# International Reserves, External Debt Maturity, and the Reinforcement Effect for Financial Stability

Xingwang Qian
SUNY Buffalo State

Andreas Steiner
ifo Institute

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**Abstract**

This paper studies how the maturity structure of external debt is affected by international reserves and how they reinforce financial stability through a more crisis-resilient maturity structure. We show in an illustrative theoretical model that reserves lengthen the maturity of external debt via a flattening of the yield curve. Using data of 66 emerging and developing countries and applying different econometric approaches, we find robust evidence that reserves increase the share of long-term (LT) relative to short-term (ST) external debt. Results hold for private and public external debt individually. Taking reserves and their effect on the debt maturity structure together, they reinforce financial stability.

Keywords: International Reserves, Capital Inflows, Debt Maturity
JEL Classification Numbers: F3, F4

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Corresponding Addresses:
Xingwang Qian, Economics and Finance Department, SUNY Buffalo State, Buffalo, NY 14222, USA, Email: qianx@buffalostate.edu
Andreas Steiner, ifo Institute, 81679 München. Email: asteiner@uni-osnabrueck.de

## 1. Introduction

Since the global financial crisis of 2008, emerging economies have attracted substantial capital inflows thanks to a relatively stable macroeconomic environment, low debt levels and better prospects of economic growth compared to advanced economies. These capital inflows combined with government policies in favour of financial development have facilitated the growth of debt markets. The share of emerging market bonds in global bond market capitalization has risen from 2% in 1995 to 13% in 2013 (IMF, 2014). Goldman and Sachs (2013) projected this share to rise to nearly 40% by 2050.

A functioning and developed debt market provides manifold benefits for emerging and developing economies. For instance, it may improve the capital structure, provide the prerequisite for capital account liberalization and facilitate the supply of liquidity for investment projects and economic growth. Moreover, open capital markets contribute to the spread of best practices of corporate governance, legal practice and accounting standards and impose a disciplinary effect, which limits a government's ability to pursue bad policies.

However, external debt flows to emerging and developing economies have also caused economic turmoil. The level of external debt, its maturity composition, its currency denomination, and variable interest rates, among others, all potentially make emerging markets crisis-prone. Crises usually entail enormous output losses (Aizenman and Ito, 2014; Catão and Milesi Ferretti, 2014; Edwards, 2008; Gupta et al., 2007; Hutchison and Noy, 2005).

Nevertheless, emerging economies withstood well the tide of the global financial crisis of 2008, which wracked primarily advanced economies (see IMF, 2010). Improved macroeconomic and public debt policies over the past decade in emerging markets may have contributed to this stability (Anderson et al, 2010). Learning from their painful experience, emerging markets engaged in debt management policies that have reduced the level of public debt, cut the share of debt denominated in foreign currency, decreased the share of variable interest rate debt, and, particularly, helped to extend the maturity of external debt (Arslanalp and Tsuda, 2014; Figure 1).

Furthermore, these debt management policies have been often accompanied by the enormous build-up of international reserves at central banks (Figure 2), which provide insurance against financial crises and help to maintain a stable exchange rate and a stable

financial system, making emerging and developing economies more resilient to domestic and external shocks.

International reserves may provide such a stabilization effect through two channels: First, a higher level of reserves lowers the probability of a financial crisis (Aizenman and Marion, 2004). It subsequently reduces the riskiness of an investment in the domestic economy because financial crises often entail exchange rate devaluations and cause recessions. Second, reserves create bailout expectations and reduce the costs if a crisis materialises (Aizenman et al., 2011). In a nutshell, reserve hoardings are perceived as an implicit insurance of foreign investors; therefore, they may enhance capital inflows to emerging markets.

This implicit insurance value of reserves might affect the behaviour of borrowers and creditors engaged in cross-border capital flows. More precisely, the following decisions with respect to the form of financing might depend on the level of reserves: (1) the choice between domestic and foreign borrowing; (2) the currency denomination of external debt; (3) the choice of financing instrument and (4) the maturity structure of external debt.

This paper focuses on reserves' impact on the maturity structure of external debt and the reinforcement effect for financial stability. We argue that, among other factors, an extended debt maturity is the endogenous response to the build-up of international reserves in emerging and developing economies. Thus, besides their direct effects on financial stability, international reserves tilt the maturity structure of external debt towards more LT debt, which further enhances the financial stability of an emerging and developing economy.

To be specific, we investigate whether and how reserves affect the maturity composition of external debt, measured by the ratio of long-term (LT) to short-term (ST) external debt[1]. In the first place, we examine the relationship between reserves and the maturity of external debt in a theoretical model that establishes the link between reserves and the yield curve. To account for possible differences between private and public debt, we split the data and investigate the maturity structure of public and private debt in the empirical section separately.

ST external debt provides relatively lower capital cost than LT debt (Broner et al, 2013), but it is the leading factor that causes financial crises, usually entailing devastating

[1] The definitions of LT and ST external debt follow the World Bank International Debt Statistics. LT debt is debt that has an original or extended maturity of more than one year; in all other cases debt is labelled ST.

output losses and a recession (Furman and Stiglitz, 1998; Reinhart and Calvo, 2000). In contrast, LT debt is more stable and resilient to crises, although it is more expensive due to the higher default risk. When the trade-off between higher costs and crises-prevention benefit for LT debt are balanced, a county reaches its optimal maturity structure of external debt. International reserves, by reducing the crisis probability and creating bail-out expectations, reduce the cost (interest rate or yield) of LT debt more than that of ST debt. Consequently, reserves induce foreign investors to engage more in LT investments, altering the maturity composition of external debt towards LT obligations.

We then confront our theory with the data: We analyse a panel data set of 66 emerging and developing economies over the period 1984-2012 using a variety of econometric methods, including fixed effect panel data regressions, two-stage instrumental variable approaches, and a dynamic panel data vector autoregression (VAR).

To preview the results, we find that, via the channel of self-insurance against financial crises, international reserves raise the share of LT relative to ST debt. Hence, they effectively extend the average maturity of external debt in emerging and developing economies. This positive effect on the share of LT debt is stronger for private than for public debt, possibly because international reserves help private borrowers to loosen their credit constraints more than sovereign borrowers. In addition, to account for the potential interdependence between the maturity structures of public and private debt, we utilize a dynamic panel data VAR approach. The VAR results show that international reserves increase the share of LT debt in both public and private debt; but the magnitude of this effect is higher for private debt. In addition, the dynamic processes are slightly different: while LT private debt responds immediately to a positive shock from international reserves, peaking after two years and fading out quickly, the response of public debt to the same international reserves shock is more persistent; it slowly peaks four years later and fades out gradually. Furthermore, utilizing a regression specification featuring international reserves, debt maturity and their interaction, we find that, apart from the positive effect of both reserves and LT debt for financial stability, they reinforce each other in enhancing financial stability of emerging and developing economies.

Our paper is related to various strands of the existing literature. There is a vast literature on the optimal maturity structure of corporate debt. Most papers study the maturity structure from the perspective of liquidity risk and information asymmetries. Borrowers that finance a LT project with ST debt are vulnerable to refinancing and interest rate risks.

Premature liquidation hurts firms and investors because the value of assets is higher within the firm than outside (Hart and Moore, 1994). Diamond (1991) stresses that debt maturity is the result of a trade-off between liquidity risk and borrowers' preference for ST debt due to private information about the future credit rating.[2] Moreover, ST debt may serve as disciplining device to reduce moral hazard (Cheng and Milbradt, 2012).

Studies on the macroeconomic determinants of the maturity composition of debt are relatively few. In an influential paper, Rodrik and Velasco (2000) formulate a theoretical model for the determination of the maturity structure of external debt focussing on the liquidity risk of an investment project[3]. Empirically, they find that the share of ST debt is positively associated to GDP per capita and the size of the financial system of the recipient country but not to foreign trade activities. In addition, economic and political uncertainty may tighten the solvency constraints and subsequently tilt the debt profile towards ST debt (Bussière et al, 2004; Velev, 2006). Finally, a rate race towards shorter maturities might results from the strategic behaviour of individual creditors who have an incentive to shorten the maturity of their loan (Brunnermeier and Oehmke, 2013).

The paper is organized as follows: The next section develops the theoretical model to illustrate the link between international reserves, the debt yield curve and the optimal maturity structure of external debt. Section 3 is devoted to the empirical analyses including a variety of econometric methods and robustness checks. The policy implications of our findings are discussed in Section 4. The final section summarises our results and concludes.

## 2. Theoretical considerations: Reserves and the maturity of external debt

This section presents a theoretical model that establishes the link between the level of reserves and the choice between ST and LT external debt. What are plausible channels through which international reserves might affect the maturity structure of external debt? We argue that the maturity choice may depend on the relative cost of debt instruments, that is, the term structure of interest rates; the latter, in turn, might be influenced by the level of international reserves.

International reserves are well-known to reduce the probability of a financial crisis and mitigate the output cost when a crisis cannot be prevented. If these benefits of reserves

[2] Diamond points out that investors who borrow ST are either high or low rated companies. While the former wait for the arrival of positive news, which allow for more favourable credit conditions, the latter have no access to LT financing.

[3] Diamond and Rajan (2001) study ST debt from the perspective of liquidity risk of an investment project.

affect ST and LT debt contracts to varying degrees, reserves change the term structure of interest rates. As a result, the level of reserves affects the choice between ST and LT debt.

### 2.1. A model of the term structure of debt: Theoretical setting

Our theoretical considerations are based on the model of the cost of external borrowing provided by Rodrik and Velasco (2000). This model determines the term structure of interest rates where the riskiness of different debt maturities determines their cost. The original model analyses the debt contract between a representative investor and foreign lenders. We add government as an additional actor to this setting: A government – represented by its central bank – may influence the debt contract through its hoarding and provision of international reserves.

Assume that a representative investor has access to a fixed-size investment project that lasts three periods: She prepares the project in period 0 and executes it in periods 1 and 2. An investment of $k$ units of the single tradable good in period 0 yields $Rk$ units of the good in period 2 with $R>1$. The project may be dissolved partly in period 1 due to liquidity issues. However, premature liquidation is costly: Liquidation of an amount of $l \leq k$ in period 1 only yields $\rho l$ units, where $\rho<1$.

The investor has no own resources, but may borrow from abroad. The required resources $k$ can be split between ST borrowing ($d$) and LT borrowing ($k$-$d$). Assume for simplicity that the riskless world interest rate is zero for both ST and LT loans. ST loans have a maturity of one period, whereas LT contracts are made for two periods. Creditors may choose not to renew the contract in period 1 with probability $p$. If creditors refuse to roll-over ST debt, the investor is forced to partly liquidate the project.

In our interpretation of the model, creditors decide not to roll-over their credits when the likelihood of a crisis in the host country is high. A macroeconomic crisis might depreciate the real value of the investment and increases the probability that the investor declares bankruptcy. Hence, we assume that the probability that investors refuse to roll-over debt ($p$) is a function of the probability of a financial crisis.

Since the model focuses on the term structure of interest rates – as opposed to their absolute level – the project-specific risk is irrelevant in our analysis. The project-specific risk affects ST and LT loans alike.

Depending on the size of ST debt relative to LT debt the results of the benchmark model may be summarised as follows[4]: If ST debt is small relative to LT debt, the project yields enough resources in period 2 to repay the entire stock of ST and LT debt. This statement even holds after premature liquidation of ST debt in period 1. Consequently, both ST and LT debt carry the world riskless interest rate. In the intermediate case, premature liquidation and repayment of ST obligations implicate that available resources in period 2 fall short of debt obligations. Hence, the investor defaults on her LT debt partly. Since under this scenario LT debt is riskier than ST debt, creditors will demand a risk premium which makes LT debt costlier than ST debt. In the worst scenario where the stock of ST obligations is large relative to LT debt, the investor defaults on her entire LT debt and repays only part of her ST debt if there is no refinancing in period 1. Hence, while LT debt is still riskier than ST debt, ST debt contracts also carry a risk premium. This term structure of interest rates is depicted in Figure 4.

### 2.2 Term structure of interest rates and international reserves

How do central banks' international reserves enter the model? Reserves affect the stability of the economy where the investment takes place. In particular, higher reserves reduce the risk of a financial crisis. They can be used to defend the local currency and to smooth the effects of a currency crisis if it cannot be prevented.

Financial instabilities reduce foreign creditors' willingness to invest in the economy. Under a mechanism of self-fulfilling crises, foreign creditors may suddenly stop renewing the debt contract such that capital reversals or capital flight take place and result in a full-blown financial crisis. Therefore, in a financial crisis financial constraints become tighter and foreign ST creditors do not renew their contracts. The negative repercussions of a financial crisis are aggravated by the reaction of foreign investors.[5] This leverage effect may be prevented by the presence and use of reserves.[6]

In the following, we examine the effect of reserves on the interest rate differential between LT and ST debt. Since this effect depends on the relative amount of ST debt, we distinguish several cases:

[4] For the formal analysis refer to Rodrik and Velasco (2000).
[5] If the crisis does not have a global dimension, one might argue that foreign creditors prefer to move their resources to unaffected countries. They demand a higher risk premium such that credit costs exceed the return of the project.
[6] Reserves also reduce exchange rate risk. Exchange rate risk, however, does not affect the term structure of interest rates. Therefore, this effect is neglected in this section.

*Case 1*: $d \le \rho k$

In this scenario, a crisis in period 1 does not affect ST creditors' returns: their claims on the borrower (*d*) are smaller than liquidable resources ( $\rho k$ ). Hence, there are always sufficient resources to service ST debt. The interest rate on ST debt equals the world riskless rate, namely $r_S = 0$. What about the LT interest rate $r_L$? There are two possible sub-cases:

*Case 1a*: $d \le \left( \frac{R-1}{R-\rho} \right) \cdot \rho k$

Both ST and LT debt can fully be repaid. As a result $r_S = r_L = 0$ and the availability of reserves does not affect the term structure of interest rates.

*Case 1b*: $\left( \frac{R-1}{R-\rho} \right) \cdot \rho k < d < \rho k$

In this setting, after servicing all ST creditors, available resources in period 2 fall short of liabilities. In this case the interest rate on LT debt is determined by the condition that the expected return of a risky loan equals the world interest rate:

$$(1-p)\cdot(1+r_L) + pq_L(1+r_L) = 1 \qquad (1)$$

where *q* denotes the probability of repayment in the case of a crisis.[7] *q* is assumed to equal the ratio of available resources to outstanding claims:

$$q_L = \min\left[ \frac{R\left(k - \frac{d}{\rho}\right)}{(1+r_L)\cdot(k-d)},\ 1 \right] \qquad (2)$$

After plugging (2) in (1), the LT interest rate can be expressed as

$$(1+r_L) = \left( \frac{1}{1-p} \right) \cdot \left[ 1 - \frac{pR\left(k - \frac{d}{\rho}\right)}{k-d} \right] \qquad (3)$$

[7] *q* can be considered either as the probability of being repaid or as the recovery ratio if remaining resources are distributed among all creditors equally.

Along the lines of Aizenman and Marion (2004) we assume that the probability of a currency crisis increases in the level of external debt and falls in reserves:

$$p = \phi + \alpha \frac{d}{IR}\,. \tag{4}$$

Hence, the derivative of *p* with respect to IR is negative ( $p_{IR} < 0$). Analysing how *IR* affects the differential $(r_L - r_S)$ reduces to the effect of *IR* on $r_L$ since $r_s$ is constant:

$$\frac{\partial(1+r_L)}{\partial IR} = -\frac{p_{IR}}{(1-p)^2}\left[\frac{R\left(k-\frac{k}{\rho}\right)}{(k-d)} - 1\right] < 0$$

This expression is negative because $p_{IR} < 0$ and, by assumption for case 1b, $0 < \frac{R\left(k-\frac{d}{\rho}\right)}{k-d} < 1$. International reserves reduce the interest rate on LT debt. The interest differential between LT and ST debt decreases.

<u>*Case 2*:</u> $d > \rho k$

In this case, liquidation of the project in period 1 does not provide sufficient resources to cover all ST claims. The entire project has to be liquidated and after partially servicing ST debt there are no resources left to cover LT liabilities. The model assumes that LT debt is junior to ST debt. This assumption is in line with the observation by Berglöf and von Thadden (1994) that ST debt is usually repaid while creditors of junior LT debt may agree to a partial debt waiver.

The interest rate differential can be expressed as

$$(r_L - r_S) = \left(\frac{1}{1-p}\right)\left[\frac{p\rho k}{d}\right]$$

and the effect of reserves on the interest rate differential is given by

$$\frac{\partial(r_L - r_S)}{\partial IR} = \frac{p_{IR} \cdot \rho \cdot k}{(1-p)^2 \cdot d} < 0$$

In this case, increasing reserves make LT debt contracts more attractive relative to ST debt because their relative cost decreases.

In sum, our model suggests that increasing in international reserves lowers the probability of financial crisis, *p*, and any change in *p* has a stronger effect on $r_L$ than on $r_S$ since all LT debt is lost in case of premature liquidation, whereas part of ST debt will be repaid even in case of a crisis. Thus, international reserves affect the term structure of interest rate – higher reserves flatten the yield curve, making the LT debt more attractive than ST debt due to the reduced relative cost. This, consequently, will induce foreign creditors to adjust they portfolio toward more LT debt.

## 3. Empirical analysis

In this section, we use macroeconomic data to empirically test the hypothesis that international reserves affect the maturity structure of external debt and reinforce the effect of reserves on financial stability. In addition to using aggregate external debt data, we split the data into private and public and publicly guaranteed debt. This allows us to examine whether the effects depend on the nature of the borrower. Concerning the possible interdependence between private and public debt, we apply a panel data vector autoreggression (VAR), which allows for dynamic interdependence among private debt, public debt, and international reserves, while controlling for cross-sectional heterogeneity.

### 3.1. The maturity composition of external debt – a panel data analysis

*3.1.1 Aggregate external debt*

We first consider the fixed effects panel data regression[8] on annual data for 66 countries (Appendix I) from 1984 to 2012. The sample size is determined by data availability. We estimate the following equation:

$$\left(LT/ST\right)_{i,t} = \alpha \cdot X_{i,t-1} + \beta \cdot Y_{i,t-1} + \gamma \cdot Z_{i,t-1} + \varepsilon_{i,t} \qquad \text{(E1)}$$

where the dependent variable $\left(LT/ST\right)_{i,t}$ measures the maturity composition of external debt, computed as the ratio of country *i*'s stock of long-term (LT) to short-term (ST) external debt. *i* and *t* are country and year indices, respectively. External debt data is gathered from

[8] The Hausman test rejects a random effects regression.

the World Bank International Debt Statistics. All independent variables are lagged by one period to cope with potential endogeneity and reverse causality.

We group the independent variables into three categories. $X_{i,t-1}$ contains macroeconomic fundamentals, including the variable of interest, international reserves (measured as the ratio of international reserves to GDP). According to our theory, we expect that international reserves positively affect LT relative to ST external debt. Apart from international reserves, a group of macroeconomic factors scrutinized by Rodrik and Velasco (2000) is also included: the productivity of the economy (GDP per capita), financial depth (M2 to GDP ratio), and the real openness of an economy (imports over GDP)[9]. Rodrik and Velasco (2000) argue that increasing productivity and deepening financial markets rise the share of ST debt. The same holds for trade openness due to trade-related ST credits. Following their argument, we expect that our variables GDP per capita, M2 to GDP, and the ratio of imports over GDP have negative coefficients because our dependent variable is constructed as the ratio of LT over ST debt.

$Y_{i,t-1}$ includes variables that are related to political uncertainty and institutional quality. In particular, we consider the change of government as a measure for political uncertainty (de Haan and Jong-A-Pin, 2007; Hausmann et al, 2005). In addition, we include two controls for institutional quality, namely the quality of bureaucracy and law and order from the International Country Risk Guide (ICRG). Citron and Nickelsburg (1987) and Ozler and Tabellini (1991) find that a country with frequent government changes and weak institutions faces difficulties to obtain LT financing.

Finally, we include a few other relevant determinants of the maturity structure of debt in $Z_{i,t-1}$. The first one are capital control policies such as Chilean-type capital controls that directly alter the maturity composition of investors' portfolios. Although it is widely known that capital controls change the maturity composition of external debt, it is notoriously difficult to quantify all those regulations and policies (Montiel and Reinhart, 1997). For simplicity, we rely on a commonly used *de jure* measurement, the Chinn-Ito Index, to measure the strictness of a country's capital control policies. The Chinn-Ito Index takes smaller values when an economy has more capital account restrictions.

[9] Definitions for each variable and its data source are provided in Appendix II.

The second one is the world factor that may affect external debt flows (Calvo *et al*, 1993; Chuhan *et al*., 1996; Montiel and Reinhart, 1999). We use the US interest rates as the world factor. Although decreasing, a significant share of external debt in emerging and developing economies is still denominated in US Dollar. Hence, US interest rates have a direct effect on emerging economy debt. Indeed, a tighter Federal Reserve policy is found to drive up marginal funding costs of emerging and developing borrowers, typically by more than one-for-one (Arora and Cerisola, 2001; Hartelius, Kashiwase, and Kodres, 2008; Uribe and Yue, 2006). US interest rates are measured by the yield change of 1-year US Treasury bills. We expect that higher US interest rates drive up the term spread between LT and ST interest rates, resulting in a higher share of ST external debt. Finally, a time trending variable is included in $Z_{i,t}$ to control for a possible trend in the time series.

The results of fixed effects panel data regressions using aggregate external debt data are reported in column (1) of Table 1. In line with our theory, international reserves are positively associated with the share of LT debt. In other words, a developing country may receive more LT relative to ST external debt if it has a higher level of international reserves. As the regression result suggests, an increase in international reserves over GDP by one percentage point is associated with 0.14% more LT relative to ST external debt.

Three macroeconomic factors, namely productivity, financial depth, and trade openness, are negatively associated with the ratio of LT to ST debt. Rodrik and Velasco (2000) find that when an economy gets more productive and financial markets become deeper, the maturity structure of external debt tilts toward ST liabilities. Our results are consistent with these findings. In contrast to Rodrik and Velasco (2000), who did not find a significant relation between trade openness and ST debt, we find that trade openness significantly shortens the debt maturity.

Regarding institutional and political factors, the frequency of government change is found to be negatively associated with the share of LT debt, which is in accordance to the findings of Citron and Nickelsburg (1987) and Ozler and Tabellini (1991). Good bureaucratic quality can be a “shock absorber” that tends to minimize the impact from changes in policy or interruptions in government services. The positive and significant effect of bureaucratic quality suggests that better institutional and bureaucratic quality tend to attract a higher share of LT external debt. We do not find a significant relationship between law and order and debt maturity.

As Montiel and Reinhart (1997), we find that a financially more open economy tends to have relatively less LT liabilities. Regarding the world factor, higher US interest rates negatively influence the share of LT debt. Indeed, due to investors' concern with respect to the Federal Reserve's exit from its quantitative easing (QE), there were a few episodes of drastic capital outflows from emerging and developing economies. This may reflect that rising US interest rates could reshape the structure of external debt in emerging and developing economies.

The R-squared is relatively low – our basic model explains about 10% of the total variation in the maturity composition of external debt. Rodrik and Velasco (2000) provide an explanation for the low explanatory power arguing that "it is difficult to quantify the myriad policies and regulations that directly affect short-term capital flows".

ST debt flows are typically considered to be "hot" – highly volatile. Being a leading indicator for financial crises (Kaminsky et al, 1998), a high proportion of ST debt exposes countries to the risk of self-fulfilling crises (Caballero and Krishnamurthy, 2001). Crises are usually coupled with a sudden stop of capital flows and a capital reversal. There is a plethora of discussions about the experience of sudden outflows of ST capital during crises in emerging and developing economies. We anticipate that during financial crises, there are substantial outflows of ST debt, while the amount of LT debt remains relatively stable.

Thus, we add three dummy variables for notorious financial crises to examine our anticipation and the robustness of our estimation results: Mexico 1994, East Asia 1997, and the global financial crisis of 2008. Such large-scale regional or global financial crises usually impose substantial contagion effects on countries outside the inflicted region. Each crisis variable is set to 1 in the crisis year and all following years before the next crisis hits; and equal to 0 before the current crisis and after the next crisis materialized. For instance, the crisis variable of the 1994 Mexican crisis is set to 1 from 1994 to 1997 (Asian financial crisis materialized), while it equals 0 before the year 1994 and after 1997 [10].

We report the regression results for the specification including crisis variables in column (2) of Table 1. As expected both the Mexican crisis of 1994 and the East Asian crisis of 1997 raise the share of LT debt. In contrast, the 2008 global financial crisis is found to be

[10] We experimented to add a country specific crisis variable in the regression. For example, one that equals 1 if the annual exchange rate depreciation of the local currency exceeds 15% (Reinhart and Rogoff, 2010). However, such a crisis variable is highly correlated with international reserves. To avoid multicollinearity, we decided to drop it from the regressions. Alternatively, we use exchange rate volatility to proxy for currency crisis. The main results are robust and the estimates for exchange rate volatility are insignificant in all cases.

insignificant. This may be explained by the fact that the 2008 crisis affected primarily the advanced world; although emerging markets may have felt the crunch of capital flows due to soaring riskiness in global financial markets, they have not been forced to change their structure of assets and liabilities. Adding these three crisis variables does not affect other results, but raises the explanatory power of our model by 2 percentage points.

*3.1.2 Private and public debt*

In the previous section, we examine the relevant factors that affect the maturity composition of external debt using aggregate data. While this procedure provides a general picture of the determinants of debt maturity, it may obscure differences between public and private debt. Indeed, while both LT public and LT private debt trended upwards during the past three decades, private LT debt has a much faster pace – it increased more than 17 times from 1984 to 2012 (Figure 3). This section tries to scrutinize those factors that explain the differences in public and private LT debt and affect their maturity composition idiosyncratically.

There are common factors that affect the maturity structure of both public and private debt, possibly in different degree though. These common determinants may include the aforementioned macroeconomic factors, political uncertainty, and institutional quality. For the sake of consistency, in the regressions on public and private debt we first use the same basic set of independent variables as in Section 3.1.1.

In the specifications using private external debt we include an additional variable – the inflation rate. Private borrowers are more concerned about high inflation rates than sovereign borrowers that can print money out of debt. We expect that the inflation rate affects the maturity structure of private debt because inflation reveals information about the expected real value of LT debt contracts denominated in domestic currency (Demirgüç-Kunt and Maksimovic, 1999).

Due to the unavailability of both public and private ST debt data, we construct the maturity composition variable slightly different from the one in the previous section. The ratio of public (private) LT debt to total ST debt is used to measure the maturity composition of public (private) debt. Tables 2 and 3 report the results for the maturity composition of public and private debt, respectively. International reserves are found to significantly extend the maturity of both types of external debt.

On the one hand, the estimation for public debt yields results similar to those for the aggregate debt regression, except that the R-squared increases substantially from 10% to

16%, indicating that the explanatory power of the model is much higher for public debt data than for aggregate data.

On the other hand, the estimation results for the maturity composition of private debt display some differences. First of all, although we find that international reserves positively affect the maturity of private debt, the magnitude of the effect is twice as large as in Tables 1 and 2. This result implies that international reserves affect the borrowing behaviour of private entities more than that of the public sector – a very same shock from international reserves causes LT private debt to increase twice as much as LT public debt.

Second, both GDP per capita and financial development turn positive, insignificant though. Third, changes of government become statistically significant and the value of the coefficient indicates that government changes have a stronger effect on private debt than on public debt. Perhaps private borrowers fear that frequent government changes acerbate the riskiness of their business.

Fourth, capital controls have significant, but opposite effects on private and public debt. Thus, our results indicate that, while fewer controls (or more capital account openness) reduce the share of LT public debt, they raise the share of LT private debt. The reason might be linked to the lender's recovery ratio when default occurs. When firms in a financially more open country default, it usually has more collateral assets available for international lenders to confiscate overseas, which would reduce the default cost incurred to lenders. However, if the sovereign defaults, there is no super-nation that can hold a sovereign accountable, leading international lenders to prefer ST to LT debt investments.

Fifth, the world interest rate becomes insignificant in the private debt regression. Finally, the results for the 1994 Mexican crisis and the 2008 global financial crisis differ from those in Tables 1 and 2. The 1994 Mexican crisis is now insignificant. Indeed, the main trigger of the 1994 Mexican crisis was the sudden increase of US dollar denominated debt rather than a maturity mismatch. The 2008 global financial crisis is found to positively affect the maturity of private debt, whereas it is insignificant for public debt.

Regarding the additional variable included in private debt maturity regressions, a high inflation is found to shorten the maturity of private debt[11], which is in line with the findings of Boyd et al. (2001) and Rousseau and Wachtel (2002).

[11] To check robustness, we also included the inflation rate in the public debt estimation; coefficients are insignificant however.

Overall, the explanatory power of our regression model for the maturity of private debt is much higher than those of both aggregate and public debt – it explains about 30% of the variation in the maturity of private debt.

### 3.2. Robustness check

In this section, we check the robustness of our empirical results: First, we utilize an alternative measure for the maturity composition, second, apply a two-stage regression approach to account for possible endogeneity, and finally we split the sample into emerging markets and other developing economies .

World Bank International Debt Statistics provide data of the weighted average maturity (in years) on new external debt commitments for aggregate, public, and private external debt. Weights are given by the amounts of the loans. For example, Argentina had a weighted average external debt maturity of about 10.4 years in 1986 and it extended this maturity to 24.8 in 2012. We use this average maturity as alternative dependent variable to check whether international reserves have an effect on the weighted maturity.

The effect of international reserves on the maturity composition is expected to evolve slowly over time because reserves cannot change the maturity of outstanding debt, but only affect the chosen maturity of new credit contracts. This variable has the virtue that it focuses on this latter measure because it provides the maturity of credit contracts that are newly contracted in a given year.

As shown in Table 4, international reserves lengthen the weighted maturity of aggregate and public debt. Their effect on private debt maturity, however, is insignificant. Interestingly, two of three major financial crises seem to shorten the weighted maturity. High inflation is found to drive a country's debt maturity to more ST liabilities. Overall, the explanatory power is poor – the R-squared is as low as 2% for aggregate and public debt and 9% for the private debt regression.

Next, we adopt a two-stage approach to control for potential endogeneity. In previous sections we used predetermined variables lagged by one period to deal with endogeneity; however, if variables are persistent over time, this approach is unable to remove endogeneity concerns. For this reason, we use a two-stage method: In the first step, we regress international reserves on their opportunity cost, measured as the log differential between the bank lending interest rate in developing countries and the U.S. one-year T-bill yield. In the second step, we run our maturity regression but replace the value of international reserves by

their fitted values from the first-step regression. As reported in Table 5, international reserves are found to significantly increase, with similar coefficient values, the maturity of all three types of external debt. We can replicate the results of previous sections with a few exceptions in the private debt regression. Compared to Table 3, trade openness and capital controls become insignificant, while law and order turns significant. The inflation rate remains negative and significant.

Finally, we split the data into two samples – emerging markets and other developing economies, to study the robustness of our result in different country samples. As a prior, we expect that emerging markets have better developed financial markets that allow risk-sensitive private borrowers to better interact with foreign investors than in other developing countries. Hence, according to our theory, we expect for emerging markets that the effect of international reserves in reducing the risk premium of LT debt more than that of ST debt is especially relevant for private debt. Indeed, as shown in Table 6, we find that international reserves extend the maturity of private debt, whereas reserves insert an insignificant effect on aggregate and public debt in emerging markets. As for the sample of other developing countries, we confirm once again that international reserves are positively associated with a longer maturity of external debt. This effect holds for all three categories of external debt: aggregate, private and public debt. Moreover, the magnitude of the effects is much stronger in developing countries compared to emerging markets.

In sum, using an alternative measure for the maturity composition, an instrumental regression approach, and different country samples, we are able to validate the robustness of our empirical results; and once again confirm our theoretical postulation.

### 3.3. The interactions between the maturity composition of public and private debt

Thus far, our empirical exercises assume that public and private debt evolve independently to each other. However, the debt literature suggests that there are two possible interactions between public and private debt. The first one is the "crowding out" effect of public debt with respect to private debt, which is usually found in the context of advanced economies. The theoretical conjecture is that increasing public debt drives up the interest rate and negatively affects the borrowing abilities of firms and households. At the same time, Ricardian equivalence suggests that households restrict their demand for debt as public debt increases. The empirical evidence, however, is ambiguous (Aschauer, 1989; Evens, 1985, 1987). In the developing world, the prevailing view is that public debt can be a substitute for private debt in that borrowers in emerging and developing economies are usually subject to

borrowing limits due to credit rationing. Governments, which are less credit constrained, can relax private borrowing limits by issuing public debt (Caballero and Krishnamurthy, 2006; Kocherlakota, 2007, 2009; Holmstrom and Tirole, 1998, and Woodford, 1990). Moreover, the development of the sovereign bond market may serve as a catalyst for the development of the corporate bond market (Dittmar and Yuan, 2008).

Against these theoretical backdrops, we augment our empirical exercise by considering potential interactions between public and private debt. Panel data vector autoregressions (VAR) provide a straightforward way to control for these interactions. However, the normal VAR estimator for panel data with lagged dependent variables as explanatory variables may be biased and inconsistent (Anderson and Hsiao, 1981). To address this issue, we turn to the System Generalized Method of Moments (GMM) estimator by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). Additionally, system GMM panel data VAR offers supplementary benefits, e.g. accounting for autocorrelation and cross-sectional heterogeneity.

The dynamic panel data VAR is specified as a three-equation system with international reserves and the maturities of public and private debt as endogenous variables. As exogenous variables we include the set of controls from the previous sections. All exogenous variables are lagged by one-period. The number of dynamic lags for each endogenous variable is determined on the basis of the Bayesian Information Criterion (BIC).

We report the panel data VAR results in Table 7. For simplicity, we skip reporting the results for exogenous variables. Column *IR* reports how international reserves are explained by their own history and by the maturity compositions of public and private debt. The maturities of public and private debt do not affect international reserves. That is, central banks' reserve policies do not actively react to changes in the maturity composition of debt. The variation in reserves is almost exclusively explained by its own history. Indeed, as shown by the variance decomposition in Table 8, about 99% of IR variation is explained by itself.

The results in Columns *Pub* and *Priv* confirm the hypothesis that international reserves shift the maturity compositions of both public and private debt towards LT debt. Private debt is more sensitive to international reserves than public debt. The dynamic processes are different: Whereas international reserves have an immediate effect on the maturity composition of private debt, the effect on public debt materializes with a lag of one year. Compared to the results in Tables 2 and 3, we find that the magnitude of international reserves' effects is substantially smaller (0.07 versus 0.12; 0.08 versus 0.23) when the interaction between public and private debt is taken into account.

With respect to the question whether public LT debt crowds-out private LT debt or substitutes it, our results seem to be in line with the substitution theory. First, as shown in Figure 3, both public and private LT debt of emerging and developing economies have substantially increased during the last three decades. But private LT debt has increased much faster than public one. Apparently, public debt has not been "crowding out" private debt in emerging and developing economies. Moreover, according to our results shown in Table 7, the maturity of private debt negatively affects the maturity of public debt, but this effect is absent in the opposite direction. A plausible interpretation is that, with decades of stable economic growth and deepening bond markets in emerging and developing economies, private LT debt is less credit constrained, which makes public debt substitution less necessary.

In addition to the regression results, we also report impulse responses (Figure 6) to isolate the effect of international reserves. They reveal information of how shocks in one endogenous variable affect the other endogenous variables and how this effect evolves dynamically. Figure 6 shows that both the maturity of public and private debt respond positively to an innovation in international reserves; both responses start slowly and reach their peak after a few years and then gradually decay. There is a slightly different dynamic pattern in each response. The response of public debt is virtually muted in the first year, but gradually reaches its peak (0.072) in year 4 and then gradually dies out over time. The maturity of private debt, however, responds more smoothly than public debt; it reaches the peak (0.089) in year 4 before it gradually fades out.

Table 8 reports the variance decomposition, which measures the percentage of variation of each endogenous variable that is explained by other endogenous variables. While international reserves are shown to be positively related to the maturity composition of both public and private debt, reserves are only one of many factors that determine debt maturity. In fact, international reserves explain 5% and 7% of the variation of the maturities of private and public debt, respectively. The major part of the variations is explained by their own history, namely the lagged dependent variables. This shows that the maturity composition of external debt is relatively persistent over time.

In sum, using robust dynamic panel data VAR, we validate the robustness of our hypothesis that international reserves lengthen the maturity of external debt in emerging economies. Further, this approach reveals how this effect evolves over time. While international reserves affect the maturity of debt, the analysis shows that there are many other factors that determine the debt maturity, especially its own history.

### 3.4. The reinforcement effect for financial stability

In this section, we study the empirical evidence of how international reserves and the structure of LT debt reinforce financial stability. In doing so, we setup a regression specification with a measure of financial stability being the dependent variable and explanatory variables including international reserves (IR), the debt maturity structure (LT/ST), and their interaction term (IR*LT/ST) that proxies for the reinforcement effect.

Financial stability is an enormously broad concept that could include all aspects of a country, e.g. the real economy, financial system, political and institutional quality, and interactions between the real and financial economy, as well as interactions between countries. This makes it tremendously difficult to numerically measure financial stability with a single aggregate index. To rein this issue, many papers including financial stability reports (FSRs) from the IMF and numerous central banks usually dissect it and focus on six main sectors - the real sector, corporate sector, household sector, external sector, financial sector, and financial market - of an economy to assess systemic vulnerability and financial stability[12]. Since the subject that we are studying is primary related to the external sector, we focus on the vulnerability of this sector to assess financial stability. The financial risk index (FRI) extracted from ICRG is used to measure external vulnerability. FRI is compiled from the risk components of foreign debt as a percentage of GDP, foreign debt service as a percentage of exports of goods and services (XGS), current account as a percentage of XGS, net liquidity as months of import cover, and exchange rate stability.

To carefully identify the reinforcement effect and to check the robustness of our results, we run a set of fixed effect panel data regressions displayed in Table 9. Regression (1) is a bare-bone specification that contains international reserves, the maturity structure of external debt, and their interaction term[13]. Regressions (2) and (3) are designed to capture how international reserves and the maturity structure of external debt individually affect financial stability while controlling for other relevant factors. Those factors include conditions of the economy (GDP growth rate, domestic financial development, and inflation rate), political and institutional factors (government changes, bureaucracy qualities, and law and order), financial openness (Chinn-Ito Index), and potential contagion from major financial crises (dummies for 1994 Mexico crisis, 1997 Asia crisis, and 2008 global financial crisis). Regression (4) contains the full set of variables used in the previous three regressions.

[12] See IMF (2006) and a comprehensive survey paper (Gadanecz and Jayaram, 2009)
[13] A time trend and a constant are also included in the regression.

The bare-bone specification (column 1) shows that both international reserves and a higher share of LT debt in total external debt buttress financial stability. The positive and significant estimate for the interaction term, IR*LT/ST, indicates the presence of a strong reinforcement effect to financial stability. Individually, as reported in columns (2) and (3), international reserves are found to strengthen financial stability, whereas more LT debt is not significant after controlling for other factors. Most of those control factors are significant and the results are intuitive. For example, high economic growth and better political and institutional qualities are positively associated with financial stability, whereas financial crises deteriorate financial stability. By including all those variables in regression (4), we confirm the strengthening role of international reserves and the reinforcement effect to financial stability, although the significance is slightly lower than in column (1) and the maturity structure (LT/ST) is insignificant. This specification explains 58% of the variation in the financial stability index.

In Tables 10 and 11 we perform the same exercise on public and private debt, respectively. The evidence that both international reserves and a maturity structure tilted towards LT debt individually strengthen financial stability is confirmed for public debt in Table 10. The reinforcement effect is also present. The results for private debt, however, depart from our expectation. Although we find that international reserves buttress financial stability, more LT relative to ST debt seems to weaken financial stability and the reinforcement factor, IR*LTprv, appears to be working against financial stability (column 1 of Table 11). Nevertheless, this negative reinforcement effect becomes insignificant after controlling for the effect of other relevant factors of financial stability (column 4). More LT private debt relative to ST one does not significantly threaten financial stability by itself (column 3); but it becomes significant when being combined with international reserves in column 4. We attribute this counterintuitive result to the thin private debt market in emerging and developing economies before 2005. As shown in Figure 3, the market for LT private debt is three times smaller than the public debt market before 2005. The tiny LT private debt market perhaps is the implicit consequence of foreign investors' response to financial stability risk in emerging and developing economies. This might lead to the negative association between LT private debt and financial stability in column (4). The private LT debt market has soared since 2005 and it grew almost as large as the market for public LT debt in 2012. Against this backdrop, we study the private debt again by splitting data in two time periods, 1984-2004 and 2005-2012. Columns (5) and (6) report the contrasting results. We obtain the similar counter-intuitive results within the 1984-2004 sample. However, with

the deepened private LT debt market in emerging and developing economies after 2005, we confirm the reinforcement effect of international reserves and LT private debt to financial stability (column 6). The coefficient of the reinforcement factor equals 0.02, three times higher than that for public debt.

## 4. Discussion

Our theoretical and empirical analyses suggest that international reserves affect the maturity composition of a country's external debt: Higher reserves increase the ratio of LT to ST external debt for both private and public debt. Given that countries' vulnerability to financial crises decreases as they rely more on LT debt, reserves help countries to preserve financial stability. We call this the reinforcement effect of reserves for financial stability. This section elaborates on these issues.

The literature distinguishes two main motives for reserve holdings: a mercantilist and a precautionary one. According to the mercantilist approach, reserve accumulation may be part of an export-led growth strategy because it depreciates the exchange rate and makes export prices more competitive. The precautionary motive emphasizes reserves' role in defending the exchange rate and in coping with external shocks.

There is ample evidence that reserves provide precautionary services, both empirical studies and theoretical models coincide in the finding that reserves reduce the probability and severity of financial crises. In the presence of productivity shocks reserves allow to smooth consumption intertemporally (Aizenman and Marion, 2004) and mitigate the output effects of liquidity shocks (Aizenman and Lee, 2007). Mourmouras and Russell (2009) find that the effect of negative shocks on worker welfare might be attenuated by international reserves. Li and Rajan (2009) show in a theoretical model that high reserves may prevent speculative attacks on the currency by compensating for the negative effect of weak fundamentals.

On the empirical side, the literature on early warning indicators for currency crises generally includes reserves – scaled by GDP, M2 or ST external debt – as an important indicator. Frankel and Saravelos (2012) summarize more than 80 papers of this literature in a meta-analysis and identify low reserves as the most reliable warning indicator. This also holds for the crisis of 2008-10. De Gregorio and Lee (2004) and Aizenman et al. (2011) show that reserves reduce the output costs of crises. For the crisis of 2008-10, Obstfeld et al. (2009) and Fratzscher (2009) note that countries with low reserves are associated with larger depreciations.

In addition to this direct effect on financial stability, our analysis points to an indirect effect of reserves, which has not been considered by the literature so far: By increasing the average maturity of external debt, reserves make countries more resilient to volatile capital flows and help to maintain domestic financial stability.

On theoretical grounds, ST debt makes borrowers more vulnerable to the risk that creditors do not roll-over their loans. This may lead to the costly liquidation of projects and the default of the debtor (as described in the theoretical model and the papers cited in section 2). In the case that debtors default because creditors have refused to roll-over maturing debt, creditor runs become self-fulfilling.

The same literature on early warning indicators finds that countries are more vulnerable to crises if their level of external ST debt is high (see Frankel and Saravelos, 2012, and IMF, 2000, for general treatments). Rodrik and Velasco (2000) conclude that "countries with short-term liabilities to foreign banks that exceed reserves are three times more likely to experience a sudden and massive reversal in capital flows" and that "greater short-term exposure is associated with more severe crises when capital flows reverse". Indicators of vulnerability include ST debt as a share of total external debt (positively associated with crisis incidence) and international reserves as a share of ST external debt (negatively associated with crisis incidence). The latter reveals the double dividend of reserves: First, high reserves directly raise the indicator value by increasing its numerator. Second, for a given amount of external debt, they lower the denominator by shifting external obligations from short to long-term maturities. Hence, reserve hoardings provide a reinforcement effect for financial stability.

Since the early warning indicators literature does not allow for causal conclusions, the dependence on ST debt might be a symptom rather than the cause of a crisis (see Benmelech and Dvir, 2013; Detragiache and Spilimbergo, 2004; Diamond and Rajan, 2001): Vulnerability itself may force countries to borrow at short maturities. The direction of causality, however, does not question our conclusions: Even if ST debt rises in anticipation of a crisis, reserves help to rely more on LT debt, which, in turn, reduces the rollover risk and the amount of capital flight.

Finally, reserves also affect the access to external credit. Credit ratings improve in the level of reserves and sovereign risk premia fall (see Levy-Yeyati, 2008 ). Sovereign risk, in turn, is a crucial determinant of private sector access to external capital. Lower sovereign bond spreads are found to increase the volume of corporate debt and equity issued (Das et al., 2009). External credit to the private sector is significantly lower during periods of sovereign

debt restructuring (Arteta and Hale, 2008). The same holds true after large depreciations where external credit to the private sectors drops substantially, mainly due to a decline in supply (Hale and Arteta, 2009). Hence, through their positive influence on external financial resources, reserves contribute in an additional way to financial stability.

## 5 Concluding remarks

This paper examines the effect of central banks' international reserves on the maturity structure of countries' external debt. Our theoretical model shows that higher reserves may reduce the costs of both ST and LT external debt by lowering the riskiness of the debt contract: Reserves are a form of insurance that lowers the incidence of default and reduces the risk for creditors. Our theory suggests that these effects are stronger for LT debt reducing the cost of LT debt more than that of ST debt, which results in a flattened yield curve. This makes LT loans relatively more attractive and may induce a re-structuring of foreign debt to longer maturities.

Our empirical analysis for a sample of 66 emerging and developing countries confirms the hypothesis that international reserves positively affect the share of LT external debt. This effect holds for both private and public external debt, but it is stronger for private debt. When investigating the maturity of new loan contracts only, the positive effect of reserves is restricted to public debt and lengthens its average maturity. Finally, after controlling for endogeneity in a dynamic panel data VAR framework, we confirm the positive effect of reserves on the share of LT debt, both public and private one. These findings reveal a collateral benefit of reserves: While reserves are accumulated as insurance and/or buffer stocks against financial crises, they also attract those types of foreign debt that reduce the vulnerability to sudden stops and capital outflows. To some extent, the endogenous response of capital flows makes the country more resilient to capital account crises. Given that the ratio of ST external debt to reserves is considered a major indicator for financial crises (Frankel and Saravelos, 2012), reserves reduce the crisis probability and enhance financial stability via two complementing channels: First, reserves directly improve this indicator. Second, by reducing the share of ST debt, reserves affect the maturity structure of external debt in a way favourable for financial stability. Reserves seem to provide a reinforcement effect promoting financial stability that rarely has been discussed in the international finance literature.

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Figure 1: Long-term and short-term external debt in emerging and developing economies

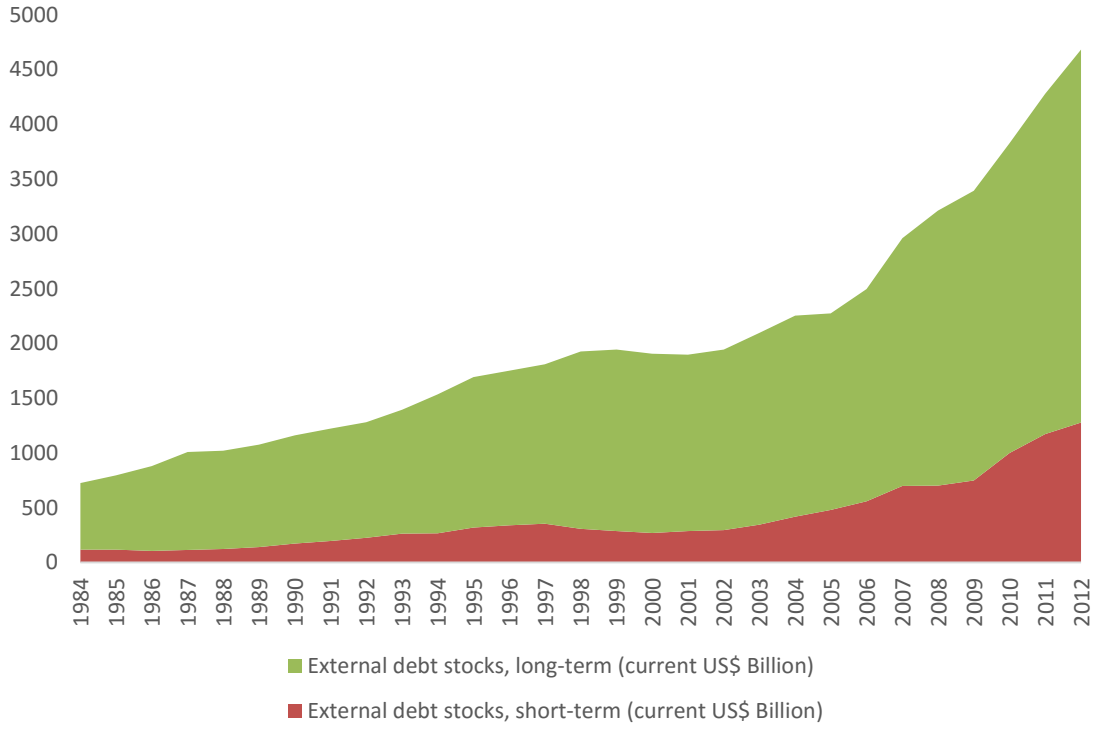



Figure 2: International reserves and external debt in emerging and developing economies

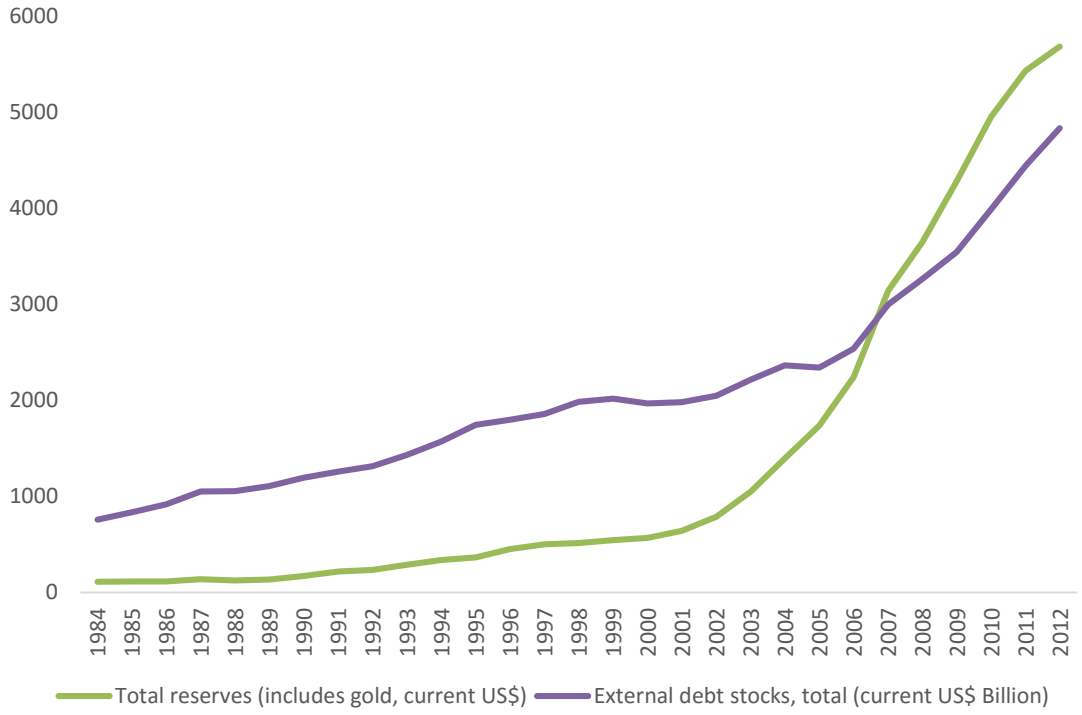


Figure 3: Public and private long-term external debt in emerging and developing economies

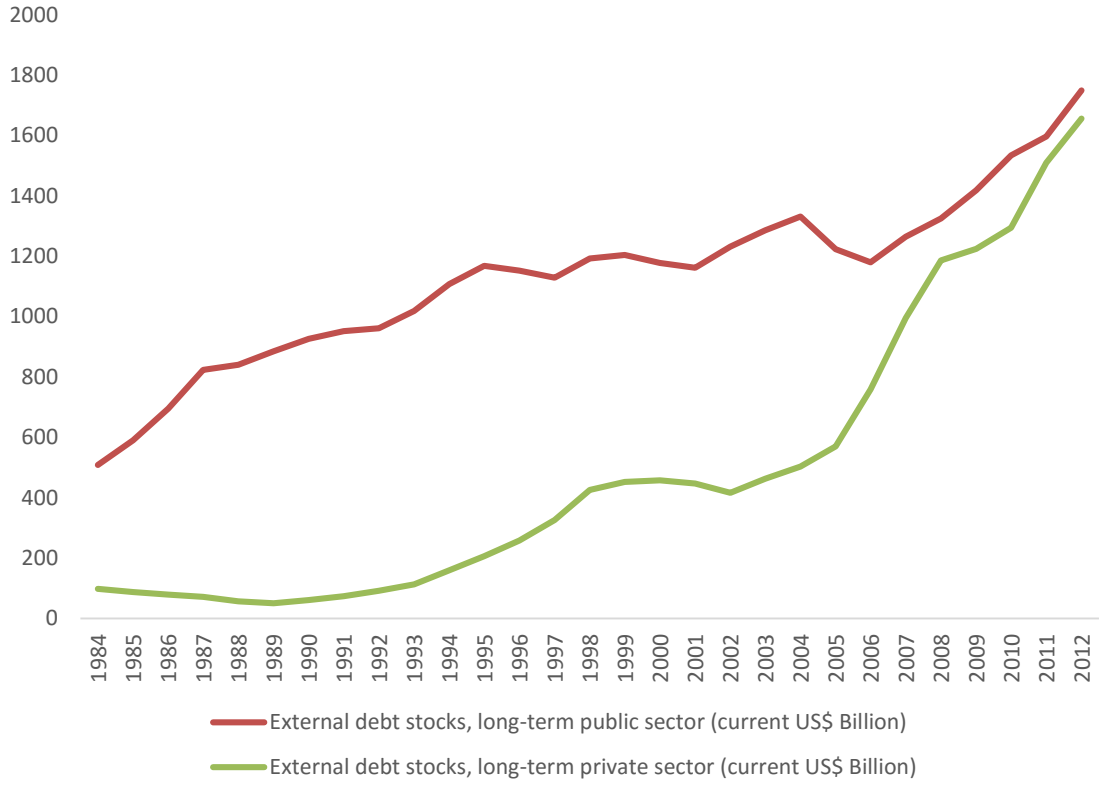
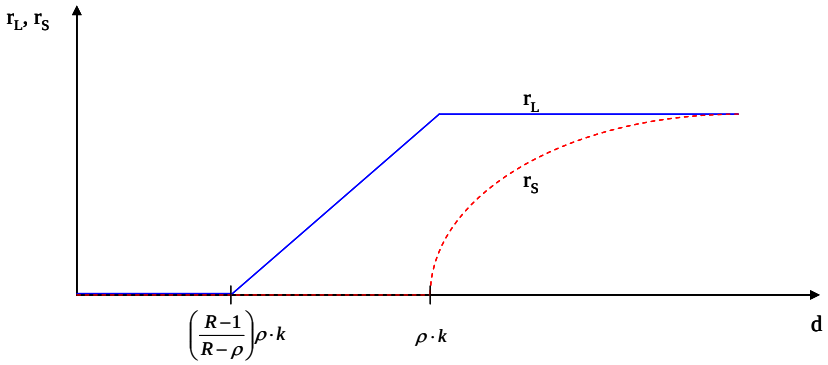
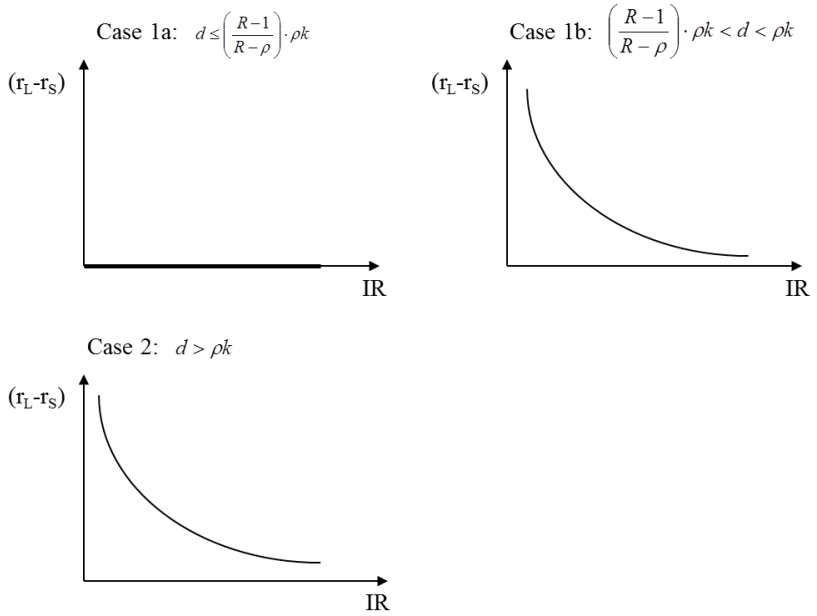



Figure 4: Terms structure of interest rates as a function of the level of ST debt



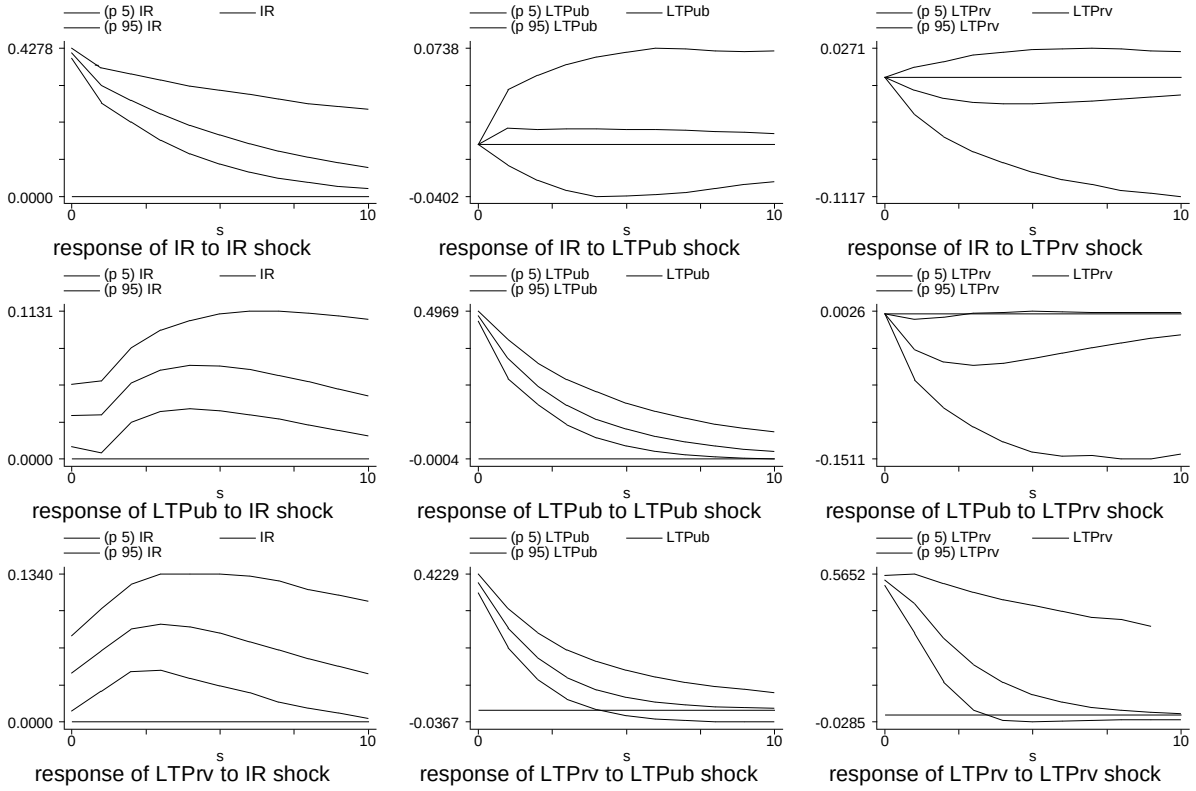

Note: $r_L$ ($r_S$) is the LT (ST) interest rate. The variable *IR* stands for international reserves, $d$ ($k$) for the amount of ST (total) debt, $R$ for the return of the investment project over two periods and $\rho$ is the recovery ratio after early liquidation in period 1.

Figure 5: Relationship between reserves and the term structure of interest rates




Note: $r_L$ ($r_S$) is the LT (ST) interest rate. The variable *IR* stands for international reserves, $d$ ($k$) for the amount of ST (LT) debt, $R$ for the return of the investment project over two periods and $\rho$ is the recovery ratio after earl liquidation in period 1.

Figure 6: Impulse response of international reserves and the maturity compositions of private and public debt to 1 Cholesky S.D. shock



## Appendix I: Country Samples

*Emerging Markets (MSCI classification)*

Brazil, Chile, China, Colombia, Indonesia, India, Morocco, Mexico, Malaysia, Peru, Philippines, Romania, Thailand, Turkey, South Africa

*Other developing countries*

Angola, Albania, Argentina, Burkina Faso, Bangladesh, Bulgaria, Bolivia, Botswana, Cameroon, Costa Rica, Algeria, Ecuador, Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Guatemala, Guyana, Honduras, Haiti, Jordan, Kenya, Lebanon, Liberia, Sri Lanka, Madagascar, Mali, Mongolia, Mozambique, Malawi, Niger, Nigeria, Nicaragua, Pakistan, Panama, Papua New Guinea, Paraguay, Sudan, Senegal, Sierra Leone, El Salvador, Togo, Tunisia, Tanzania, Uganda, Uruguay, Vietnam, Zambia, Zimbabwe

## Appendix II: Variable definitions

| | |
|---|---|
| *debts*: | External debt stocks, total (DOD, current US$). Data source: The World Bank International Debt Statistics. |
| *ST*: | External debt stocks, short-term (DOD, current US$). Data source: The World Bank International Debt Statistics. |
| *LT*: | External debt stocks, long-term (DOD, current US$). Data source: The World Bank International Debt Statistics. |
| *LTpub*: | External debt stocks, long-term (public). Data source: The World Bank International Debt Statistics. |
| *LTprv*: | External debt stocks, long-term (private). Data source: The World Bank International Debt Statistics. |
| *Maturity*: | The weighted average maturity (years) on new external debt commitments. Data source: The World Bank World Development Indicators (WDI). |
| *IR*: | Total reserves minus gold (current US$) over GDP in current US dollar. Data source: The World Bank World Development Indicators (WDI). |
| *GDPpc*: | GDP per capita (constant 2000 US$). Data source: The World Bank World Development Indicators (WDI). |
| *GDPG*: | Annual percentage growth rate of GDP at market prices based on constant local currency. Data source: The World Bank World Development Indicators (WDI). |

*FinDev*: Financial development, measured by Money and quasi money (M2) as % of GDP. Data source: The World Bank World Development Indicators (WDI).

*Imports*: Imports of goods and services (% of GDP). Data source: The World Bank World Development Indicators (WDI).

*Inflation*: Inflation rate measured by annual percentage changes in consumer price index. Data source: IMF IFS.

*GovChng*: the dummy for the government or regime change in a country. Variable is defined according to de Haan and Jong-A-Pin (2007). Dummy takes on the value one in the five years following a regime change. A regime change is defined as a three-unit change in the Polity score of the Polity IV dataset.

*Bureau*: the measurement of bureaucracy quality (ICRG), 4 points in total. High points are given to countries where the bureaucracy has the strength and expertise to govern without drastic changes in policy or interruptions in government services.

*Laworder*: the measurement of law and order (ICRG), 6 points in total. High points means strong law and order.

*Control*: the Chinn-Ito index for capital control measurement. A higher value means more open in capital account, in other words, less capital controls.

*World*: the global factor that affect the debt composition, measured by the rate change of US one-year Treasury Bill.

*FRI*: Financial risk Index (ICRG) that measures the external vulnerability of a country. Risk points are assessed for each of the component factors of foreign debt as a percentage of GDP, foreign debt service as a percentage of exports of goods and services (XGS), current account as a percentage of XGS, net liquidity as months of import cover, and exchange rate stability. Risk ratings range from a high of 50 (least risk) to a low of 0 (highest risk).

*MEX94*: the Mexican crisis in 1994 dummy variable, I(t>=1994 and t<1997) = 1.

*AFC97*: the Asian financial crisis in 1997 dummy variable, I(t>=1997 and t<2008) = 1.

*GFC08*: the global financial crisis in 2008 dummy variable, I(t>2008) = 1.

*Trend*: a time trend variable.

**Table 1: Determinants of the ratio of LT to ST external debt**

Method: Fixed effect panel data estimation

| | (1) | (2) |
|---|---|---|
| IR(-1) | 0.135*** | 0.134*** |
| | (0.03) | (0.03) |
| GDPpc(-1) | -1.333*** | -1.246*** |
| | (0.14) | (0.14) |
| FinDev(-1) | -0.054 | -0.037 |
| | (0.08) | (0.08) |
| Imports(-1) | -0.424*** | -0.415*** |
| | (0.10) | (0.10) |
| GovChng(-1) | -0.065 | -0.021 |
| | (0.06) | (0.06) |
| Bureau(-1) | 0.145*** | 0.143*** |
| | (0.04) | (0.04) |
| LawOrder(-1) | 0.013 | -0.004 |
| | (0.03) | (0.03) |
| Control(-1) | -0.083*** | -0.090*** |
| | (0.02) | (0.02) |
| World(-1) | -0.130*** | -0.201*** |
| | (0.05) | (0.06) |
| MEX94 | | 0.182** |
| | | (0.08) |
| AFC97 | | 0.356*** |
| | | (0.10) |
| GFC08 | | 0.256 |
| | | (0.16) |
| Trend | 0.016*** | -0.002 |
| | (0.01) | (0.01) |
| Constant | 12.911*** | 12.397*** |
| | (0.94) | (0.97) |
| R-Squared | 0.10 | 0.12 |
| # of observations | 1532 | 1532 |
| # of groups | 66 | 66 |

*Fixed effect panel data regression. Dependent variable is LT debt/ST debt.

**Table 2: Determinants of the share of LT public debt**

Method: Fixed effect panel data estimation

| | (1) | (2) |
|---|---|---|
| IR(-1) | 0.123*** | 0.123*** |
| | (0.03) | (0.03) |
| GDPpc(-1) | -1.672*** | -1.556*** |
| | (0.15) | (0.15) |
| FinDev(-1) | -0.061 | -0.033 |
| | (0.09) | (0.09) |
| Imports(-1) | -0.484*** | -0.482*** |
| | (0.11) | (0.11) |
| GovChng(-1) | -0.086 | -0.030 |
| | (0.06) | (0.06) |
| Bureau(-1) | 0.124*** | 0.123*** |
| | (0.04) | (0.04) |
| LawOrder(-1) | 0.046 | 0.026 |
| | (0.03) | (0.03) |
| Control(-1) | -0.137*** | -0.145*** |
| | (0.03) | (0.03) |
| World(-1) | -0.136*** | -0.240*** |
| | (0.05) | (0.06) |
| MEX94 | | 0.200** |
| | | (0.08) |
| AFC97 | | 0.368*** |
| | | (0.10) |
| GFC08 | | 0.178 |
| | | (0.17) |
| Trend | 0.013*** | -0.004 |
| | (0.01) | (0.01) |
| Constant | 15.285*** | 14.536*** |
| | (0.97) | (0.99) |
| R-Squares | 0.16 | 0.18 |
| # of Observations | 1480 | 1480 |
| # of Groups | 64 | 64 |

* Fixed effect panel data regression. Dependent variable is LT private debt/total ST debt.

**Table 3: Determinants of the share of LT <u>private</u> debt**

Method: Fixed effect panel data estimation

| | (1) | (2) |
|---|---|---|
| IR(-1) | 0.235*** | 0.239*** |
| | (0.06) | (0.06) |
| GDPpc(-1) | 0.461 | 0.299 |
| | (0.30) | (0.31) |
| FinDev(-1) | 0.220 | 0.224 |
| | (0.16) | (0.16) |
| Imports(-1) | -0.506** | -0.460** |
| | (0.22) | (0.22) |
| GovChng(-1) | -0.328*** | -0.375*** |
| | (0.12) | (0.12) |
| Bureau(-1) | 0.197*** | 0.219*** |
| | (0.07) | (0.07) |
| LawOrder(-1) | 0.018 | 0.059 |
| | (0.05) | (0.05) |
| Control(-1) | 0.137*** | 0.146*** |
| | (0.05) | (0.05) |
| World(-1) | -0.095 | 0.077 |
| | (0.09) | (0.10) |
| Inflation(-1) | -0.122*** | -0.093** |
| | (0.04) | (0.04) |
| MEX94 | | -0.197 |
| | | (0.14) |
| AFC97 | | 0.568*** |
| | | (0.18) |
| GFC08 | | 1.078*** |
| | | (0.29) |
| Trend | 0.047*** | 0.001 |
| | (0.01) | (0.02) |
| Constant | -3.422 | -2.058 |
| | (2.09) | (2.15) |
| R-Squares | 0.28 | 0.30 |
| # of Observations | 876 | 876 |
| # of Groups | 48 | 48 |

*Fixed effect panel data regression. Dependent variable is LT private debt/total ST debt

**Table 4: Determinants of the weighted maturity of private and public debt**

Method: Fixed effect panel data estimation

| | AllMatu | PubMatu | PrivMatu |
|---|---|---|---|
| IR(-1) | 0.040*** | 0.045*** | -0.015 |
| | (0.01) | (0.01) | (0.03) |
| GDPpc(-1) | -0.084 | -0.158*** | 0.032 |
| | (0.06) | (0.06) | (0.12) |
| FinDev(-1) | -0.081** | 0.013 | -0.017 |
| | (0.04) | (0.03) | (0.08) |
| Imports(-1) | 0.026 | -0.001 | 0.045 |
| | (0.05) | (0.04) | (0.09) |
| GovChng(-1) | -0.032 | -0.018 | 0.046 |
| | (0.03) | (0.02) | (0.05) |
| Bureau(-1) | 0.009 | 0.014 | 0.081*** |
| | (0.02) | (0.02) | (0.03) |
| LawOrder(-1) | 0.005 | 0.010 | -0.012 |
| | (0.01) | (0.01) | (0.02) |
| Control(-1) | 0.026** | 0.013 | 0.052** |
| | (0.01) | (0.01) | (0.02) |
| World(-1) | -0.012 | -0.017 | 0.013 |
| | (0.03) | (0.02) | (0.05) |
| Inflation(-1) | | | -0.078*** |
| | | | (0.02) |
| MEX94 | -0.073** | -0.033 | -0.104 |
| | (0.04) | (0.03) | (0.07) |
| AFC97 | -0.091** | -0.037 | -0.047 |
| | (0.04) | (0.04) | (0.08) |
| GFC08 | -0.109 | -0.019 | -0.074 |
| | (0.07) | (0.07) | (0.13) |
| Trend | 0.004 | -0.002 | 0.006 |
| | (0.00) | (0.00) | (0.01) |
| Constant | 3.896*** | 4.373*** | 1.881** |
| | (0.42) | (0.38) | (0.83) |
| R-Squares | 0.02 | 0.02 | 0.09 |
| # of Obs. | 1519 | 1488 | 877 |
| # of Groups | 65 | 65 | 55 |

*Fixed effect panel data regression. The dependent variable is the log of weighted average maturity (years) of total external debt, private external debt, and public guaranteed external debt, respectively.

**Table 5: Determinants of external debt maturities: Two-stage regression**

| | All | Pub | Priv |
|---|---|---|---|
| IR(-1) | 0.200*** | 0.190*** | 0.198** |
| | (0.05) | (0.06) | (0.09) |
| GDPpc(-1) | -1.309*** | -1.605*** | 0.323 |
| | (0.16) | (0.17) | (0.31) |
| FinDev(-1) | -0.038 | -0.021 | 0.284 |
| | (0.10) | (0.11) | (0.19) |
| Imports(-1) | -0.539*** | -0.637*** | -0.148 |
| | (0.13) | (0.13) | (0.26) |
| GovChng(-1) | 0.010 | -0.004 | -0.340*** |
| | (0.07) | (0.08) | (0.13) |
| Bureau(-1) | 0.182*** | 0.152*** | 0.264*** |
| | (0.04) | (0.05) | (0.07) |
| LawOrder(-1) | 0.036 | 0.064* | 0.110** |
| | (0.03) | (0.04) | (0.05) |
| Control(-1) | -0.092*** | -0.145*** | 0.076 |
| | (0.03) | (0.03) | (0.05) |
| World(-1) | -0.193*** | -0.235*** | 0.067 |
| | (0.07) | (0.07) | (0.10) |
| Inflation(-1) | | | -0.161*** |
| | | | (0.05) |
| MEX94 | 0.175* | 0.210** | -0.220 |
| | (0.09) | (0.10) | (0.15) |
| AFC97 | 0.327*** | 0.358*** | 0.592*** |
| | (0.12) | (0.12) | (0.19) |
| GFC08 | 0.113 | 0.015 | 1.038*** |
| | (0.19) | (0.20) | (0.30) |
| Trend | -0.001 | -0.004 | -0.018 |
| | (0.01) | (0.01) | (0.02) |
| Constant | 13.328*** | 15.455*** | -3.37 |
| | (1.16) | (1.20) | (2.26) |
| | | | |
| R-Squares | 0.14 | 0.21 | 0.30 |
| # of Obs. | 1193 | 1141 | 697 |
| # of Groups | 64 | 62 | 45 |

*Two-stage regression using the opportunity cost of reserves and the one-period lagged reserve variable to instrument international reserves. The dependent variables in column All, Pub, Priv-1, and Priv-2 are LT debt/ST debt, private external debt/ST debt, and public guaranteed external debt/ST debt, respectively.

**Table 6: Determinants of external debt maturities: Emerging v.s. other developing economies**

| | Emg | Emg-pub | Emg-prv | Oth | Oth-pub | Oth-prv |
|---|---|---|---|---|---|---|
| IR(-1) | 0.078 | 0.007 | 0.317*** | 0.141*** | 0.129*** | 0.224*** |
| | (0.06) | (0.08) | (0.08) | (0.03) | (0.03) | (0.08) |
| GDPpc(-1) | -1.254*** | -1.620*** | 0.425* | -1.310*** | -1.406*** | -0.497 |
| | (0.17) | (0.20) | (0.25) | (0.20) | (0.20) | (0.55) |
| FinDev(-1) | -0.349*** | -0.370** | -0.065 | 0.003 | 0.035 | 0.044 |
| | (0.13) | (0.15) | (0.16) | (0.10) | (0.10) | (0.22) |
| Imports(-1) | -0.259 | -0.460** | 0.314 | -0.475*** | -0.482*** | -1.206*** |
| | (0.17) | (0.19) | (0.20) | (0.12) | (0.12) | (0.33) |
| GovChng(-1) | -0.145 | -0.193* | -0.026 | 0.005 | 0.008 | -0.446** |
| | (0.09) | (0.11) | (0.11) | (0.07) | (0.07) | (0.17) |
| Bureau(-1) | 0.076* | 0.062 | 0.061 | 0.184*** | 0.140*** | 0.437*** |
| | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.12) |
| LawOrder(-1) | 0.013 | 0.020 | 0.170*** | 0.001 | 0.044 | 0.004 |
| | (0.03) | (0.04) | (0.04) | (0.04) | (0.04) | (0.08) |
| Control(-1) | 0.030 | -0.026 | 0.062 | -0.137*** | -0.190*** | 0.209*** |
| | (0.03) | (0.04) | (0.04) | (0.03) | (0.03) | (0.07) |
| World(-1) | -0.027 | -0.059 | -0.091 | -0.259*** | -0.305*** | 0.179 |
| | (0.07) | (0.08) | (0.09) | (0.07) | (0.08) | (0.15) |
| Inflation(-1) | | | -0.164*** | | | -0.021 |
| | | | (0.04) | | | (0.06) |
| MEX94 | 0.034 | 0.032 | 0.129 | 0.236** | 0.271*** | -0.454** |
| | (0.10) | (0.12) | (0.11) | (0.10) | (0.10) | (0.21) |
| AFC97 | 0.674*** | 0.559*** | 1.107*** | 0.292** | 0.338*** | 0.211 |
| | (0.13) | (0.15) | (0.15) | (0.13) | (0.13) | (0.27) |
| GFC08 | 0.690*** | 0.465** | 0.870*** | 0.155 | 0.076 | 1.331*** |
| | (0.20) | (0.24) | (0.24) | (0.21) | (0.21) | (0.43) |
| Trend | -0.010 | -0.001 | -0.035** | 0.002 | -0.002 | 0.030 |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.02) |
| Constant | 13.477*** | 16.340*** | -3.543* | 12.692*** | 13.098*** | 5.93 |
| | (1.29) | (1.51) | (1.89) | (1.37) | (1.38) | (3.91) |
| R-Squares | 0.33 | 0.45 | 0.70 | 0.11 | 0.15 | 0.26 |
| # of Obs. | 375 | 349 | 337 | 1157 | 1131 | 539 |
| # of Groups | 15 | 14 | 14 | 51 | 50 | 34 |

*Fixed effect panel data regression. Dependent variable is LT private debt/total ST debt. The results based on emerging economies sample are reported in column "Emg, Emg-pub, and Emg-prv". Column "Oth, Oth-pub, Oth-prv" report results for other developing countries.

**Table 7: GMM based dynamic panel data VAR**

| | IR | Pub | Priv |
|---|---|---|---|
| IR(-1) | 0.770*** | 0.028 | 0.079* |
| | (0.07) | (0.03) | (0.04) |
| Pub(-1) | 0.045 | 0.758*** | -0.152 |
| | (0.05) | (0.08) | (0.12) |
| Priv(-1) | -0.023 | -0.069** | 0.826*** |
| | (0.03) | (0.03) | (0.13) |
| IR(-2) | 0.077* | 0.066** | 0.031 |
| | (0.05) | (0.03) | (0.04) |
| Pub (-2) | -0.018 | 0.001 | 0.105 |
| | (0.02) | (0.06) | (0.09) |
| Priv(-2) | 0.003 | 0.017 | -0.123 |
| | (0.01) | (0.02) | (0.09) |

*The results of GMM based panel data VAR regression with exogenous variables. Endogenous variables are LT debt/ST debt, private external debt/ST debt, and public guaranteed external debt/ST debt, respectively. The lag structure of endogenous variable is determined by BIC.

**Table 8: Variance decomposition**

| | IR | Pub | Priv |
|---|---|---|---|
| IR | 0.99 | 0.00 | 0.01 |
| Pub | 0.07 | 0.90 | 0.03 |
| Priv | 0.05 | 0.27 | 0.68 |

*Note: This table reports variance decompositions – the percentage of variation in the row variable explained by the column variable.

**Table 9: The reinforcement effect of international reserves and the debt maturity structure to financial stability – aggregate debt**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| IR(-1) | 0.017* | 0.038*** | | 0.022* |
| | (0.01) | (0.01) | | (0.01) |
| LT/ST(-1) | 0.024** | | -0.001 | 0.011 |
| | (0.01) | | (0.01) | (0.01) |
| IR(-1)*LT/ST(-1) | 0.016*** | | | 0.008* |
| | (0.00) | | | (0.01) |
| GDPG(-1) | | 0.013** | 0.013** | 0.012** |
| | | (0.01) | (0.01) | (0.01) |
| FinDev(-1) | | 0.002 | 0.016 | 0.000 |
| | | (0.02) | (0.02) | (0.02) |
| Inflation(-1) | | 0.000 | -0.003 | 0.000 |
| | | (0.01) | (0.01) | (0.01) |
| GovChng(-1) | | -0.016 | -0.015 | -0.016 |
| | | (0.01) | (0.01) | (0.01) |
| Bureau(-1) | | 0.020** | 0.018** | 0.019** |
| | | (0.01) | (0.01) | (0.01) |
| LawOrder(-1) | | 0.040*** | 0.045*** | 0.039*** |
| | | (0.01) | (0.01) | (0.01) |
| Control(-1) | | 0.028*** | 0.027*** | 0.029*** |
| | | (0.01) | (0.01) | (0.01) |
| MexC94 | | 0.022 | 0.025 | 0.022 |
| | | (0.02) | (0.02) | (0.02) |
| AFC97 | | -0.076*** | -0.077*** | -0.076*** |
| | | (0.02) | (0.02) | (0.02) |
| GFC08 | | -0.111*** | -0.114*** | -0.111*** |
| | | (0.03) | (0.03) | (0.03) |
| Trend | 0.018*** | 0.022*** | 0.024*** | 0.022*** |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| Constant | 3.157*** | 2.999*** | 2.803*** | 2.990*** |
| | (0.04) | (0.07) | (0.07) | (0.08) |
| R-Squares | 0.49 | 0.58 | 0.56 | 0.58 |
| Obs. | 1459 | 1106 | 1106 | 1106 |
| Group | 65 | 64 | 64 | 64 |

*Fixed effect panel data regression. Dependent variable is the financial risk index (FRI).

**Table 10: The reinforcement effect of international reserves and the debt maturity structure to financial stability – public debt**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| IR(-1) | 0.012 | 0.038*** | | 0.023** |
| | (0.01) | (0.01) | | (0.01) |
| LTpub/ST(-1) | 0.035*** | | 0.010* | 0.021** |
| | (0.01) | | (0.01) | (0.01) |
| IR(-1)* LTpub/ST(-1) | 0.017*** | | | 0.007* |
| | (0.00) | | | (0.00) |
| GDPG(-1) | | 0.013** | 0.014** | 0.013** |
| | | (0.01) | (0.01) | (0.01) |
| FinDev(-1) | | 0.002 | 0.005 | -0.011 |
| | | (0.02) | (0.02) | (0.02) |
| Inflation(-1) | | 0.000 | -0.006 | -0.003 |
| | | (0.01) | (0.01) | (0.01) |
| GovChng(-1) | | -0.016 | -0.016 | -0.016 |
| | | (0.01) | (0.01) | (0.01) |
| Bureau(-1) | | 0.020** | 0.025*** | 0.025*** |
| | | (0.01) | (0.01) | (0.01) |
| LawOrder(-1) | | 0.040*** | 0.041*** | 0.034*** |
| | | (0.01) | (0.01) | (0.01) |
| Control(-1) | | 0.028*** | 0.028*** | 0.030*** |
| | | (0.01) | (0.01) | (0.01) |
| MexC94 | | 0.022 | 0.028* | 0.025 |
| | | (0.02) | (0.02) | (0.02) |
| AFC97 | | -0.076*** | -0.079*** | -0.077*** |
| | | (0.02) | (0.02) | (0.02) |
| GFC08 | | -0.111*** | -0.112*** | -0.109*** |
| | | (0.03) | (0.03) | (0.03) |
| Trend | 0.019*** | 0.022*** | 0.025*** | 0.023*** |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| Constant | 3.097*** | 2.999*** | 2.806*** | 2.995*** |
| | -0.035 | -0.073 | -0.068 | -0.078 |
| | | | | |
| R-Squares | 0.52 | 0.58 | 0.59 | 0.60 |
| Obs. | 1409 | 1106 | 1085 | 1085 |
| Group | 63 | 64 | 62 | 62 |

*Fixed effect panel data regression. Dependent variable is the financial risk index (FRI).

**Table 11: The reinforcement effect of international reserves and the debt maturity structure to financial stability – private debt**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| IR(-1) | 0.042*** | 0.038*** | | 0.047*** | 0.043*** | 0.049** |
| | (0.01) | (0.01) | | (0.01) | (0.01) | (0.02) |
| LTprv(-1) | -0.036*** | | -0.006 | -0.025** | -0.023 | 0.025 |
| | (0.01) | | (0.01) | (0.01) | (0.02) | (0.02) |
| IR(-1)*LTprv(-1) | -0.011** | | | -0.006 | -0.005 | 0.021** |
| | (0.01) | | | (0.01) | (0.01) | (0.01) |
| GDPG(-1) | | 0.013** | 0.007 | 0.007 | 0.009 | -0.002 |
| | | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| FinDev(-1) | | 0.002 | -0.061*** | -0.070*** | -0.078*** | 0.036 |
| | | (0.02) | (0.02) | (0.02) | (0.03) | (0.05) |
| Inflation(-1) | | 0.000 | 0.000 | 0.001 | 0.006 | -0.007 |
| | | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| GovChng(-1) | | -0.016 | -0.002 | -0.002 | -0.005 | 0.003 |
| | | (0.01) | (0.02) | (0.02) | (0.02) | (0.01) |
| Bureau(-1) | | 0.020** | 0.028*** | 0.034*** | 0.024** | 0.282*** |
| | | (0.01) | (0.01) | (0.01) | (0.01) | (0.08) |
| LawOrder(-1) | | 0.040*** | 0.041*** | 0.036*** | 0.034*** | 0.051*** |
| | | (0.01) | (0.01) | (0.01) | (0.01) | (0.02) |
| Control(-1) | | 0.028*** | 0.035*** | 0.038*** | 0.058*** | -0.029*** |
| | | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| MexC94 | | 0.022 | 0.036** | 0.027 | 0.008 | |
| | | (0.02) | (0.02) | (0.02) | (0.02) | |
| AFC97 | | -0.076*** | -0.083*** | -0.082*** | -0.103*** | |
| | | (0.02) | (0.02) | (0.02) | (0.03) | |
| GFC08 | | -0.111*** | -0.146*** | -0.139*** | | -0.020* |
| | | (0.03) | (0.03) | (0.03) | | (0.01) |
| Trend | 0.016*** | 0.022*** | 0.025*** | 0.021*** | 0.025*** | 0.012*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Constant | 3.273*** | 2.999*** | 3.085*** | 3.312*** | 3.301*** | 2.595*** |
| | -0.038 | -0.073 | -0.082 | -0.09 | (0.11) | (0.27) |
| R-Squares | 0.46 | 0.58 | 0.57 | 0.60 | 0.57 | 0.42 |
| Obs. | 896 | 1106 | 735 | 735 | 505 | 230 |
| Group | 48 | 64 | 47 | 47 | 42 | 41 |

*Fixed effect panel data regression. Dependent variable is the financial risk index (FRI). Column (5) reports results for a subsample covering 1984 to 2004 and column (6) covers the period 2005 to 2012.