MATURITY OF BANK LOANS IN EMERGING MARKETS

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ABSTRACT. We use a detailed data set on bank loans in EU member countries to estimate the effect of global factors on local credit condition, with breakdown by maturity and by counterpart sector (households, non-financial corporations (NFCs), government). We find that global factors, proxied by the VIX (Chicago Board Options Exchange Volatility Index), have a significant effect on domestic bank lending. The effects are different for emerging economies and developed economies: during times of high global uncertainty, bank lending to households and NFCs rise in developed economies, but contract for emerging markets. Short-term debt decreases faster than long-term debt, making emerging market maturities lengthen in bad times. This finding contrasts the standing result in the literature that emerging sovereigns borrow more in short-term debt during bad times.

1. INTRODUCTION

The world economy sees massive gross capital flows in the aftermath of the 2008 Financial Crisis, mostly due to the various conventional and unconventional monetary policies implemented by world's largest central banks. The spillover effects of such policies on credit condition and real consumption/investment in smaller emerging economies have been an active research area.

Our baseline regression shows significant and differential effects of global credit on emerging and developed economies. In particular, we find that during times of high global uncertainty, bank lending to households and NFCs rise in developed economies, but contract for emerging markets. Short-term debt contracts faster than long-term debt, making emerging market maturities lengthen in bad times. The opposite is true for good times: when the VIX is low, emerging market firms and households borrow more in short- and long-term debt, with short-term debt expanding more, shortening maturities.

(Broner et al., 2013) find that during crises, emerging sovereigns issue more short-term debts and effectively shorten maturities. Our paper finds just the opposite: emerging firms and households debt of all maturities lower, with short-term debt retiring faster than long-term debt, lengthening the aggregate maturity. In this paper, we will not be able to say definitively what causes this difference, but we offer a brief explanations.

It may be that the government is more averse to default and/or have better ability to borrow during hard times. In particular, if the cost of defaults of firms (losing collaterals, liquidating projects) is lower than that of the sovereign (losing access to international market, reputational issue, etc.), than government will be more inclined to borrow more debt even at very high cost to service old debt during bad times, while

the private sector is less inclined to do so. In such case, we will see sovereign debt tilts towards shorter maturities, while NFCs' debts tilt towards longer maturities, as short-term borrowers simply default on their debt without paying.

The result that during good times, emerging market borrows more in short-term debt is also of our interest. This stylized fact is portrayed in figure 1, with the (1-period lagged) VIX in black, and percentage change in outstanding stock of short-term debts of emerging markets (in blue) and developed markets (in red). The correlation is negative, suggesting low VIX periods accompany short-term debt expansion in European emerging markets. The change is less dramatic for long-term debt, as shown in figure 2. As a result, maturity will be driven by movements in short-term debt in emerging markets.

This pattern begs the question "why do emerging markets borrow short-term debt in good time?" Alternatively, one can ask, why *don't* emerging markets borrow more long-term debt in good time? While not having definitive evidence, we believe this puzzle can be explained by a combination of firm heterogeneity and the perception that global credit is very ephemeral.

This logic is made clear in section 4, in which we provide a three-period model of emerging market borrowing. Our explanation is that while global credit is abundant and cheap in good times, emerging market firms perceive interest rate will soon rise in the future, as global credit condition tightens (say, as the Fed raises its interest rate). Anticipating high interest rate in the future, a veil-like emerging market bank[1] charges higher annualized interest rate for long-term debt, so that on expectation, the bank would break even.

Facing the choice between borrowing expensive long-term debt and and inexpensive short-term debt but facing a risk of higher interest rate in the future, the only firms that find it profitable to borrow are those with low project values. These firms have the highest option value of not rolling over: they would borrow short-term debt and re-finance in the future. In the event of tightening global credit and higher interest rate, they would simply give up on the project, and liquidate to pay back the short-term debt. When project values are low, firms do not have much to lose, hence higher option value of not rolling over its debt. Note that in this environment, firms still pay back all of its short-term debt, making short-term lending to NFCs financed by cheap short-term wholesale credit risk-free for domestic banks.[2]

Our current model has an empirical prediction: periods of cheap global credit but not expected to last generate lending to low-value projects in emerging markets. In future version of the paper, we want to explore if the expanse of short-term debt in emerging markets during periods of easy global credit is concentrated in firms with lower net worth or growth opportunities.

[1] By 'veil-like', we mean banks here do not have special intermediary roles as explained in current literature (cf. Krishnamurthy and He (2014), Brunnermeier and Sannikov (2014)).

[2] The assumption that short-term lending is risk-free may appear unnatural. However, there are evidences that suggest emerging markets firms usually enlist collateral up to 80-100% of loan value to be able to borrow.

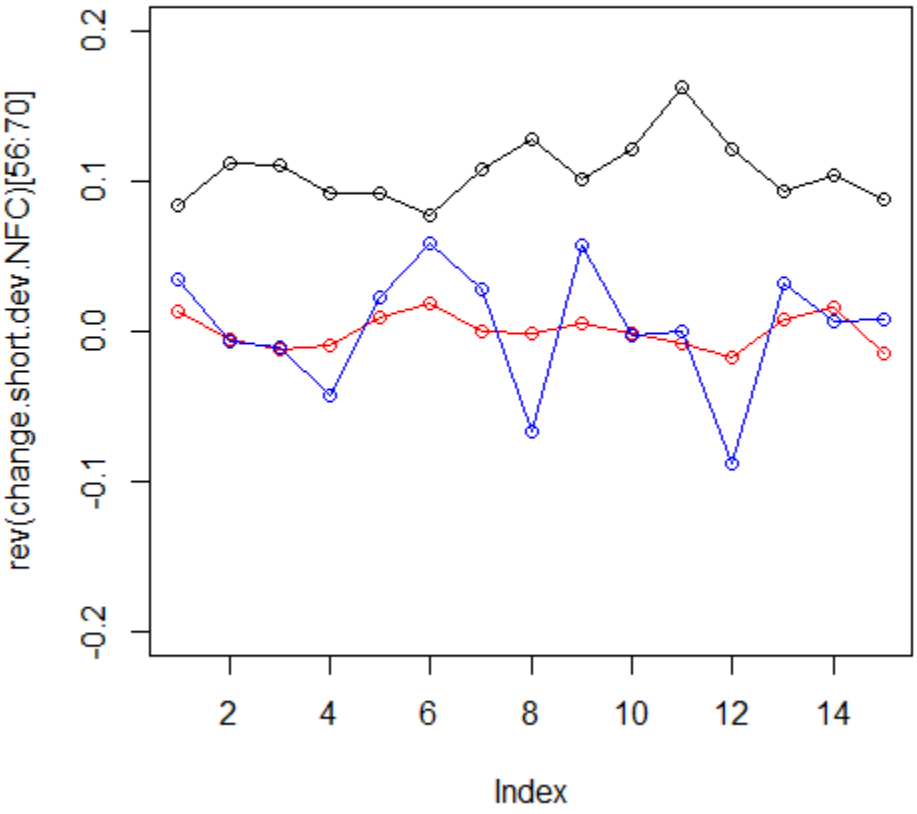

FIGURE 1. Pct Change in outstanding short-term bank loans to NFC and the VIX, EM (blue) and Dev (red)

This paper has the following outline: section 2 reviews current literature. Section 3 presents the main empirical results about the role of VIX in maturity composition of debt. Section 4 presents a theory model to explain the growth of short-term debt in emerging markets during good times. The final section concludes.

2. LITERATURE REVIEW

This paper is related to two main strands of the literature: the macro literature on (sovereign) debt maturity and crises, and the corporate finance literature on maturity choice.

In macro, the theme of short-term borrowing in emerging market has been discussed in the context of sovereign debt. Empirically, Broner et al. (2013) document

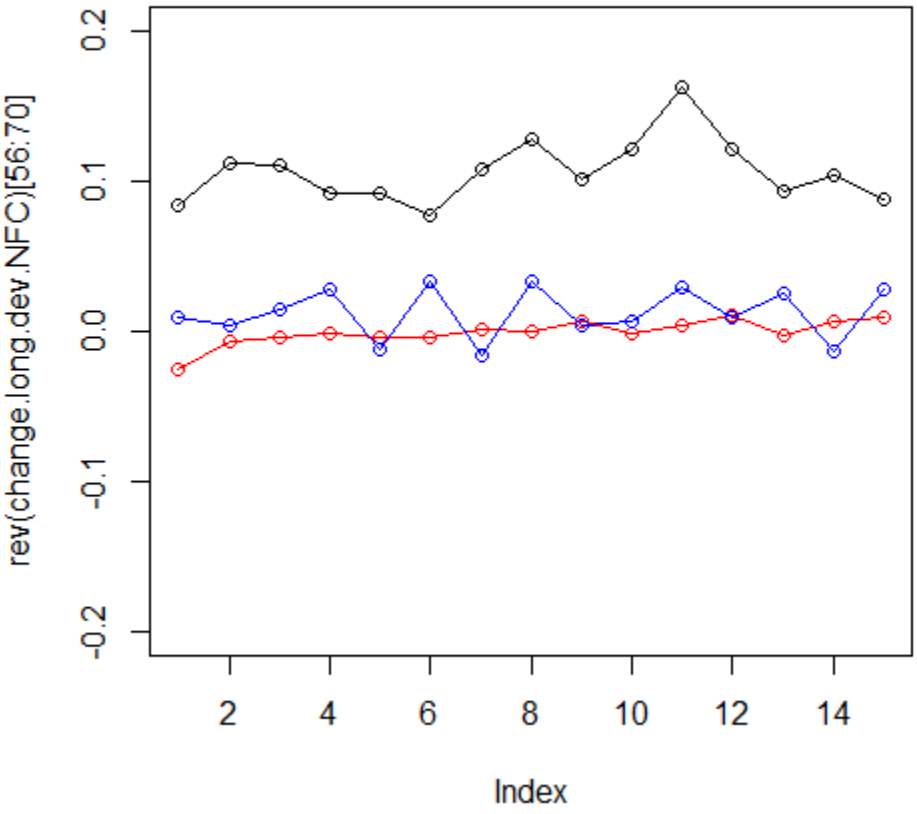

FIGURE 2. Pct Change in outstanding long-term bank loans to NFC and the VIX, EM (blue) and Dev (red)

that emerging markets pay a higher risk premium for longer maturity securities. In this paper, maturity structure moves because of time-varying risk aversion of foreign investors. A related paper by Arellano and Ramanarayanan (2012) document another feature of the spreads curve: the slope tends to 'flatten', i.e. short-term bond spread rises more than long-term spread, in crises. In this model, short-term debt is favorable because it provides extra incentives to repay, since when issuing long-term debt, the government cannot commit to not issuing debt further in the future, hence raising the probability of defaults. In both of these papers, there is more short-term debt in crisis, contrasting with our empirical finding.

Converse (2015) argues that greater uncertainty regarding the availability of foreign borrowing causes firms to cut long-term investment. Similarly, Arellano and Ramanarayanan (2012) argues that short-term debt has an effect on debt overhang and investments. These findings are related to our three-period model, in which firms who face uncertainty over future borrowing costs decide not to invest due to credit constraint.

There is some parallel to the sovereign's problem in the corporate finance literature. A seminal paper by Hart and Moore (1994) analyzed the optimal contract between investors and an entrepreneur who wants to finance an illiquid project. The characterization of the optimal contract depending on two forces: having the loans paid back to early could make the firms go bankrupt due to insufficient cash-on-hand, while having the loans paid back to late gives incentives for the firms to default.[3] If anything, the evidence goes against the asset-liability maturity matching argument: firms in emerging markets often borrow short and roll over their debts – a behavior that is not allowed in the model.

Another theory about the time series of corporate maturity is the *gap filling theory* (Hart and Moore 19940 r c.f. Greenwood et al. (2010) in which corporate borrowing often complement government borrowing. When government decides to borrow heavily using long-term bond, the long-term yield increases relative to short-term. Given the supply shock of long-term securities, assuming there is limit to arbitrage, the corporate sector will borrow more short-term debt. This theory is not consistent with our stylized facts that bank loans to government co-move strongly with bank loans to NFCs – thus hinting at a more supply-side theory of capital rather rather than demand-side. Finally, according to Baker et al. (2002), firms try to time the market and issue long-term debt only when credit becomes low.

3. Empirical Analysis on Macro Data

3.1. **Baseline estimation.**

The baseline regression equation in this paper is

$$Y_{c,t} = \alpha_c + G_t'\gamma_g + D_{c,t}'\beta + u_{it} \tag{1}$$

where G_t is a vector of global factors, and $D_{c,t}$ is a vector of country-specific domestic fundamentals. Country fixed-effects are included to account for long-standing cross-country differences in borrowing practice, institutions, outstanding debt, level of financial development, etc.

The dependent variables are quarterly percentage change in stock of outstanding bank debt of maturities shorter and longer than 1 year, and borrowed by the household, nonfinancial corporations, and government sector. Domestic controls currently include GDP and inflation. To proxy for global effect, we use the VIX index - the implied volatility index calculated by the Chicago Board Options Exchange.

Equations similar to (1) have been used to estimate the *pull vs. push* effect on capital flows and exchange rates in the literature. For example, Forbes and Warnock

[3] A subsequent paper by Hart and Moore (1995) de-emphasizes short-term debt, and advocates for long-term debts as a tool to discipline managers from empire-building behaviors, a channel we consider not the primary effect in emerging markets.

(2012) use the VIX as a global variable to estimate the probability of surges/retrenchment of capital flows. Bruno and Shin (2013) also note the effect of lower VIX in inducing greater capital flows.

It remains a debate whether this VIX index is a good instrument for capital flows to emerging market. We will turn to a discussion of the use of VIX in section 3.3.

3.2. **Baseline regression result.** Table 1 shows the baseline regression results. Unlike previous studies which show only how VIX affects total capital flows, by breaking down into sector of borrowers and maturities, we can see clearer the effect of the VIX on local credit conditions via the banking channel.

In particular, the VIX has a significant effect on long-term household debts, as well as both long- and short-term debts undertaken by NFCs. Such an effect is only statistically significant for emerging market, showing clear different between developing and developed economies in response to global uncertainty.

In particular, our regression shows that during times of high global uncertainty, banks in developed economies extend long-term lending to domestic NFCs, while banks in emerging markets cut lending at all maturities. Short-term debt is retired faster than long-term debt, which makes maturities of bank loans in emerging economies lengthen during uncertain times.

This pattern can be read of columns (3) and (4) of table 1. Consider a 10-point increase in the VIX: the stock of short-term debt in developed economy increases by 0.1%, suggesting a tilt towards short-term maturities in developed economy during times of crises. However, compared to develop economies, short-term debt in emerging market reduces by 2%. Similarly, while long-term debt increases in developed economy, it decreases by 1% in emerging economies. Since short-term debt retires faster than long-term debt, maturities lengthen for emerging markets during time of high global uncertainties.

We can also see the same pattern for the long-term debt stock of household sector: developed economies' banks extend lending in long-term debt, while emerging economies cut back long-term lending. Our model seems unsuccessful in explaining short-term household debt (with a negative adjusted R^2). This is expected, as there is no variation at all in this part of the data, which includes short-term borrowing such as credit card debt for day-to-day spending, which is not likely to be affected by global factors.

Estimates for short-term lending to the government sector, on the other hand, seem very unreasonable. This is because the sample for European countries contain several episodes where sovereign default risk (eg. Greek debt crises) is pronounced, affecting both the VIX and the stock of government borrowing from domestic banks. This raises eyebrows to the potential endogeneity of the VIX, which brings us to the discussion in section 3.3.

3.3. **Discussion of VIX.** Many recent papers (c.f. Forbes and Warnock (2012), Bruno and Shin (2013), Sebnem et. al. (2016)) use the VIX as an exogenous proxy for global credit supply: low VIX means more capital flows, hence more easily accessible credit for emerging markets. However, given the interconnectedness of the modern

	Households		NFCs		Government	
	ST	LT	ST	LT	ST	LT
VIX_t	-0.1160 .	-0.0210	0.0123	0.0051	10.917	0.0562
	(0.0697)	(0.0202)	(0.0495)	(0.0313)	(148.54)	(0.0823)
VIX_{t-1}	0.0965	0.0445*	-0.0633	0.0203	54.65	0.0182
	(0.0713)	(0.0207)	(0.0506)	(0.0320)	(151.98)	(0.0842)
$VIX_t \times EM$	0.0104	0.0232	-0.2045*	0.0216	2341.88***	-0.0584
	(0.1212)	(0.0351)	(0.0861)	(0.0545)	(258.45)	(0.1432)
$VIX_{t-1} \times EM$	-0.0973	-0.1741***	0.0672	-0.1159*	-1339.61***	0.2456
	(0.1221)	(0.0353)	(0.0867)	(0.0548)	(260.26)	(0.1442)
ΔGDP_t	0.1859 .	0.2956 ***	0.2163**	0.3536***	343.60	0.1990
	(0.0999)	(0.0290)	(0.0709)	(0.0449)	(212.93)	(0.1179)
π_t	0.5844 **	0.4825***	0.8824***	0.4356***	-178.24	(0.1418)
	(0.1821)	(0.0528)	(0.1293)	(0.0818)	(388.15)	(0.2150)
CA_t	-0.0502	-0.0349**	-0.0243	-0.0610**	-18.234	-0.0016
	(0.0460)	(0.0133)	(0.0327)	(0.0207)	(98.08)	(0.0543)
No. observations	930	930	930	930	930	930
Adj R^2	-0.007	0.243	0.055	0.118	0.0950	-0.0199

TABLE 1. Correlation between Principal Components of Short/Total Bank Loan ratio with the VIX, by Borrower

world financial market, it is hard to argue that VIX is truly exogenous to changes in emerging markets, especially negative events which induce loss and higher risk aversion of investors.

Figure 3 plots the VIX and VXEEM – the CBOE Emerging Markets ETF Volatility Index. The two series exhibit high correlation suggesting that either (1) emerging market volatility mainly driven by VIX-induced risk aversion of US investors, or (2) the VIX is affected by emerging markets events, or both.

Under the logic that any given emerging market is too small to have a significant impact on global investors' risk aversion, the VIX can be used to proxy for exogenous 'push factors' of capital flows to one or a group of emerging markets. However, if fundamental shocks of emerging market are highly correlated and/or contagion effects are high, which amplify one country's shock, one small fundamental/political shock to a country will affect investors' sentiments about emerging markets as a whole, changing both VXEEM and VIX.

For the purpose of this paper, we have assumed that the VIX is exogenous to shocks from the set of emerging markets included. The result is robust to specification including and excluding Greece in the set of emerging markets, which is re-assuring, given that if any country's risk most likely affects the VIX, it would be Greece. If our assumption is correct, the estimated coefficient for VIX_t may be biased, but

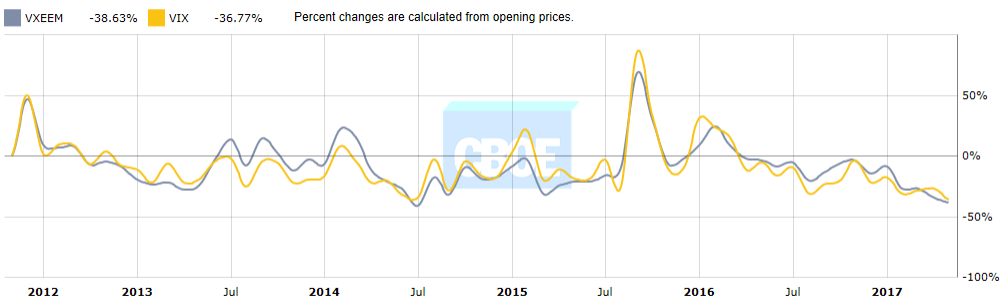

FIGURE 3. The VIX and VXEEM (CBOE Emerging Markets ETF Volatility Index)

. Source: CBOE

$VIX_t \times EM$ is not. As a result, we cannot definitely conclude our results for developed economy, but we can for emerging markets.

In the future, we plan to address further the endogeneity problem of the VIX, perhaps by using the narrative approach to identifying US monetary policies and cross-check.

4. THEORETICAL FRAMEWORK

4.1. **3-period model.** Consider the a small open emerging market whose interest rate is affected by the world credit market. There are three dates: $t = 0, 1, 2$.

A local bank in the EM can borrow from the world credit market at (gross) interest rate R_1 on date 0 to be paid on date 1, and at rate R_2 on date 1. There are two states of the world. In both states, $R_1 = R_L$. In the good state, which occurs with probability $1-p$, the interest rate stays unchanged on the second date $R_2 = R_1 = R_L$. In the bad state, which occurs with probability p, the interest rate increases to $R_2 = R^H > R_L$.

The idea is to capture the fact that capital flows to EM bank tend to be short-maturity borrowing from wholesale funding sources. We want to consider the effect of a probability of reversal p of capital becoming more expensive, perhaps because of credit tightening in the US for example.

A local firm has a project which requires 1 unit of investment in period 0 and yields return V on date 2. The firm has net worth $n < 1$, and needs to borrow the remaining $1-n$ from the local bank should the firm decides to take on the project. The firm can chooses two borrowing strategy:

- Short-term borrowing with rollover: the firm can borrow $1-n$ on date 0, and refinance on date 1. On date 1, upon seeing the new interest rate R_2, the bank can choose whether to renew funding for the firm, or force the firm to liquidate. If the bank forces liquidation, it recovers the full payment $R_L(1-n)$.
- Long-term borrowing: the firm can choose to borrow $1-n$ on date 0, to be paid back on date 2 at interest rate $\overline{R}$. In this case, the firm does not have to refinance; hence, not subject to rollover risk.

To focus on the scenario of interest, we will assume that the hike of interest rate on date 2 will be severe. In particular, it will be so high that the payment on date 2 in case of interest rate hike $R^H R_L(1-n)$ will exceed the total yield on the investment V:

Assumption 4.1. *The hike in interest rate on date 1 forces firm not to roll over its debt on date 1:* $R^H > \frac{V}{R_L(1-n)}$.

4.2. **Equilibrium.** My first result is about firm's maturity choice. In particular, given assumption (4.1), the firm always chooses to borrow short term and never long term.

Theorem 4.2 (Firm's maturity choice)**.** *Firm will borrow short-term if and only if*

$$R_L R^H(1-n) > V$$

which is the 'severe hike' condition in assumption (4.1)*.*

Proof. Let us consider first the simpler case of a long-term contract. Assume that the banking sector is competitive and risk-neutral. Thus, the bank will charge the long-interest rate as the expected cost of getting a unit of funding from the world market:

$$\overline{R} = R_0 \cdot \mathbb{E}_0[R_1] = R_L((1-p)R_L + pR_H)$$

Now, if the firm borrows short term, consider the refinancing problem on date 1. The outstanding debt (principal plus interest) is $R_L(1-n)$. If the realized date-1 interest rate is R_L, the firm will not default. The bank is then willing to refinance the firm, earning gross payment $R_L^2(1-n)$ in period 2.

However, if the realized interest rate is R_H, the firm will default, in which case the bank recover only the net worth of the firm $n < V < R^H R_L(1-n)$. Thus, seeing an interest rate hike and anticipating a default, the bank will choose optimally not to refinance. The expected payoff to a firm borrowing short is:

$$(1-p)[V - R_L^2(1-n)] + p \cdot 0$$

The firm thus will borrow short-term if and only if

$$(1-p)[V - R_L^2(1-n)] > V - \overline{R}(1-n)$$

which reduces to $R_L R^H(1-n) > V$. □

This theorem is surprising insofar as it links firm's maturity choice with the interest rate condition. While the exact algebra is sensitive to the micro details of the model, the intuition is clear: with the possibility of a rate hike being priced into the long term borrowing rate, if the rate hike is severe enough, the long term rate could well exceed the benefit of taking on the project.

The remaining question is, do firms want to borrow short term to finance project, or not at all? For that, we have a participation theorem:

Theorem 4.3. *Only firms with low enough net worth are willing to borrow to finance the project:*

$$n < \widehat{n} \equiv \frac{(1-p)(V - R_L^2)}{1-(1-p)R_L^2}$$

and the cutoff threshold $\widehat{n}$ does not depend on the rate hike R_H.

The result that the cutoff threshold does not depend on the higher interest rate R_H reflects that firms that borrow short-term already plan to default when interest rate hike rises. As long as the rate hike is severe enough (assumption (4.1)), it does not matter how severe the rate hike is anymore.

Why do only low net worth firms choose to borrow to invest? There are two reasons. First, all else equal, high net worth get less benefit out of this fixed return project (high n implies low $R - n$). However, more importantly, low net worth firms have *higher options value of default* (since default is less costly), which makes borrowing more attractive. While the first reason depends on our modeling choice, the second captures the intuition that one often has: low net worth firms 'have less to lose', thus taking riskier actions.

5. Conclusion

In this paper, we have found the main empirical result that shows significant and differential effects of global credit on emerging and developed economies. In particular, we find that during times of high global uncertainty, bank lending to households and NFCs rise in developed economies, but contract for emerging markets. Short-term debt contracts faster than long-term debt, making emerging market maturities lengthen in bad times. The opposite is true for good times: when the VIX is low, emerging market firms and households borrow more in short- and long-term debt, with short-term debt expanding more, shortening maturities.

In future version of paper, we want to take care of the endogeneity problem of VIX more seriously, and address that problem either by using the narrative approach and/or cross-sectional problem.

6. Figures and Tables

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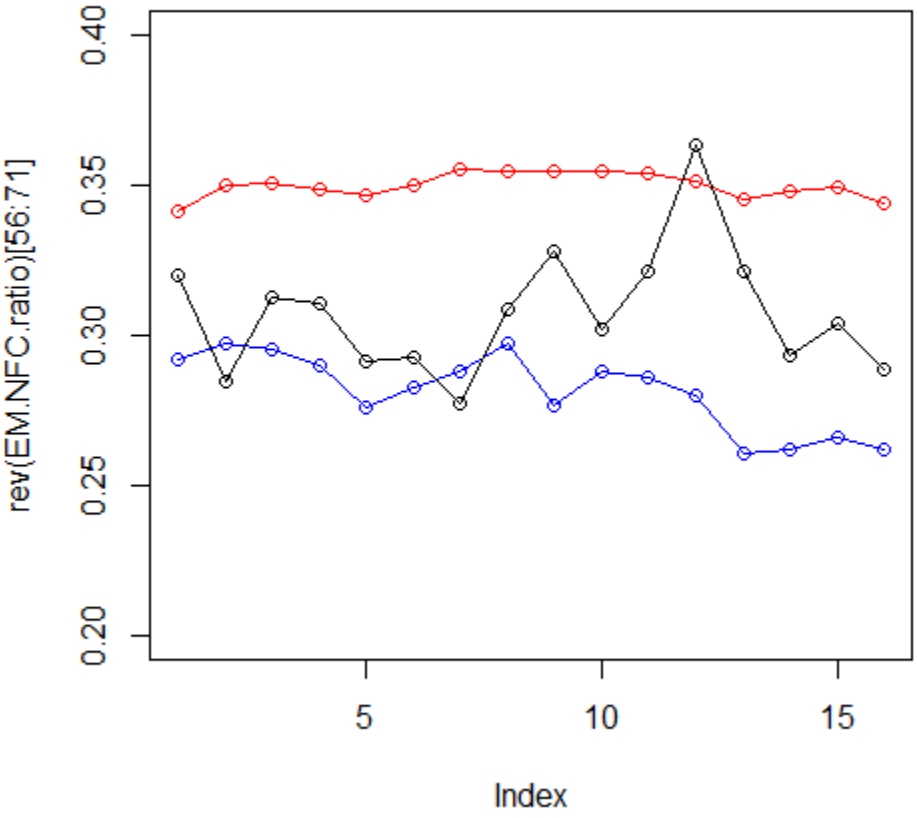

FIGURE 4. Maturity ratio (short liability/total liability) of bank loans to NFC and the VIX, EM (blue) and Dev (red)

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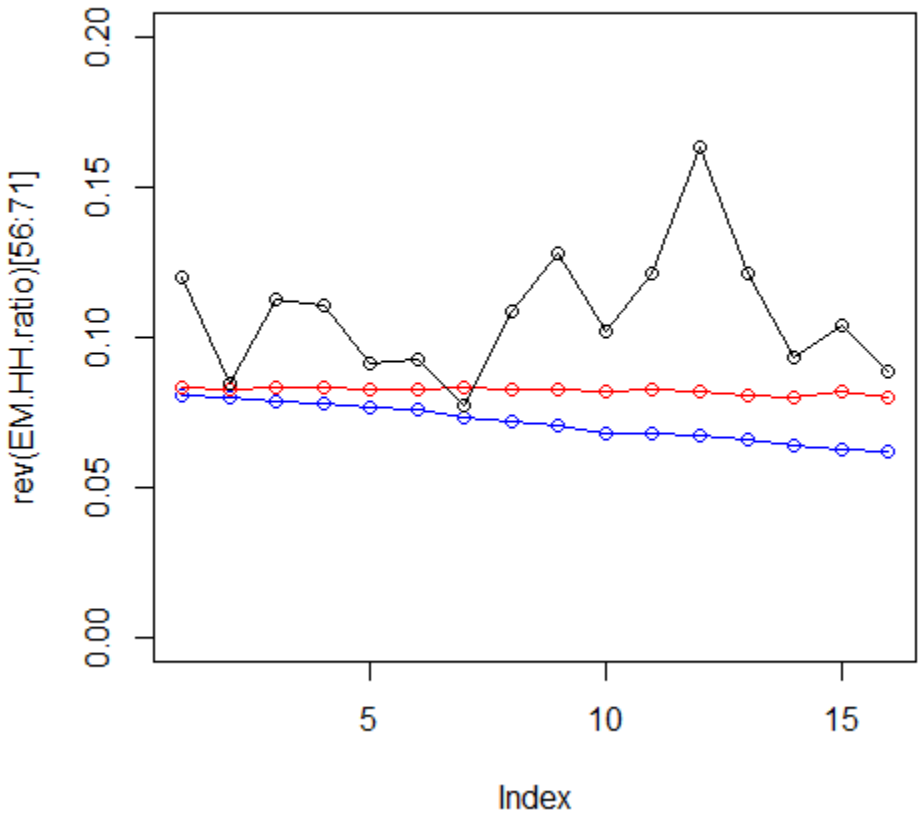

FIGURE 5. Maturity ratio (short liability/total liability) of bank loans to HH and the VIX, EM (blue) and Dev (red)

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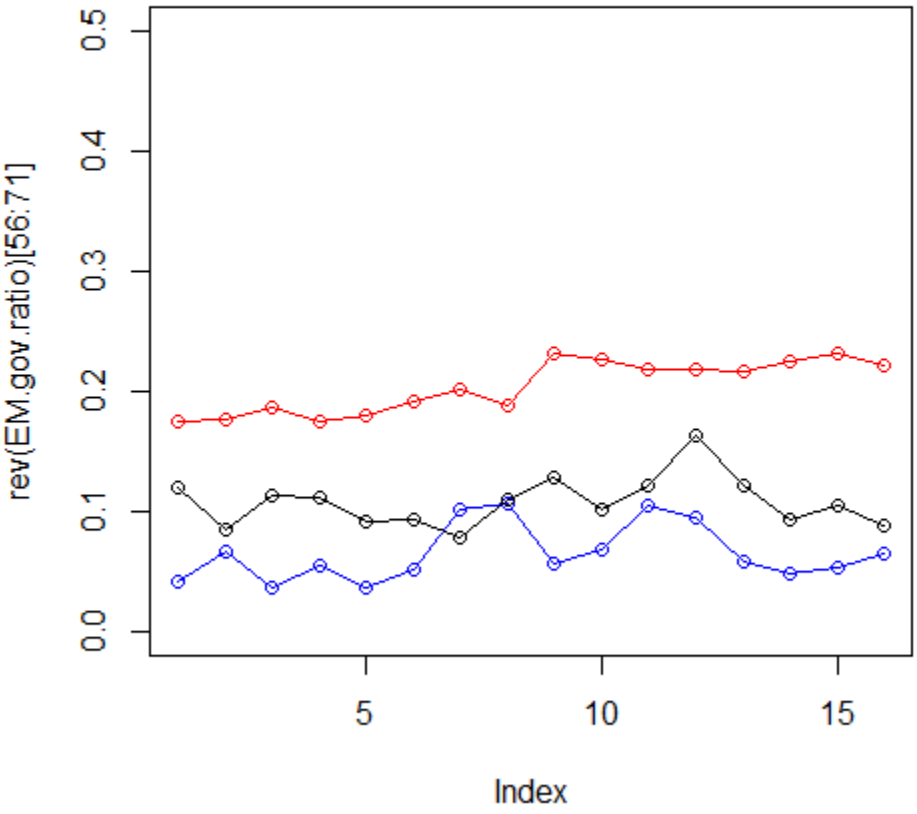

FIGURE 6. Maturity ratio (short liability/total liability) of bank loans to Government and the VIX, EM (blue) and Dev (red)