is corporate overseas net debt issuance within the quarter. If a decrease in risk premium is followed by an increase in corporate overseas debt issuance, we conclude that there is some evidence to support the monetary policy spillover effect. Risk premium is measured by BAA bond yield minus 10 year Treasury bond yield, which captures corporate risk premium. Driscoll and Kraay (1998) robust standard errors are reported in all estimations.

	(1)	(2)	(3)	(4)	(5)	(6)
	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance
Risk Premium (t-1)	-119.5**	-137.7**	-147.6**	-142.2**	-141.4**	-169.0***
	(-2.44)	(-2.66)	(-2.68)	(-2.56)	(-2.55)	(-3.11)
Real GDP Growth (t-1)		-15.52	-16.75	-20.86	-22.21	-26.33
		(-0.94)	(-1.06)	(-1.30)	(-1.42)	(-1.55)
Current Account Balance (t-1)			0.00474*	0.00471*	0.00437	0.00664**
			(1.82)	(1.80)	(1.66)	(2.40)
Exchange Rate Volatility (t-1)				-15.92**	-18.41**	-6.883
				(-2.30)	(-2.42)	(-1.13)
Exchange Rate (t-1)					-0.0576*	-0.0302
					(-1.91)	(-1.52)
Capital Control: Bond Market (t-1)						2.749***
						(3.01)
Constant	549.7***	995.0***	1043.7***	1264.6***	1297.5***	1019.1***
	(5.58)	(4.53)	(4.38)	(8.93)	(9.24)	(4.25)
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1700	1597	1502	1469	1469	1276

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Monetary Policy Transmission: An Indirect Test (Advanced Economy)

This table performs an indirect test on advanced economy monetary policy spillover effect based upon corporate risk premium. The dependent variable is corporate overseas net debt issuance within the quarter. If a decrease in risk premium is followed by an increase in corporate overseas debt issuance, we conclude that there is some evidence to support the monetary policy spillover effect. Risk premium is measured by BAA bond yield minus 10 year Treasury bond yield, which captures corporate risk premium. Driscoll and Kraay (1998) robust standard errors are reported in all estimations.

	(1)	(2)	(3)	(4)	(5)	(6)
	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance
Risk Premium (t-1)	-33.45	-38.14	-74.25	33.67	32.78	98.31
	(-0.10)	(-0.11)	(-0.21)	(0.09)	(0.09)	(0.25)
Real GDP Growth (t-1)		-5.659	3.825	5.418	3.562	22.93
		(-0.11)	(0.07)	(0.11)	(0.08)	(0.48)
Current Account Balance (t-1)			-0.00951	-0.0110	-0.0108	-0.00431
			(-0.41)	(-0.48)	(-0.47)	(-0.17)
Exchange Rate Volatility (t-1)				-156.6	-156.5	-156.8
				(-1.44)	(-1.46)	(-1.31)
Exchange Rate (t-1)					-3.905	-10.48
					(-0.26)	(-0.56)
Capital Control: Bond Market						-2.222
						(-0.24)
Constant	1606.3	1636.7	-1035.6	-1030.5	-953.3	0
	(1.03)	(1.05)	(-1.44)	(-1.43)	(-1.37)	(.)
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1020	1003	949	949	949	796

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

3.6 Robustness Check

So far, our main results show that the compression in risk premium increases corporate overseas debt issuance and the stronger regulation policy makers impose at the border, the more bonds corporates issue overseas. These features seem to suggest the role of corporates as surrogate financial intermediaries. If this interpretation is solid, by adding the interaction between risk premium and capital control measures, we should see the effect of this interaction term is negative in the second phase of global liquidity. The reason is as follows. If corporates are indeed surrogate financial intermediaries, they have stronger incentive to issue overseas when both risk premium is lower and financial corporates face more strict capital control at the borders. Given a constant level of capital control, the lower the corporate risk premium is, the more corporate bond issuance. Given a constant level of risk premium, the tighter the capital control is, the less corporate bond issuance. This is because, corporate capital cost from issuing bonds is the risk free interest rate plus corporate risk premium. A constant level of risk premium implies a constant level of capital cost in the bold part. Given a constant level of capital cost, the corporates should have less incentive to serve as surrogate financial intermediaries when facing more strict capital regulation at the borders. Therefore, the effect of the interaction term in the second phase of global liquidity is expected to be negative if corporates indeed serve as surrogate financial intermediaries.

We provide the robustness test results in Table 10 below. To tease apart the effect of capital control and risk premium, we incorporate them separately in different regressions and also split the whole sample based on the timing of the second phase of global liquidity. The first two columns report the effect of capital control on corporate overseas debt issuance. The effect of capital control in the 2007-2013 subsample is positive and three times as much as the counterpart in the 1993-2006 subsample, suggesting that strengthened international capital control policies indeed stimulate corporates to act as financial intermediaries across borders. The middle two columns report the effect of risk premium on corporate overseas debt issuance. Corporates were not sensitive to corporate risk premium before 2007. However, since 2007, one percentage decrease in corporate risk

premium lead to more than 100 million US dollar more corporate bond issuance within the following quarter. The last two columns provide further evidence to support the corporate role as surrogate financial intermediaries in the second phase of global liquidity. The effect of interaction term between capital control and risk premium is insignificant before 2007, while in the second phase of global liquidity, the coefficient of the interaction is negative and significant. Based on the intuition described in the last paragraph, the data favor the conjecture about corporates behaving like financial intermediaries. It is worth to point out, in the last two regressions, we control for linear time trend instead of time fixed effect because our capital control measures are in annual frequency. There will not exist meaningful variation in the interaction term if we control for annual time fixed effect. Therefore, we instead use annual time trend to control for the variation over time.

To sum up, we perform a robustness check to verify our interpretation about corporates serving as financial intermediaries, with further evidence by exploiting information in subsamples and allowing for the interaction between variables.

Table 10: Robustness: The Corporate Role as Surrogate Financial Intermediary

The table provides the effect of capital control and risk premium on corporate overseas debt issuance before and after 2007, when was perceived as the start of the second phase of global liquidity. The negative sign of the coefficient of the interaction term of capital control and risk premium is line with the corporate role as surrogate financial intermediaries, because the corporate overseas issuance is expected to increase when both capital control is strengthened and risk premium is falling. Driscoll and Kraay (1998) robust standard errors are reported in all estimations.

	(1)	(2)	(3)	(4)	(5)	(6)
	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance	Net Debt Issuance
Real GDP Growth (t-1)	7.180	-27.07	4.520	-39.94**	7.551	-32.50
	(0.67)	(-1.12)	(0.62)	(-2.41)	(0.65)	(-1.69)
Current Account Balance (t-1)	-0.00906**	0.00101	-0.00921**	0.000421	-0.00869*	0.0000590
	(-2.19)	(0.11)	(-2.31)	(0.05)	(-2.03)	(0.01)
Capital Control: Bond Market (t-1)	2.901***	9.528***			2.285	15.46***
	(4.44)	(3.22)			(1.42)	(5.18)
Risk Premium (t-1)			11.33	-220.0***	-116.6***	40.03
			(0.21)	(-3.99)	(-3.75)	(0.74)
Capital Control(Bond)*Risk Premium(t-1)					0.284	-2.119**
					(0.38)	(-2.56)
year					13.37*	126.1***
					(1.78)	(5.74)
Constant	78.85	-18.28	0	1388.2***	-26572.9*	-253503.1***
	(1.40)	(-0.09)	(.)	(6.50)	(-1.77)	(-5.76)
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	No	No
Observations	719	557	898	604	719	557

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

3.7 Conclusions and Policy Implication

This paper studies the determinants of corporate overseas debt issuance in 32 countries during the period 1993-2015. The results provide some macro evidence to support the conjecture that corporates in emerging markets serve as financial intermediaries at the border to facilitate global liquidity transmission. Corporates hold a carry trade position, in other words, borrowing liabilities in foreign currency and holding assets in domestic currency, during the periods when domestic currency is expected to appreciate against US dollar and the exchange rate is less volatile. The rise in corporate overseas debt issuance can be explained as the product of advanced economy monetary policy spillover and capital control policies at the border. As corporate risk premium compresses, corporates have incentive to serve as surrogate financial intermediaries across border, especially in countries where domestic financial sector faces strict international capital flow regulation.

Policy makers should carefully evaluate the potential side effect from international capital control policies. Ill-designed these policies reduces the effectiveness of cross-border capital control. Furthermore, these policies may create the systematic risk outside the traditional framework and makes it harder for policy makers to monitor and manage international capital flow activities. Additionally, policy makers should be aware the international financial risk transmission through either monetary policy shocks in advanced economies or financial risk materialization in emerging market corporates. The last but not the least, domestic currency depreciation and volatile exchange rate against US dollar may add uncertainty in the capacity for emerging markets corporates to borrow and rollover the existing debt.

Chapter 4

What is Driving Debt Dollarization in Global Economy? A Dynamic Factor Analysis

4.1 Introduction

The takeoff of US dollar-denominated debt issuance [19] has been one of the most eye-catching phenomena in the global financial market since the Great Recession. Many studies suggest that loose US monetary policy may factor in the global liquidity transmission during this period. (Chung et al., 2015) While Basel III tightened the cross-border capital flow regulation, the border-control policy loopholes push international capital flow towards the global bond market from the global banking system. In short, the rapid growth of dollar debt seems to be closely related to the super-low policy rates and quantitative easing policies from the Fed. Nevertheless, it is possible that some other factors, such as, the fast economic growth of emerging market economies, European Sovereign Debt Crisis and some country-specific factors, could play a critical role in explaining the second phase of global liquidity. (Shin, 2014)

In this paper, we want to understand the relative role of these factors in explaining the dollar-denominated debt growth in the global bond market. This research question becomes more important nowadays in the sense that market participants and policy makers are more aware of international liquidity transmission as a potential threat to global

[19] This phenomenon is often termed as debt dollarization, referring to the international borrowers issuing dollar debt in global bond market.

financial stability. The conventional wisdom in the literature suggests that domestic business cycle and monetary policy determine the liquidity condition within one country. This was mainly due to lack of global financial market integration. Domestic condition was more relevant for policy makers at that time to implement policies to offset economic fluctuation. With global trade and financial integration, the impact of the external shocks on domestic market has been increasing over time. It is important for market participants and policy makers to watch the external economic environment, especially the most influential player in global financial market - Federal Reserve System of United States (the Fed). [20] Taper Tantrum in 2013 is a good example of the Fed's monetary policy influence on foreign exchange rates and asset prices. Meanwhile, regional economic integration, for instance, the European Monetary Union (EMU), also have an impact on foreign currency loans and deposit in domestic banking system. (Kishor and Neanidis, 2015)

This paper decomposes the movements in dollar debt in a set of 12 countries into global, emerging market and idiosyncratic factors using a dynamic factor model. This approach helps us in examining the relative importance of different factors in evolution of dollar debt growth in these countries. This also helps us in examining the hypothesis of loose US monetary policy as the primary source of the boom in dollar debt growth.

We find that the global factor accounts for most of the variations of the dollar debt growth in these countries. The emerging market factor also plays a secondary role in explaining the rapid growth of the outstanding dollar debt balance among emerging market economies. The country-idiosyncratic factor, however, is not as important compared to these external factors. The results suggest that the global financial market integration plays an important role in the cross-border liquidity transmission. From the time series of three decomposed factors, we find that the global factor has been accelerating since 2009. This pattern coincides with the extremely loose monetary policy environment in the US after Great Recession. This result further enhances the message to the policy makers that major country monetary policy spillover effect can have a significant impact on the cross-border capital flow of other countries. We also find that financial market

[20]The Managing Director Christine Lagarde of International Monetary Fund (IMF) has warned Chairwoman Janet Yellen many times to take into account the global effect of US monetary policy.

uncertainty, VIX, is highly negatively correlated with the level of global factor implying global increase in the level of debt dollarization in case of a decline in financial market uncertainty.

The rest of the paper are structured as follows. The second section provides a literature review about global liquidity transmission and discusses the associated monetary policy spillover effect. The third section introduces the data used in this study and the setup of the dynamic factor model. The fourth section interprets and presents the results from the model. The last section concludes the paper.

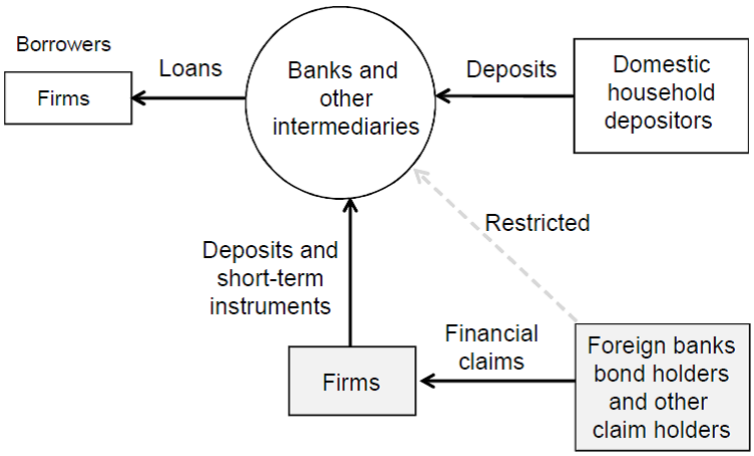
4.2 Literature Review

The recent surge in non-financial corporate (hereafter "corporate") overseas debt issuance after 2007-2009 financial crisis has started drawing attention from macroeconomic researchers, as it plays a critical role in the conduct of international capital flow activities in the emerging markets. This surge in the overseas debt issuance is also referred to as the second phase of global liquidity (Shin, 2013).The first phase (2003-2007) of global liquidity is associated with a rapid increase in cross-border international bank loans. The international banks lose the market share to international bond markets in the cross-border activities substantially after the global financial crisis, partly because of the strengthened financial system regulation. This fall in cross-border lending by international banks was followed by a rise in the overseas debt issuance of the non-financial corporate sector. The relative importance of corporate overseas debt issuance can be gauged from the fact that more than half of the net "external" financing of emerging economies in 2012 took place through the issuance of international debt securities (Turner, 2014).

We borrow Figure 9 from Shin and Zhao (2013) to visualize the role of corporate debt issuance in global liquidity transmission. In the first phase of global liquidity, domestic household depositors and international investors (mostly international banks) supply liquidity to domestic financial system to finance the final corporate borrower production projects. However, in the second phase of global liquidity, domestic large corporates, rise to serve as surrogate intermediaries to facilitate liquidity transmission into domestic

financial system, presumably due to the restriction on direct lending from international banks. The large corporates headquartered in emerging markets may use their overseas subsidiaries to issue bonds in international financial markets and receive the proceeds through intra-company transactions (The subsidiaries can pay for operation costs for the headquarters, for instance). In this way, the proceeds owing into emerging markets are treated as a form of foreign direct investment and do not appear in the residency-based external debt positions. This conjecture worries policy makers about the effectiveness of capital control policies at the border and the creation of systematic risks outside traditional international financial regulation framework.

Figure 9: Transmission of Global Liquidity across Borders



Dynamic factor model has been widely used in the literature to study the relative contribution of global, regional and country-idiosyncratic factors on international finance issues. Kishor and Ssozi (2001) use a dynamic factor model to measure business cycle synchronization as the proportion of structural shocks that are common across East African Community (EAC) countries. Kishor and Neanidis (2013) use a dynamic factor model to decompose fluctuations in financial dollarization for 24 transition economies into a common factor, an EU factor, a non-EU factor, and country-idiosyncratic factors to study the relative importance of the EU factor to the financial dollarization of a country. Bhatt et. al. (2017) decomposes the observed variation in long-term sovereign bond yields for each of 21 OECD countries into a common factor, a regional factor (EMU/non-EMU) and an idiosyncratic country specific factor to study the impact of EMU on bond

yield convergence, using a time-varying dynamic factor model. These papers use dynamic factor model to study the relative importance of various levels of co-movements across countries. Therefore, we believe it is appropriate to use a dynamic factor model to answer the question about the relative strength of the global, regional and idiosyncratic factors on the dollar debt growth rates across 12 countries.

4.3 Data and Empirical Model

4.3.1 Data Description

We download the country-level time series data of the outstanding dollar-denominated debt securities from Bank of International Settlement (BIS) debt security statistics. The ultimate borrowers of these securities are non-financial corporations. The outstanding amount of dollar debt is aggregated based upon the nationality instead of the residency of the issuers. We take the log difference of the outstanding amount to compute the growth rate of the dollar debt growth for each country. In this study, we pick top 12 countries with the largest dollar debt amount outstanding at the forth quarter of 2016. There are 6 developed economies: Australia, Canada, France, Germany, United Kingdom and United States, and 6 emerging market economies: Brazil, China, Hong Kong India, Indonesia and Mexico. These data series start from the forth quarter of 1993 and end at the last quarter of 2016, in total 93 quarters.

The summary statistics of the dollar debt growth rates in these countries is in Table 11. For the developed economies, the average dollar debt growth rates are around 2 to 3 percents; while for the emerging market economies, the average dollar debt growth rates are around 5 percents during the sample period. Not surprisingly, the standard deviation of the debt growth rates in emerging market economies are on average higher than the developed counterparts. This distinction between the developed economy and emerging markets suggests that there may be common movements specific to the developed economies and the emerging market economies respectively. Therefore, in the model below, we propose to model this feature by adding a developed market factor to capture the co-movements among Australia, Canada, France, Germany, United Kingdom and United

States. Similarly, an emerging market factor is added in modeling the dynamics of Brazil, China, Hong Kong India, Indonesia and Mexico.

Table 11: Summary Statistics: The Dollar Debt Growth in 12 Countries

Statistic	N	Mean	St. Dev.	Min	Max
Australia	93	2.931	7.859	−7.309	55.701
Canada	93	2.225	2.763	−4.319	10.330
France	93	2.932	9.456	−35.292	60.661
Germany	93	3.599	13.356	−23.209	80.950
UK	93	3.211	4.685	−6.336	22.306
US	93	2.956	6.086	−12.723	22.765
Brazil	93	4.073	6.829	−7.566	33.001
China	93	7.478	10.861	−7.966	64.189
HongKong	93	4.925	15.376	−7.710	132.599
India	93	5.882	19.621	−29.570	119.760
Indonesia	93	5.175	10.770	−16.461	51.456
Mexico	93	2.929	7.332	−19.100	28.162

4.3.2 Empirical Model

Our objective is to measure the relative impact of the global/ regional/idiosyncratic factors on the dollar debt growth. For this purpose, we construct a model where we decompose the dollar debt growth into four factors: (i) a global factor, (ii) a developed market factor, (iii) an emerging market factor and (iv) an individual country factor. The global factor is common across all the 12 countries in the system, regardless of whether the country is a developed country or an emerging market country. The developed market factor is common across countries including Australia, Canada, France, Germany, United Kingdom and United States, whereas the emerging market factor is common across Brazil, China, Hong Kong India, Indonesia and Mexico. The portion of dollar debt growth that can not be explained by the unobservable (global, developed economy, emerging market) factors is the idiosyncratic factor that is unique to each country. All dynamic relationships in the model are captured by modeling each of the factors as autoregressive processes.

Suppose y_{it} (y_{jt}) stands for the growth rate of dollar debt for country i (j) at time period t. We can decompose this variable into four components. The global factor (C_t) is

the common factor that estimates the impact of macroeconomic conditions in all countries on the dollar debt growth of country i at time t. For example, if there is a common shock that would accelerate the dollar debt growth, it would be captured by an increase in C_t. Similarly, D_t denotes the developed market factor that captures the common movement across the six developed economies, whereas E_t denotes the emerging market factor that captures the common movement across the six emerging market economies. The inclusion of the regional factors absorbs the common movement within each country type, to control for potentially higher volatility not being due to an idiosyncratic country component. Coefficients γ_i, δ_i, γ_j, δ_j are the factor loadings on the common factor of the developed country i, the developed market factor of the developed country i, the common factor of the emerging country j, the emerging market factor of the emerging country j. These factor loadings reflect the degree to which the variations in the dollar debt growth can be explained by each of the factors. Finally, η_{it} (η_{jt}) is an idiosyncratic component, which is unique to each country. This idiosyncratic component reflects the fluctuations in the dollar debt growth that can be explained by the individual country characteristics.

Developed Economies

$$y_{it} = \gamma_i C_t + \delta_i D_t + \eta_{it} \tag{13}$$

$$i = Australia, Canada, France, Germany, UnitedKingdom, UnitedStates \tag{14}$$

Emerging Markets

$$y_{jt} = \gamma_j C_t + \delta_j E_t + \eta_{jt} \tag{15}$$

$$j = Brazil, China, HongKong, India, Indonesia, Mexico \tag{16}$$

Because the three factors and the idiosyncratic component are unobserved, we need to specify a dynamic structure for their identification. To this end, we follow the dynamic factor model of Stock and Watson (1991) and assume an AR (1) process for all four components. They are specified as below, where the innovation terms in equations (5) -(8), ε_t, υ_t, ν_t, and e_{kt}, are mutually orthogonal across all equations and countries in the system.

Common Factors

$$C_t = \beta_1 C_{t-1} + \varepsilon_t, \varepsilon_t \sim N(0,1) \tag{17}$$

$$D_t = \beta_2 D_{t-1} + \upsilon_t, \upsilon_t \sim N(0,1) \tag{18}$$

$$E_t = \beta_3 E_{t-1} + \nu_t, \nu_t \sim N(0,1) \tag{19}$$

Idiosyncratic Factors

$$\eta_{kt} = \delta_k \eta_{kt-1} + e_{kt}, e_{kt} \sim N(0, \sigma_k^2) \tag{20}$$

$$k = i, j \tag{21}$$

Further, we measure the relative contributions of each of the four factors to the dollar debt growth in each country with variance decomposition analysis. This provides an empirical assessment of how much of a country's fluctuations in the dollar debt growth are attributable to each of the three common factors and to the idiosyncratic component. Because the global factor, the developed market factor, the emerging market factor, and country-specific factors are by construction orthogonal to each other, it is possible to perform variance decomposition for these components in the dynamics of dollar debt growth based on equation (1) or (3), which can be rewritten as

$$var(y_{it}) = var(\gamma_i C_t) + var(\delta_i D_t) + var(\eta_{it}) \tag{22}$$

$$var(y_{jt}) = var(\gamma_j C_t) + var(\delta_j E_t) + var(\eta_{jt}) \tag{23}$$

or as

$$var(y_{it}) = \gamma_i^2 \sigma_\varepsilon^2/(1-\beta_1^2) + \delta_i^2 \sigma_\upsilon^2/(1-\beta_2^2) + \sigma_{\eta i}^2/(1-\delta_i^2) \tag{24}$$

$$var(y_{jt}) = \gamma_j^2 \sigma_\varepsilon^2/(1-\beta_1^2) + \delta_j^2 \sigma_\nu^2/(1-\beta_3^2) + \sigma_{\eta j}^2/(1-\delta_j^2) \tag{25}$$

The last term in equation (12) and (13) represents the variance of the dollar debt

growth associated with country-specific factors. The fraction of volatility due to the global factor would be

$$\gamma_k^2 \sigma_\varepsilon^2 / (1 - \beta_1^2) / var(y_{kt}) \tag{26}$$

which suggests that the share of each factor depends on its relative variance as well as the relative persistence of its autoregressive parameter.

To disentangle the importance of the various factors, we can cast the dynamic factor model given by equations (1), (3), (5)-(8) into a state-space framework. Following the literature, we assume zero covariance across shocks to the global factor, the developed economy factor, the emerging market factor, and the idiosyncratic factors. The preceding state-space model is estimated using maximum likelihood via the Kalman filter. Due to the fact that the scales of those unobserved factors cannot be uniquely identified, we assume a unit innovation variance for all factors.

In sum, the dynamic factor model we use is well suited for studying the properties of the fluctuations in dollar debt growth. This technique allows estimation of the evolution of each factor over time. In this way, we can identify changes or breaks in the relationship between the factors and dollar debt growth during the examined period of time. Importantly, such regime shifts can be traced back to changes in policies and, thus, offer intuitive interpretations and policy recommendations.

Measurement Equation:

$$\begin{bmatrix} y_{it} \\ y_{jt} \end{bmatrix} = \begin{bmatrix} \gamma_i & \delta_i & 0 & 1 & 0 \\ \gamma_j & 0 & \phi_j & 0 & 1 \end{bmatrix} \begin{bmatrix} C_t \\ D_t \\ E_t \\ \eta_{it} \\ \eta_{jt} \end{bmatrix}$$

Transition Equation:

$$\begin{bmatrix} C_t \\ D_t \\ E_t \\ \eta_{it} \\ \eta_{jt} \end{bmatrix} = \begin{bmatrix} \beta_1 & 0 & 0 & 0 & 0 \\ 0 & \beta_2 & 0 & 0 & 0 \\ 0 & 0 & \beta_3 & 0 & 0 \\ 0 & 0 & 0 & \delta_i & 0 \\ 0 & 0 & 0 & 0 & \delta_j \end{bmatrix} \begin{bmatrix} C_{t-1} \\ D_{t-1} \\ E_{t-1} \\ \eta_{it-1} \\ \eta_{jt-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_t \\ \upsilon_t \\ \nu_t \\ e_{it} \\ e_{jt} \end{bmatrix}$$

Variance-Covariance Matrix of the Shocks to Factors:

$$Q = \begin{bmatrix} \sigma^2_{\varepsilon t} & 0 & 0 & 0 & 0 \\ 0 & \sigma^2_{\upsilon_t} & 0 & 0 & 0 \\ 0 & 0 & \sigma^2_{\nu_t} & 0 & 0 \\ 0 & 0 & 0 & \sigma^2_{e_{it}} & 0 \\ 0 & 0 & 0 & 0 & \sigma^2_{e_{jt}} \end{bmatrix}$$

4.4 Results and Interpretation

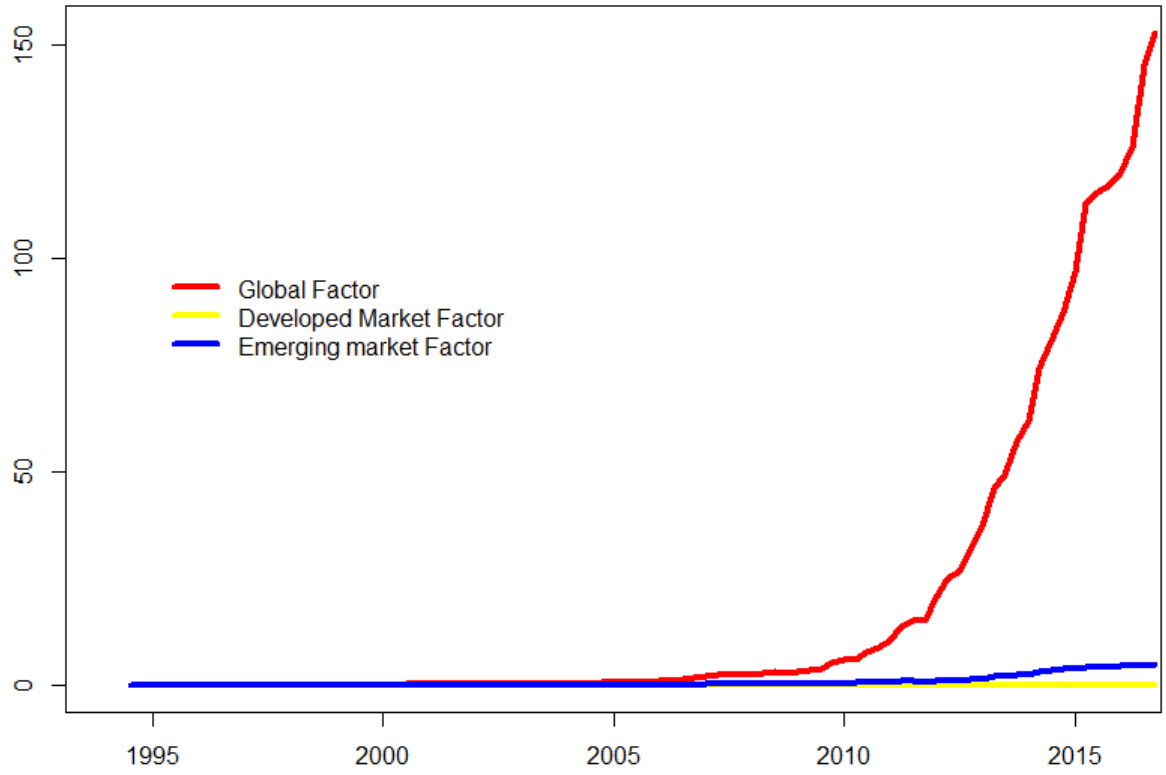
In this section, we examine the evolution of the various factors and analyze their ability to track changes in the outstanding dollar debt in our sample. We then examine the sources of fluctuations across factors, using variance decomposition.

4.4.1 Evolution of the Global, Developed, and Emerging Market Factors

Figure 10 displays the dynamics in the outstanding dollar debt that is associated with the global factor, the developed market factor and the emerging market factor. It is very

clear that the global factor has been increasing dramatically since 2009. Compared to the global factor ,the changes in the regional factors are subtle. This is to say, the global factor plays a dominant role in explaining the rapid growth of dollar debt during the post Great Recession period.

Figure 10: Dollar Debt: Dynamic Factor Decomposition in 12 Countries



What is the underlying global factor that drives the skyrocketing outstanding dollar debt since 2009? The Fed almost immediately lowered the federal funds rate towards zero after the 2009 financial crisis outbreak. Quantitative easing programs further dampen the shadow federal funds rate to the negative territory (Wu and Xia, 2016). The ultra-low interest rate environment motivates American investors to seek for higher yields outside the US. Prior to 2009, global banking system closed the cross-border interest rate arbitrage opportunity by operating the commercial bank business at the international scope, i.e., taking deposit from low interest rate environment and giving loans to the

borrowers that were facing higher domestic interest rates. Since 2009, the changes to Basel III capital framework have accentuated the cross-border regulation on the global banks, with adverse impacts on cross-border capital flows into emerging markets through international bank loans. At the same time, the global bond market started taking the market share of the cross-border capital flow from global banking system, due to the comparative advantage gained through the capital control policy loopholes. In sum, the joint force of low interest rate environment and ill-designed cross-border banking regulation might explain the boom of global bond market during the post crisis period.

Figure 11: Dollar Debt: Dynamic Factor Decomposition in 12 Countries

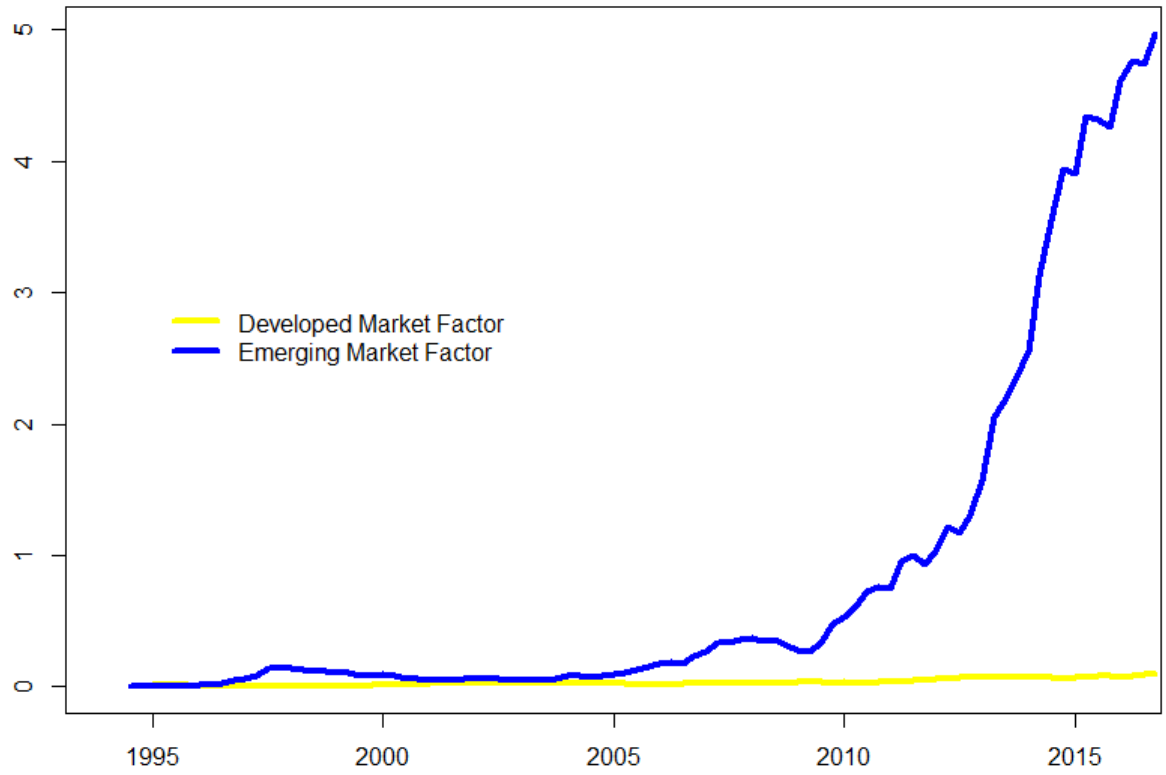


Figure 11 takes a closer look at the evolutions of the developed market factor and the emerging market factor. Although the changes in the emerging market factor are not as sizable, we still observe a similar pattern as from the global factor. The emerging market factor reached the local maximum prior to 2009 financial crisis. While there was

a downturn afterwards, the dip only lasts one year followed by a take-off. Since then, the emerging market factor appear to skyrocket throughout the rest of the sample period. The developed market factor almost stays flat around zero throughout the whole sample period.

What explains the difference between the emerging market factor and the developed market factor? What is unique among the emerging markets? There are probably two reasons. The first one is the economic growth among emerging market economies. Prior to the crisis, there was a boom phase of global economy. The increase of dollar debt in emerging market economy during this period captured the boom phase of credit cycle. Since 2009, the financial crisis hit most of the developed economies, whereas the emerging markets provide an opportunity for safety and return. The fast economic growth among emerging markets encourage the borrowers to take advantage of global low interest rate environment. Moreover, as the overall interested rates among the emerging markets are higher than the counterpart among the developed economies, the borrowers from the emerging markets have stronger incentive to issue dollar debt in the global bond market. The second reason is the developed market is more integrated into the global financial market; therefore the global factor probably captures the majority of the variations among the developed countries.

4.4.2 Sources of Dollar Debt Fluctuations

We now examine the sources of fluctuations in dollar debt using variance decomposition. As a measure of the importance of the factors for the dollar debt growth, we present the variance shares attributable to each factor: the global factor, the developed market factor, the emerging market factor and the country-idiosyncratic factors.

Table 12 shows the results for this variance decomposition for the dollar debt growth rates among 12 countries during 1993-2016. In most of the countries, the global factor explains the majority of the variations of the dollar debt growth of the country. The regional factors, whether the developed market factor or the emerging market factor, plays the secondary role in explaining these variations. The country-idiosyncratic factors

account for only single-digit percentages of the variations of the dollar debt growth among most of the sample countries.

Table 12 clearly reflects the dominant impact of the global factor and the minor influence from the country-idiosyncratic factors. This result suggests that it is the global factor that drives the cross-border debt issuance behavior. The global low interest rate environment creates the surge of the dollar debt around the world. This is to say, sometimes the Fed's monetary policy can be more important to explain a country liquidity condition than the country domestic economic events per se. These results shed light on the global financial stability issues. On one hand, the US monetary policy, with the traditional objective of dual mandate, could be the source of uncertainty to stabilize the global capital flow. If the domestic price and employment requires the Fed to behave in a different way than that being expected from the global financial stability perspective, then the US monetary policy might create turbulences to global economy. On the other hand, policy makers around the world have to watch the external factors closely and maintain enough foreign reserves to manage international financial risk in this interconnected global economy.

There are three countries in the sample that the global factor does not play a dominant role in explaining the dollar debt growth of that country. For Germany, 48.50 percents of the the variations attribute to the global factor and 48.97 percents attribute to the developed market factor. This result might be due to the critical role of Germany within European Monetary Union. Brazil and India have less than 50 percents of variations that can be explained by the global factor, whereas the emerging market factor becomes the primary source of variations for these two countries. Compared to China, Hong Kong, Indonesia and Mexico, Brazil and India are less integrated in the global financial market. The variations of the dollar debt growth are more related to the emerging market comovements. This result suggests that the external shocks from other emerging market economies may have a significant impact on Brazil and India. Policy makers in these two countries should pay attention to not only the US monetary policy shocks but also the macroeconomic conditions among the emerging market economies.

Table 12: Factor Variance Decomposition: Dollar Debt Growth (1993-2016)

Country	Global	Developed	Emerging	Idiosyncratic
Australia	67.89%	26.14%		5.96%
Canada	78.89%	8.38%		12.73%
France	94.50%	0.11%		5.39%
Germany	48.50%	48.97%		2.53%
UK	65.42%	29.60%		4.98%
US	88.55%	4.57%		6.88%
Brazil	36.79%		61.19%	2.02%
China	82.97%		15.71%	1.32%
Hong Kong	75.64%		18.54%	5.82%
India	14.21%		84.88%	0.91%
Indonesia	60.46%		34.19%	5.35%
Mexico	85.01%		7.66%	7.34%

4.4.3 What is behind the global factor?

So far, from the dynamic factor model, we have found that it is the global factor that accounts for most of the variations in the dollar debt growth among these countries. Furthermore, since 2009, the global factor increases sharply. Combining these empirical results, we believe that the global factor helps explain the rapid growth of dollar debt during the post recession period.

Nevertheless, we still have not dived into the question what is the global factor. In the literature, the global factor that drives cross-border spillovers in financial conditions and credit growth is often termed as "Global Liquidity". The term is often used in connection with monetary policy spillovers from advanced economies. (Shin, 2013) A few papers suggest that, due to low US monetary policy rate, US dollar weakens against other currencies and also the term premium decreases in the post-recession period, which is featured with the expectation of low near term volatility, which can be measured by VIX (CBOE Volatility Index). We build a correlation matrix to see the co-movements between the global factor and key macro variables from the literature. (Table 13) We find that, during 1994-2016, the global factor is moderately negatively correlated with shadow federal funds rate, suggesting that federal funds rate is a decent indicator of global liquidity transmission. The US monetary policy rate could be the underlying global driver of

liquidity transmission. Further research can be done to disentangle the macroeconomic fundamentals behind the global factor.

Table 13: Correlation Matrix

Sample Period: 1994:Q4 - 2016:Q4					
Measure	1	2	3	4	5
1. Global Factor	1.00	-0.28	0.17	0.10	-0.55
2. VIX	-0.28	1.00	0.24	-0.08	-0.01
3. Dollar Index	0.17	0.24	1.00	0.03	0.10
4. Term Premium	0.10	-0.08	0.03	1.00	-0.24
5. Shadow Rate	-0.55	-0.01	0.10	-0.24	1.00

4.5 Conclusions

This paper investigates the debt dollarization in global financial market. The amount of the outstanding dollar-denominated debt securities has been increasing over time, particularly during the post Great Recession period when the Fed implemented a series of unconventional monetary policies to combat the economic downturn. Using a dynamic factor model, we decompose the fluctuations in the dollar debt growth of 12 countries into a global factor, a developed market factor, an emerging market factor, and country-specific factors. We find that, it is the global factor that plays the dominant role in the dollar debt growth of these countries. Furthermore, since 2009, the global factor of the dollar debt growth has been increasing dramatically, suggesting that the global liquidity transmission is closely related to the US monetary policy spillover effect. Regarding to the policy implication of this paper, we think the US monetary policy, with the traditional objective of dual mandate, could be the source of uncertainty to stabilize the global capital flow in the interconnected global financial market. Policy makers around the world have to watch the external factors closely and maintain enough foreign reserves to actively manage international financial risk.

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