NBER WORKING PAPER SERIES

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Working Paper 22592
http://www.nber.org/papers/w22592

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
September 2016

We are grateful to Mark Aguiar, Daniel Andrei, Adrien Auclert, John Campbell, Lorenzo Garlappi, Joshua Gottlieb, Oleg Itskhoki, Thomas Mertens, Vincenzo Quadrini (discussant), Julio Rotemberg, Rosen Valchev (discussant), Adrien Verdelhan, Jenny Tang, and seminar participants at AEA 2016, UCLA Anderson, Stanford GSB, MIT Sloan, NBER Summer Institute, UC Santa Barbara, the San Francisco Federal Reserve, and the University of British Columbia for helpful comments. Jiri Knesl and Sandra Ramirez provided excellent research assistance. Pflueger thanks MIT Sloan and Stanford GSB for their hospitality and UBC for research funding while working on this research. Schreger thanks the Princeton Economics Department for their hospitality during the research process and the Harvard Business School Division of Research for financial support. The views in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System, any other person associated with the Federal Reserve System, or the National Bureau of Economic Research. All errors are our own.

At least one co-author has disclosed a financial relationship of potential relevance for this research. Further information is available online at http://www.nber.org/papers/w22592.ack

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JEL No. E4,F3,G12,G15

ABSTRACT

Nominal debt provides consumption-smoothing benefits if it can be inflated away during recessions. However, we document empirically that countries with more countercyclical inflation, where nominal debt provides better consumption-smoothing, issue more foreign-currency debt. We propose that monetary policy credibility explains the currency composition of sovereign debt and nominal bond risks in the presence of risk-averse investors. In our model, low credibility governments inflate during recessions, generating excessively countercyclical inflation in addition to the standard inflationary bias. With countercyclical inflation, investors require risk premia on nominal debt, making nominal debt issuance costly for low credibility governments. We provide empirical support for this mechanism, showing that countries with higher nominal bond-stock betas have significantly larger nominal bond risk premia and borrow less in local currency.

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An online appendix is available at http://www.nber.org/data-appendix/w22592

1 Introduction

Over the past decade, the market for emerging market government debt has undergone a remarkable transformation. In the 1980s and 1990s, most emerging market sovereigns and several developed country governments relied heavily on foreign currency (FC) in their foreign borrowing. This left borrowers vulnerable to currency fluctuations and financial crises (Eichengreen and Hausmann, 2005). Since the Asian Financial Crisis, the share of government bonds issued in local currencies (LC) has grown rapidly and now constitutes more than half of external debt issued by major emerging market sovereigns (Du and Schreger, 2015). However the shift towards local currency government bonds has been highly uneven across markets, raising the question of what drives these cross-country differences.

The standard approach to optimal government finance suggests that governments should smooth the costs of taxation across states of the world. If raising taxes is costlier during recessions, due to high marginal utility of consumption or distortionary taxes (Barro, 1979), it is optimal to issue bonds that require low repayments in recessions and higher repayments in expansions (Bohn, 1990a,b; Barro, 1997; Lustig et al., 2008). From this perspective, a key benefit of nominal local currency debt is that the government can inflate away the real debt burden when relief is needed most. However we find that countries where nominal local currency debt provides little or no flexibility during adverse states of the world, issue the most nominal debt.

Our primary proxy for the hedging properties of local currency debt is the regression beta of local currency bond returns with respect to stock market returns. A positive bond-stock beta indicates that local currency bonds pay off less during stock market downturns and hence provide fiscal flexibility. Figure 1 summarizes the key stylized fact that countries with the most positive local currency bond betas have the lowest local currency debt shares. Issuers for whom nominal bonds have better hedging properties actually rely less on nominal financing.[2]

[2]We show average local currency debt shares in central government debt and the estimated slope coefficient

We begin by documenting significant cross-country heterogeneity in local currency bonds' hedging properties and inflation cyclicality in a sample of 30 developed and emerging markets with sizable nominal local currency bond markets. Over the last decade, local currency bond-stock betas range from significantly negative (-0.2) to significantly positive (0.3). Bond-stock betas in developed markets, such as the US, tend to be negative. Emerging markets' bond-stock betas span a wide range, but tend to be positive. Since local currency bonds lose value when inflation expectations increase, and stock returns are procyclical, we expect that positive bond-stock betas coincide with countercyclical inflation, or negative inflation-output betas. We verify this prediction in the data, consistent with inflation expectations being a key driver of the hedging properties of local currency bonds. We show that countries with more procyclical local currency bond returns and countercyclical inflation expectations rely less on nominal local currency debt relative to real or foreign currency debt. This is the opposite of what we would expect if governments issue local currency debt to smooth taxes across states of the world.

What explains this apparently puzzling relation? We demonstrate that it is the equilibrium outcome of a model, where monetary policy credibility drives the cyclicality of inflation, with investors who require a risk premium to hold positive-beta assets. We build on the loose commitment mechanism of Debortoli and Nunes (2010), where the government communicates a contingent plan for future inflation, but it may revert to a myopic policy (Kydland and Prescott, 1977; Barro and Gordon, 1983; Rogoff, 1985). When commitment fails, the government uses inflation to reduce the real burden of local currency debt. The incentive to inflate is more pronounced during low output states, when marginal utility is highest. Crucially, debt is priced by risk-averse lenders, whose stochastic discount factor (SDF) is correlated with domestic output.

The key insight of the model is that when governments with imperfect credibility borrow in nominal terms from risk-averse lenders, they not only have a classic inflationary bias, but

of local currency government bond returns against local stock market returns for the period 2005-2014 for a sample of 30 emerging and developed countries. For details see section 2.

also lack the ability to commit to a degree of state-contingency on the debt. With risk-averse lenders, a government's temptation to generate excessively countercyclical inflation leads lenders to charge a risk premium on nominal borrowing. This lowers average borrower consumption. But a government with full commitment that borrows from risk-averse lenders can lower the risk premium it pays on LC debt. It achieves this by committing to an inflation process that keeps LC bond payouts relatively stable during recessions, when investors' marginal utility is high. In contrast, a government lacking commitment cannot credibly promise to restrict itself to such a limited amount of state-contingency and therefore pays a higher-than-optimal risk premium. Because of this, in equilibrium governments that obtain little consumption-smoothing from issuing nominal debt (those with more procyclical inflation) issue the most nominal debt, and those that could obtain the most consumption-smoothing from issuing nominal debt (those with more countercyclical inflation) issue the least.

Significantly, limited commitment alone cannot resolve the stylized fact in Figure 1. With risk-neutral lenders, the model implies that bond-stock betas increase and inflation-output betas decrease with local currency debt shares, in contrast with the empirical evidence in Figure 1. The intuition is that with risk-neutral investors, a high credibility issuer uses local currency debt to smooth consumption and chooses higher inflation during recessions than during expansions. A low credibility issuer uses foreign currency debt and receives less consumption-smoothing benefits for each percentage point of inflation variation. He hence chooses less countercyclical inflation, because the benefit from varying inflation across states of the world is smaller. It is only the interaction of imperfect commitment and risk-averse lenders that can explain the empirical patterns.

Finally, we present empirical support linking local currency bond risk premia with bond return cyclicality, monetary policy credibility, and local currency debt issuance. First, we show empirical evidence that higher local currency bond-stock betas are associated with significantly higher local currency bond risk premia, supporting the model mechanism, whereby investors require a premium for holding local currency bonds that tend to depreciate during downturns. Second, we provide direct evidence for the model mechanism by relating local currency bond-stock betas and local currency bond risk premia to two de-facto measures of monetary policy credibility, based on official central bank inflation targets and newspaper text analysis. Third, we show empirical evidence that local currency debt shares are strongly negatively related to local currency bond risk premia. Decomposing local currency bond risk premia into a world CAPM component and a residual or alpha, we find that the world CAPM component accounts for the majority of the downward-sloping relation between LC debt shares and risk premia.

This paper contributes to a recent literature on inflation commitment and debt limits when the debt denomination is exogenous (Jeanne, 2005; Araujo et al., 2013; Aguiar et al., 2014; Chernov et al., 2015; Sunder-Plassmann, 2014; Bacchetta et al., 2015; Du and Schreger, 2015; Corsetti and Dedola, 2015) and the large literature on government debt and inflation (Sargent and Wallace, 1981; Leeper, 1991; Sims, 1994; Woodford, 1995; Cochrane, 2001; Davig et al., 2011; Niemann et al., 2013). We expand on these papers along two dimensions. First, we model the government's optimal share of internationally held local currency debt. Second, we allow the central bank to engage in optimal forward guidance with partial credibility. While a long-standing literature has considered dollarization or monetary unions as commitment devices for central banks (Obstfeld, 1997), we consider how the government optimally chooses the denomination of sovereign debt to mitigate limited monetary policy credibility. This research is also closely related to Broner et al. (2013), who consider a sovereign's optimal debt maturity choice in the presence of risk-averse investors. We add to it, as well as the related quantitative frameworks of Alfaro and Kanczuk (2010); Díaz-Giménez et al. (2008), by matching stylized cross-sectional facts about inflation cyclicality and bond return cyclicality. In contemporaneous and complementary work, Ottonello and Perez (2016) and Engel and Park (2016) study the currency composition of sovereign debt in the presence of time-inconsistent monetary policy. Engel and Park (2016) study the currency composition of debt with optimal contracts and endogenous default when investors are risk-neutral. Ottonello and Perez (2016) present a quantitative model that generates predictions for the business cycle properties of local currency debt issuance. We contribute both empirically – by documenting the relation between inflation cyclicality and local currency debt shares in a cross-section of countries – and theoretically – by proposing that investor risk aversion interacted with limited monetary policy credibility can explain this new stylized fact.

The paper is also related to a recent literature on time-varying bond risks (Baele et al., 2010; David and Veronesi, 2013; Campbell et al., 2014; Ermolov, 2015; Campbell et al., 2015), that is primarily focused on the US and the UK. Vegh and Vuletin (2012) also emphasize the evolution and cross-country heterogeneity in the cyclicality of monetary policy, but do not study implications for sovereign debt portfolios. Poterba and Rotemberg (1990) examine the correlation between taxes and inflation under both commitment and no-commitment in five major developed countries, but do not consider the interaction with the currency composition of government debt. We do not take a stand in this paper on the interest rate policy needed to implement the optimal inflation process, which is studied in Campbell et al. (2015). Our work is also related to the international asset pricing literature. In our model, comovement with international fundamentals is priced, consistent with empirical evidence in Harvey (1991); Karolyi and Stulz (2003); Lewis (2011); Borri and Verdelhan (2011); Lustig et al. (2011); David et al. (2016); Della Corte et al. (2016). We contribute to this literature by providing a channel that explains why LC debt of low credibility countries comoves with international investors' stochastic discount factor and hence requires a risk premium.

The structure of the paper is as follows. In section 2, we present new stylized facts on the relation between the cyclicality of local currency bond risk and shares of local currency debt in sovereign portfolios. In sections 3 and 4 we lay out the model, provide analytical intuition for the key mechanisms, and calibrate the model to demonstrate that it can replicate the observed patterns of the currency composition of sovereign debt and inflation cyclicality.

Section 5 tests additional model implications for local currency debt issuance and risk premia. Section 6 concludes.

2 Empirical Evidence

In this section, we establish the empirical relation between local currency bond risks, inflation cyclicality, and the currency composition of sovereign debt portfolios. We focus on eleven developed markets (Australia, Canada, Denmark, Germany, Japan, New Zealand, Norway, Sweden, Switzerland, United States and United Kingdom) and 19 emerging markets (Brazil, Chile, China, Colombia, Czech Republic, Hungary, Indonesia, Israel, Malaysia, Mexico, Peru, Philippines, Poland, Russia, Singapore, South Africa, South Korea, Thailand and Turkey).[3]

2.1 Nominal Bond Risks: Bond-Stock Beta

Asset markets incorporate investors' forward-looking information at much higher frequency than surveys and can therefore provide valuable proxies for inflation cyclicality that are potentially less subject to measurement error and more robust given the relatively short time series. Local currency bond-stock betas serve as an asset market based proxy of inflation cyclicality. If stock returns are procyclical, we expect bond-stock betas to be inversely related to the cyclicality of inflation expectations.

We denote the log yield on a nominal LC n-year bond as y_{nt}^{LC}, where $y_{nt} = \log(1 + Y_{nt}^{LC})$.

[3]For LC bond yields, we use primarily Bloomberg fair value (BFV) curves. BFV curves are estimated using individual LC sovereign bond prices traded in secondary markets. Since sufficient numbers of bonds spanning different maturities are needed for yield curve estimation, the availability of the BFV curve is a good indicator for the overall development of the LC nominal bond market. Countries such as Argentina, Uruguay and Venezuela only have a handful of fixed-rate bonds and hence do not have a BFV curve. As for most emerging markets in our sample BFV curves are available starting in the mid-2000s, we focus on the period 2005-2014 to maintain a balanced panel. To measure inflation risk and the perceived cyclicality of inflation, we use realized inflation from Haver and inflation forecasts from Consensus Economics, respectively. Finally, we measure the share of local currency debt in total sovereign debt portfolios with data from BIS Debt Securities Statistics, OECD Central Government Debt Statistics, and several individual central banks. All results winsorize the highest and lowest observation to ensure that results are not driven by outliers.

The log holding period return on the bond is given by

$$r_{n,t+\Delta t}^{LC} \approx \tau_n y_{nt}^{LC} - (\tau_n - \Delta t) y_{n-1,t+\Delta t}^{LC},$$

where $\tau_n = \frac{1-(1+Y_{nt}^{LC})^{-n}}{1-(1+Y_{nt}^{LC})^{-1}}$ is the duration of a bond selling at par (Campbell et al. (1997)). We approximate $y_{n-\Delta t,t+\Delta t}^{LC}$ by $y_{n,t+\Delta t}^{LC}$ for the quarterly holding period. We let y_{1t}^{LC} denote the three-month T-bill yield and then the excess return on LC bonds over the short rate is given by

$$xr^{LC} = r_{n,t+\Delta t}^{LC} - y_{1t}^{LC}.$$

From a dollar investor's perspective, we can rewrite the excess return as

$$xr^{LC} = [r_{n,t+\Delta t}^{LC} - (y_{1t}^{LC} - y_{1t}^{US})] - y_{1t}^{US}.$$

The dollar investor can hedge away the currency risk of the holding period Δt by going long a US T-bill and shorting a LC T-bill with the same market value as the LC bond. By doing so, any movement in the spot exchange rate of the LC has the same offsetting first-order impact on the bond position and the local T-bill position and hence cancels out. After hedging currency risk for the holding period, the dollar investor bears duration risk of the LC bond.

We define the local equity excess returns as the log return on local benchmark equity over the three-month LC Treasury bill:

$$xr_{t+\Delta t}^{m} = (p_{t+\Delta}^{m} - p_t^{m}) - y_{1t}^{LC},$$

where p_t^m denotes the log benchmark equity return index at time t. Country subscripts are suppressed to keep the notation concise. We then compute the local bond-stock beta $b(bond, stock)$ by regressing LC bond excess returns $xr_{t+\Delta t}^{LC}$ on local equity excess returns

$xr^{m}_{t+\Delta t}$:

$$xr^{LC}_{t+\Delta t} = b_0 + b(bond, stock) \times xr^{m}_{t+\Delta t} + \epsilon_t. \tag{1}$$

Bond-stock betas measure the risk exposure of LC bond returns on local equity returns.

2.2 Cyclicality of Inflation Expectations: Inflation-Output Forecast Beta

We construct a new measure for the procyclicality of inflation expectations by regressing the change in the CPI inflation rate predicted by forecasters on the change in their predicted real GDP growth rate. Each month, professional forecasters surveyed by Consensus Economics forecast inflation and GDP growth for the current and next calendar year. We pool all revisions for 2006 through 2013 (so that the forecasts were all made post-2005), and run the country-by-country regression

$$\Delta\tilde{\pi}_t = b_0 + b(\tilde{\pi}, \widetilde{gdp}_t) \times \Delta\widetilde{gdp}_t + \epsilon_t, \tag{2}$$

where t indicates the date of the forecast revision. The revisions to inflation forecasts ($\Delta\tilde{\pi}_t$) and GDP growth forecasts ($\Delta\widetilde{gdp}_t$) are percentage changes of forecasts made three months before and proxy for shocks to investors' inflation and output expectations. The coefficient $b(\tilde{\pi}, \widetilde{gdp}_t)$ measures the cyclicality of inflation expectations and is the coefficient of interest.

Because forecasts are made for calendar years, the forecast horizon can potentially vary. Consensus forecasts the annual inflation rate up to two years in advance. This means that in January 2008, the forecast of calendar year 2008 inflation is effectively 11 months ahead and the forecast of calendar year 2009 is 23 months. We focus on revisions to the two-year forecast (13-23 months ahead) to minimize variation in the forecast horizon.

2.3 Cyclicality of Realized Inflation: Realized Inflation-Output Beta

While investors' beliefs about inflation cyclicality enter into government debt prices and hence sovereign debt portfolio choice, it is useful to verify that the composition of debt portfolios also lines up with the cyclicality of realized inflation and output. We compute the realized inflation-output beta by regressing the change in the inflation rate on the change in the industrial production growth rate:

$$\Delta\pi_t = b_0 + b(\pi, IP)\Delta IP_t + \epsilon_t, \tag{3}$$

where $\Delta\pi_t$ is the 12-month change in the year-over-year inflation rate and ΔIP_t is the 12-month change in the year-over-year industrial production growth rate. The coefficient $b(\pi, IP)$ measures the realized inflation cyclicality with respect to output. We obtain the seasonally adjusted consumer price index and the industrial production index from Haver between 2005 and 2014.

2.4 Local Currency Debt Shares

For developed countries, we construct the share of local currency debt based on the OECD Central Government Debt Statistics and supplement this data with hand-collected statistics from individual central banks.[4] Central banks typically directly report the instrument composition of debt securities outstanding issued by the central government.

For emerging markets, we measure the share of local currency debt in sovereign debt portfolios using the BIS Debt Securities Statistics, supplemented with statistics from individual central banks. Table 16C of the Debt Securities Statistics reports the instrument composition for outstanding domestic bonds and notes issued by the central government

[4]The OECD Central Bank Debt Statistics was discontinued in 2010. We collected the statistics between 2010-2014 from individual central banks.

(D_t^{dom}) starting in 1995. Table 12E of the Debt Securities Statistics reports total international debt securities outstanding issued by the general government (D_t^{int}). For emerging markets, as the vast majority of international sovereign debt is denominated in foreign currency, and local governments rarely tap international debt markets, D_t^{int} offers a good proxy for central government foreign currency debt outstanding. Data for developed countries are from individual central banks or the OECD. The share of local currency debt is computed as the ratio of the fixed-coupon domestic sovereign debt outstanding (D_t^{int}) over the sum of domestic and international government debt:

$$s_t = \frac{D_t^{dom,fix}}{D_t^{dom} + D_t^{int}}.$$

Inflation-linked debt, floating-coupon debt and FC debt are all treated as real liabilities. In our baseline results, we do not distinguish between foreign and domestically-owned debt, but we provide evidence in Appendix B that empirical results are similar for foreign-owned debt.

2.5 Summary Statistics

Table 1 reports summary statistics for inflation, inflation expectations, local currency bond yields, bond-stocks betas, inflation-output forecast betas, realized inflation-output betas, and local currency debt shares. Emerging market realized inflation is 2.4 percentage points higher and survey-based expected inflation is 2.0 percentage points higher than in developed markets. In addition, expected inflation and realized inflation are less procyclical in emerging markets than in developed countries.

For local currency bonds, five-year local currency yields are 3.4 percentage points higher in emerging markets than in developed markets. Nominal bond returns are countercyclical in developed markets, as evident from negative bond-stock betas. By contrast, local currency bond returns are procyclical in emerging markets. Finally, developed markets borrow almost entirely with local currency debt, while the local currency debt share in emerging market averages only 60%.

2.6 Relation between Nominal Risk Betas and Sovereign Debt Portfolios

Figure 2 adds to the evidence in Figure 1 on the relation between bond return and inflation cyclicality and the share of local currency debt in sovereign debt portfolios. If LC bonds depreciate in response to increased inflation expectations and stock returns move with the business cycle, LC bond betas should be inversely related to the cyclicality of inflation expectations. If the finding in Figure 1 is driven by macroeconomic dynamics, we expect to see a positive relation between inflation-output betas and LC debt shares. Panels A and B of Figure 2 confirm this intuition. Emerging markets tend to have lower local currency debt shares and more negative realized and expected inflation betas, as would be the case if they inflate during recessions.

Panel C of Figure 2 shows LC debt shares against LC bond betas with respect to US S&P returns, obtained by replacing the local stock market return in (1) by the US S&P return. While the bond beta with respect to the local stock market proxies for hedging benefits to the issuer, the beta with respect to US stock returns is important for understanding whether LC bonds are risky from an international investor's point of view. The strong similarity between Figure 1 and Figure 2 Panel C indicates that LC bonds that provide the best hedge for the issuer are also riskiest for an international investor.

Table 2 shows cross-sectional regressions of local currency debt shares on measures of inflation cyclicality. The first three columns show that all nominal risk betas are significantly correlated with LC debt shares. A 0.16 increase in the bond-stock beta, corresponding to the average difference between emerging and developed markets, is associated with an 18 percentage point reduction in the LC debt share. Columns (4) and (5) show that the relation is robust to controlling for mean log GDP per capita and exchange rate regimes as classified by Reinhart and Rogoff (2004). The relationship between the local currency debt share and nominal risk betas is robust to using long-term debt, excluding the financial crisis, adjusting for default risk, and using only externally held government debt. The detailed results available in Appendix B. The robust result for the local currency debt share in long-term debt is important, because Missale and Blanchard (1994) argue that a shorter debt maturity can reduce the incentive to inflate away debt.

3 Model

This section describes the model and presents analytic solutions for the debt portfolio and inflation policies under a second-order expansion. The model has two periods. In period 1, the government chooses the government debt portfolio consisting of LC and FC debt, and communicates a desired inflation policy. In period 2, output is realized and debt is repaid. With probability p, the government implements the previously communicated inflation plan. The parameter p captures credibility in the model, determining how easily the government can commit to an inflation policy. With probability $1-p$, the no-commitment state in period 2 is realized and the government re-optimizes myopically. We show in Appendix A that the model can be embedded in a simple dynamic setup.

The government objective is standard, reflecting domestic agents' power utility over consumption and a quadratic inflation cost. We assume that investor marginal utility is correlated with domestic output. If investors' marginal utility is high during recessions, they require positive local currency bond risk premia from governments that tend to inflate relatively more during low output states. The government can reduce the incentive to inflate during bad states of the world, and hence risk premia, by increasing the share of FC debt.

3.1 Government Objective

We use lower-case letters to denote logs. The government's loss function combines quadratic loss in log inflation π_2 and power utility over consumption:

$$L_2 = \alpha\pi_2^2 - \frac{C_2^{1-\gamma}}{1-\gamma}. \tag{4}$$

We do not take a stand on the source of inflation costs. A quadratic inflation cost of the form (7) may arise from price-setting frictions leading to production misallocation as in New Keynesian models (see Woodford (2003)). We assume that period 2 output is log-normally distributed

$$X_2 = \bar{X}\exp(x_2/\bar{X}), \tag{5}$$

$$x_2 \sim N\left(0, \sigma_x^2\right). \tag{6}$$

The government has an incentive to reduce real debt repayments, because period 2 consumption equals output minus real debt repayments to investors, D_2:

$$C_2 = X_2 - D_2. \tag{7}$$

3.2 Investors

We assume that financial markets are integrated in the sense that all assets are priced by the same international investor. However, markets are incomplete from the domestic borrower's point of view, who has access only to LC and FC debt, cannot go long bonds, and must split his debt portfolio between these two instruments. Inflation in the investor's home currency is assumed to be zero, so one unit of international currency delivers the international investor with one unit of international consumption. International consumption and domestic consumption can differ if international agents prefer a different consumption bundle from domestic agents.

The international investor is risk-averse over world output x_2^* , which is log-normally distributed with standard deviation σ^* We model the international investor's stochastic discount factor (SDF) in reduced form with risk aversion coefficient θ, similarly to Arellano and Ramanarayanan (2012):

$$m_2^* = \log \beta - \theta x_2^* - \frac{1}{2}\theta^2 \left(\sigma^*\right)^2 . \tag{8}$$

We assume that local output x_2 loads onto world output with coefficient λ:

$$x_2 = \lambda x_2^* + \eta_2. \tag{9}$$

Here, $\eta_2 \sim N(0, \sigma_\eta^2)$ is an idiosyncratic shock uncorrelated with world output. The SDF (8) captures risk-neutral investors as a special case when $\theta = 0$. If investor risk aversion θ is greater than zero and global and local output are positively correlated ($\lambda > 0$), the SDF (8) implies that investors' and the domestic consumer's marginal utility of consumption are positively correlated, or that bad states of the world for the domestic consumer also tend to be bad states of the world for the investor.

We interpret the stochastic discount factor (8) through (9) broadly, potentially reflecting several channels. First, if international investors are risk-averse over international consumption and output, and international output is correlated with domestic output, this may give rise to a correlation between international and domestic marginal utility. We document a high correlation in output growth across countries, lending credence to this channel. In our sample, the average correlation between emerging market output growth and U.S. output growth is equal to 58%. Second, it is plausible that these correlations are a lower bound for the degree of international comovement in stochastic discount factors (Brandt et al., 2006). We find that the average correlation between emerging market stock returns and US stock returns is even higher at 70%, as would be the case if stochastic discount factors co-vary more than output. Interpreting (8) more broadly, highly correlated consumption growth (Colacito and Croce, 2011; Lewis and Liu, 2015), correlated discount rate news (Borri and Verdelhan, 2011; Viceira et al., 2016), or correlated risk premia (Longstaff et al., 2011) may further drive up the cross-country correlations between stochastic discount factors and stock returns. Moreover, correlations between international equity markets may increase during downturns, increasing their impact on risk premia (Ang and Bekaert, 2002). A different way to motivate an SDF of the form (8) and to generate the main channel in our model, would be if bond investors are domestic and hence risk-averse over domestic output, but the government has an incentive to expropriate bond holders, because ex-post it is more efficient to use the inflation tax as opposed to income or sales taxes.

We introduce a cost of borrowing in foreign currency with a highly stylized model of real exchange rate determination. We normalize the real exchange rate in period 1 to one. The period 2 real exchange rate (in units of international goods per domestic goods) is given by

$$exp\left(\varepsilon_2 - \frac{1}{2}\sigma_\varepsilon^2\right). \tag{10}$$

We specify the shock ε_2 as uncorrelated with all other shocks:

$$\varepsilon_2 \quad \sim \quad N\left(0, \sigma_\varepsilon^2\right). \tag{11}$$

The period 2 real exchange rate has mean one, implying that changes in the real exchange rate are unforecastable. We assume ε_2 is realized after the government has chosen inflation, effectively assuming that monetary policy takes effect more slowly than exchange rate shocks. A sudden appreciation of the foreign currency increases the real cost of repaying FC debt, so uncertainty about ε_2 makes FC borrowing costly ex-ante. In the model, this cost drives otherwise unconstrained borrowers, such as the US, away from FC and towards LC debt.

The international investor hence prices state-contingent claims on real domestic consumption using the log SDF

$$m_2 = m_2^* + \varepsilon_2 - \frac{1}{2}\sigma_\varepsilon^2. \tag{12}$$

We can now price three different bonds: a foreign currency bond, a nominal local currency bond, and a real local currency bond. A FC bond pays one unit of real international consumption with price

$$\begin{aligned} q_1^{FC} &= E_1\left[exp\left(m_2^*\right)\right], &(13)\\ &= \beta. &(14)\end{aligned}$$

To express LC bond prices in terms of local output, we define the investors' *effective risk aversion*

$$\phi = \theta\lambda\frac{\left(\sigma^*\right)^2}{\sigma_x^2}. \tag{15}$$

A nominal LC bond delivers $exp(-\pi_2)$ real domestic consumption units at time 2, where π_2 is a function of local output x_2. We show in Appendix A that the LC bond price is:

$$\begin{aligned} q_1^{LC} &= E_1\left[exp\left(m_2\right)exp(-\pi_2)\right], &(16)\\ &= E_1\left[exp\left(\log\beta - \phi x_2 - \frac{1}{2}\phi^2\sigma_x^2\right)exp(-\pi_2)\right]. &(17)\end{aligned}$$

LC bonds are priced as if the international investor had risk aversion ϕ over local output x_2. Expression (15) shows that the international investor is effectively more risk-averse over local output if risk aversion θ is high or if the local output loading onto world output λ is high. The ratio of the variances enters, because if local output is more volatile than world output, world output moves less than one-for-one with local output, so international investors appear less risk-averse over local output variation.

Finally, we price a real local currency bond, which is defined as delivering one unit of real domestic consumption. The real local currency bond will not be issued by the government in the model but is priced here to clarify the difference between real local currency and foreign currency debt. Its price is

$$q_1^{LC,real} = E_1\left[exp\left(m_2\right)\right], \tag{18}$$

$$= \beta. \tag{19}$$

The real exchange rate does not enter into the pricing of real and nominal LC bonds, because in expectation one unit of real domestic consumption buys one unit of real international consumption and exchange rate shocks are assumed to be uncorrelated with all other shocks. Finally, we denote one-period log bond yields by

$$y_1^{LC} = -\log q_1^{LC},\, y_1^{FC} = -\log q_1^{FC}.$$

We assume that domestic equity is a claim on domestic output and is priced by the same international investor, giving the equity risk premium faced by the international investor as

$$E_1\left(r_2^e\right) + \frac{1}{2}Var_1\left(r_2^e\right) - y_1^{FC} = \theta Cov_1\left(x_2^*, x_2\right) \tag{20}$$

$$= \phi\sigma_x^2. \tag{21}$$

Equity is in zero supply to financial investors, thereby not entering into domestic consumption. The expression for the equity premium will be useful in section 4 to calibrate the magnitude of risk premia.

We abstract from the risk of outright sovereign default. Under the assumption of simultaneous default, which Du and Schreger (2016) and Jeanneret and Souissi (2016) argue is empirically plausible, LC and FC debt by the same issuer bears the same default risk premium. Even then, issuing FC debt may be costly if it precludes the option to use inflation to avoid outright default. In the current framework, exchange rate volatility is the main driver making FC debt issuance costly, so adding such an additional cost of FC debt would act similarly to increasing the exchange rate volatility. For an analysis of the choice of the currency denomination of sovereign debt with strategic default, see Engel and Park (2016).

3.3 Budget Constraint

To focus on the portfolio choice component of the government's decision, we assume that the government must raise a fixed amount V. The government chooses face values D^{FC} and D^{LC} to satisfy the budget constraint[5]

$$D_1^{FC} q_1^{FC} + D_1^{LC} q_1^{LC} \quad = \quad V. \tag{22}$$

Let s denote the share of nominal LC bonds in the government's portfolio:

$$s_1 \quad = \quad \frac{q_1^{LC} D_1^{LC}}{V}. \tag{23}$$

Repaying one unit face value of LC debt requires giving up domestic consumption $exp(-\pi_2)$. The cost of repaying one unit of FC debt in terms of domestic consumption is the inverse real exchange rate $exp\left(-\varepsilon_2 + \frac{1}{2}\sigma_\varepsilon^2\right)$.[6] Defining the debt portfolio log return in excess of the

[5]Here, we do not explicitly allow the government to issue inflation-indexed LC debt. In contrast to the hypothetical real LC bond considered in the previous section, in practice inflation-indexed bond issuance appears to be costly. Inflation-indexed bond issuance can be costly for reasons analogous to those for foreign currency debt, if indexation is imperfect, either because the inflation index does not correspond perfectly to the domestic borrower's consumption basket, or because indexation occurs with lags. In addition, empirical evidence from the US suggests that inflation-indexed debt requires a substantial liquidity premium (Pflueger and Viceira (2016)). For this reason, in our empirical analysis we combine inflation-indexed and foreign currency debt to capture inflation-insulated debt issuance.

[6]Taking the expectation over ε_2, the average cost in terms of domestic consumption of repaying a unit face value FC bond is greater than one. While the mean exchange rate is one, the mean inverse exchange rate is not equal to one due to Jensen's inequality. To purchase one unit of international consumption, the domestic borrower expects to give up more than one unit of real domestic consumption, because he has to average over states with different exchange rates. This divergence between the expected return on risk-free real FC and LC bonds is also known as Siegel's paradox (Siegel (1972), Karolyi and Stulz (2003)).

log return on a domestic consumption risk-free bond

$$xr_2^d = \log\left(\frac{D_1^{FC} exp\left(-\varepsilon_2 + \frac{1}{2}\sigma_\varepsilon^2\right) + D_1^{LC} exp\left(-\pi_2\right)}{\beta^{-1}V}\right), \tag{24}$$

and

$$\bar{D} = \beta^{-1}V, \tag{25}$$

we can write period 2 consumption as

$$C_2 = X_2 - \bar{D} exp\left(xr_2^d\right).$$

We normalize steady-state period 2 consumption to one, so α captures the cost of inflation distortions in units of period 2 consumption.[7] Formally, we require that $\bar{X} = 1 + \bar{D}$.

3.4 Log-Quadratic Expansion for Loss Function

This section derives a log-quadratic expansion of the government loss function, which provides intuition and is used for the log-linear analytic solution. In contrast, the numerical solutions do not rely on the log-quadratic expansion, instead using the exact expressions in sections 3.1 through 3.3. Approximating local currency bond returns as log-normal, we obtain the following second-order expression for local currency bond prices

$$q_1^{LC} \approx \beta \exp\left(-E_1\pi_2 + \frac{1}{2}Var_1\pi_2 + \phi Cov_1\left(x_2, \pi_2\right)\right). \tag{26}$$

LC bond prices fall one-for-one with expected inflation. The output-inflation covariance $Cov_1\left(x_2, \pi_2\right)$ enters as a risk premium term. Intuitively, a positive output-inflation covariance means that the issuer does not inflate during bad times, making LC bonds safe from investors'

[7] Allowing period 2 steady-state consumption different from one would scale the loss function (7) by a constant, leaving the analysis unchanged.

point of view and increasing the value to investors. The approximate risk premium on local currency bonds becomes

$$y_1^{LC} - E_1\pi_2 + \frac{1}{2}Var_1\pi_2 - y_1^{FC} \;\; = \;\; -\phi Cov_1(x_2, \pi_2). \tag{27}$$

Note that provided that π_2 is a function of local output x_2, (27) also equals the possibly more familiar expression in terms global output $-\theta Cov_1\left(x_2^*, \pi_2\right)$. Using a second-order log-quadratic expansion of the form

$$exp\left(z\right) - 1 \;\; \approx \;\; z + \frac{1}{2}z^2, \tag{28}$$

the loss function (4) becomes (ignoring constants)

$$L_2 \;\; \approx \;\; \alpha\pi_2^2 - \left(c_2 + \frac{1}{2}c_2^2\right) + \frac{\gamma}{2}c_2^2. \tag{29}$$

We expand consumption in terms of output and the excess return on the debt portfolio

$$\begin{aligned} c_2 + \frac{1}{2}c_2^2 \;\; &\approx \;\; C_2 - 1, &(30)\\ &\approx \;\; \bar{X}\left(exp\left(x_2/\bar{X}\right) - 1\right) - \bar{D}\left(\exp\left(xr_2^d\right) - 1\right), &(31)\\ &= \;\; x_2 + \frac{1}{2}\frac{x_2^2}{\bar{X}} - \bar{D}\left(xr_2^d + \frac{1}{2}\left(xr_d^2\right)^2\right). &(32) \end{aligned}$$

We expand bond portfolio excess returns similarly to Campbell and Viceira (2002):

$$\begin{aligned} xr_2^d + \frac{1}{2}\left(xr_d\right)^2 \;\; &\approx \;\; exp(xr_2^d) - 1, &(33)\\ &\approx \;\; (1 - s_1)\left(exp\left(\varepsilon_2 + \frac{1}{2}\sigma_\varepsilon^2\right) - 1\right) + s_1\left(\frac{\beta}{q_1^{LC}}exp(-\pi_2) - 1\right), &(34)\\ &= \;\; (1 - s_1)\left(\varepsilon_2 + \frac{1}{2}\left(\varepsilon_2^2 + \sigma_\varepsilon^2\right)\right) &(35)\\ &\quad + s_1\left(-(\pi_2 - E_1\pi_2) + \frac{1}{2}\left((\pi_2 - E_1\pi_2)^2 - Var_1\pi_2\right) - \phi Cov_1(x_2, \pi_2)\right) \end{aligned}$$

Substituting back into the loss function (29), ignoring policy independent terms, and taking expectations over x_2, π_2, and ε_2 gives the expected loss:

$$
\begin{aligned}
E_1 L_2 \quad = \quad & \underbrace{\alpha E_1 \pi_2^2}_{\text{Inflation Cost}} + \underbrace{s_1 \bar{D} \left(\gamma - \phi\right) Cov_1(x_2, \pi_2)}_{\text{Hedging - Nominal Risk Premium}} + \underbrace{\frac{\gamma}{2} s_1^2 \bar{D}^2 Var_1 \pi_2}_{\text{Volatility LC Debt}} \\
& \underbrace{+\frac{\gamma}{2} \bar{D}^2 (1 - s_1)^2 \sigma_\varepsilon^2 + \bar{D} \left(1 - s_1\right) \sigma_\varepsilon^2}_{\text{Volatility+Convexity FC Debt}}.
\end{aligned} \tag{36}
$$

We divide the expected loss into four terms. The first term "Inflation Cost" is simply the expected welfare cost of inflation. The second term "Hedging - Nominal Risk Premium" is new and is the focus of our analysis. This term captures the welfare benefits and costs of the state contingency of local currency debt. There are two opposing forces: the welfare benefit of domestic consumption smoothing from a positive inflation-output covariance is counteracted by the risk premium that can be earned by selling insurance to risk-averse investors. If $\gamma > \phi$, the model formalizes the intuition from the introduction, where a government inflates in bad times in order smooth consumption, and the benefits of doing so outweigh the risk-premium that needs to be paid for this insurance. In contrast, if $\phi > \gamma$, the benefit to the government from selling insurance to foreign investors outweighs the desire to smooth domestic consumption. In this case, the loss function decreases with the inflation-output covariance, because a government that inflates during good times and deflates during bad times earns a risk premium from risk-averse investors, thereby raising average domestic consumption. To preview our results, one of the most important considerations in solving this problem is to understand when the government can credibly promise a less negative or even positive inflation-output covariance. As long as the investor has non-zero risk aversion ($\phi > 0$), the government wants to limit the tendency to inflate during bad states of the world ex-ante, but may deviate ex-post.

The final two terms capture losses from consumption volatility induced by the volatility in debt repayments. The volatility of debt repayments enters into expected domestic consumption utility, because domestic consumers have a non-diversified, non-zero debt position, and consumption utility is concave. The third term, "Volatility Nom. Debt" captures the utility losses from consumption volatility caused by the fact that inflation volatility induces movements in the real amount repaid on local currency debt. If the country has no local currency debt ($s_1 = 0$) this effect disappears. The final term "Volatility+Convexity Real Debt" captures losses from borrowing in foreign currency induced by fluctuations in the exchange rate and disappears if the country has no FC debt ($s_1 = 1$). Exchange rate volatility lowers expected consumption through a convexity effect and induces variation in domestic real consumption, which is costly due to utility curvature. In the same way that inflation volatility induces fluctuations in consumption by inducing volatility in local currency debt repayments, so do exchange rate fluctuations through their effect on real debt repayments on foreign currency debt. In addition, foreign currency debt is costly because the expected inverse exchange rate is greater than one over the expected exchange rate.

3.5 Analytic Solution

This section solves the model analytically. Throughout the analytic solution, we keep only first-, and second-order terms of $\bar{D}$ in the loss function. This approximation is justified if the debt-to-GDP ratio is small and clarifies the intuition of the results. While we use a second-order expansion to solve for the government's period 1 debt portfolio choice and commitment inflation policy, we rely on a first-order expansion to obtain the myopic period 2 government's optimal inflation policy. This choice simplifies the analytic solution and provides sharper intuition. We restrict ourselves to solutions where local inflation is a function of local output. While there may be interesting implications from considering differential inflation loadings onto global and local shocks, complex monetary policy rules may be hard to verify and enforce. Our solution captures the important drivers in a world, where monetary policy can only commit to a simple rule that depends only on one variable, namely local output. For solution details see Appendix A.

3.5.1 Inflation Policy Functions

The government follows different inflation policies, depending on whether the commitment state or the no-commitment state is realized in period 2. If the no-commitment state is realized, which occurs with probability $1-p$, the government myopically re-optimizes the period 2 loss function, taking as given any quantities that were determined in period 1. The no-commitment government in particular ignores the effect of its policy on bond prices, LC bond risk premia, and sovereign debt portfolio choice. The no-commitment inflation rule depends on the aggregate state x_2, but not on the exchange rate shock, which is realized after inflation:

$$\pi_2^{nc} = \frac{s_1 \bar{D}}{2\alpha} - \gamma \frac{s_1 \bar{D}}{2\alpha} x_2. \tag{37}$$

The first term in (37) captures the standard inflation bias of a myopic government. The bias increases with the amount of LC debt $s_1 \bar{D}$ and decreases in the real marginal cost of inflation α. The second term captures inflation cyclicality, showing that the incentive to inflate is greatest during recessions, when output is low and the marginal utility of consumption is high for domestic consumers. The degree of countercyclicality depends on $\gamma \frac{s_1 \bar{D}}{2\alpha}$. This term is intuitive, because γ is the curvature of the domestic agents' consumption utility and determines how much the marginal utility of consumption increases in low-consumption states. The amount of local currency debt $s_1 \bar{D}$ and the cost of generating inflation α enter similarly as for the inflation level.

The inflation rule in the commitment state takes into account effects on risk premia:

$$\pi_2^{c} = (\phi - \gamma) \frac{s_1 \bar{D}}{2\alpha} x_2. \tag{38}$$

The commitment inflation rule (38) exhibits no inflationary bias on average. Inflation-cyclicality, as captured by the inflation-output slope coefficient also changes and has a new non-negative term ϕ. The slope coefficient in (38) is positive and the government wants to commit to procyclical inflation if and only if investors have higher effective risk aversion than the government, because government debt has hedging value to investors and sells at a premium.

3.5.2 Inflation Moments and LC Debt Share

Analogously to our empirical analysis, we define the inflation-output beta as the slope from regressing period 2 log inflation π_2 onto period 2 log output x_2. The mean, variance, and inflation-output beta for period 2 inflation then equal:

$$
\begin{aligned}
E_1(\pi_2) &= (1-p)\frac{s_1\bar{D}}{2\alpha}, && (39)\\
Var_1(\pi_2) &= \left(\frac{s_1\bar{D}}{2\alpha}\right)^2 \left(p(1-p) + \left(\gamma^2 - p\phi\left(2\gamma - \phi\right)\right)\sigma_x^2\right), && (40)\\
Beta(\pi_2, x_2) &= \frac{\left(p\phi - \gamma\right)s_1\bar{D}}{2\alpha}, && (41)
\end{aligned}
$$

We can gain intuition by considering two special cases with zero credibility ($p = 0$) and full credibility ($p = 1$). With $p = 0$, the government has no ability to commit and the inflation-output beta reduces to $Beta(\pi_2, x_2) = -\frac{\gamma s_1 \bar{D}}{2\alpha}$. A government without commitment is always tempted to inflate during recessions, leading to countercyclical inflation and a negative inflation-output beta.

With full credibility ($p = 1$), the inflation-output beta becomes $Beta(\pi_2, x_2) = \frac{(\phi-\gamma)s_1\bar{D}}{2\alpha}$, which is greater than the inflation-output beta with zero commitment as long as effective investor risk aversion ϕ is positive. In particular, when $\phi = \gamma$ the full credibility government's inflation-output beta is zero and inflation is constant. More generally, provided that $\phi > 0$, (41) increases with credibility p. While it is well understood that a lack of credibility can lead to an inflationary bias, our contribution is to show that a lack of credibility can also affect inflation cyclicality, which in turn affects optimal debt issuance.

Substituting (39) through (41) into the expected loss function (36) and taking the first-order condition with respect to the LC debt share s_1 gives:

$$s_1 \quad = \quad \frac{2\alpha \left[\gamma + 1/\bar{D}\right] \sigma_\varepsilon^2}{(1-p)\left(1+\phi^2\sigma_x^2\right) - (\phi-\gamma)^2 \sigma_x^2 + 2\alpha\gamma\sigma_\varepsilon^2}. \tag{42}$$

3.5.3 Comparative Statics

From (42), we derive the comparative static for the local currency debt share with respect to credibility:

$$\begin{aligned} \frac{ds_1}{dp} &= s_1^2 \frac{1+\phi^2\sigma_x^2}{2\alpha\left[\gamma + 1/\bar{D}\right]\sigma_\varepsilon^2}, \\ &> 0. \end{aligned} \tag{43}$$

Provided that the LC debt share s_1 is at an interior solution, it increases with credibility. As credibility increases, the government faces smaller risk premia for issuing local currency debt. Moreover, the probability of inefficiently high inflation for a government with local currency debt declines. Both of these factors reinforce each other to increase the local currency debt share for high credibility governments.

Next, we explore the model implications for the relation between inflation cyclicality and LC debt shares. Combining (41) and (43) and applying the chain rule gives the total derivative:

$$\begin{aligned} \frac{dBeta(\pi_2, x_2)}{ds_1} &= \frac{\partial Beta(\pi_2, x_2)}{\partial s_1} + \frac{\partial Beta(\pi_2, x_2)}{\partial p} \frac{1}{\frac{ds_1}{dp}} \\ &= \underbrace{\frac{(p\phi - \gamma)\, D}{2\alpha}}_{\text{Direct Effect}} + \underbrace{\frac{\phi \bar{D}}{s_1} \frac{\left[\gamma + 1/\bar{D}\right]\sigma_\varepsilon^2}{\left(1+\phi^2\sigma_x^2\right)}}_{\text{Equilibrium Effect}} \end{aligned} \tag{44}$$

Our main stylized empirical fact, that finds that LC debt shares are positively related to inflation-output betas, predicts $\frac{dBeta(\pi_2,x_2)}{ds_1} > 0$. The model inflation-output beta varies with the LC debt share s_1 through two channels. First, the direct effect of a higher LC debt share is to increase both the consumption-smoothing benefits of countercyclical inflation and the amount of real consumption that can be gained from making LC debt safe for investors. Through this channel, the effect of increasing the LC debt share s_1 is proportional to the inflation-output beta (41). The first term in (44) is negative if the government is weakly more risk-averse with respect to domestic output than than investors ($\gamma > \phi$), or if credibility p is low. In this case, in order to generate a positive relation between inflation-output betas and LC debt shares as in the data, the second term would be to be sufficiently positive to outweigh the direct effect.

Second, the equilibrium relation between inflation-output betas and LC debt shares reflects the effect of credibility on both variables. Expression (41) shows that the inflation-output beta increases with credibility (strictly, if $\phi > 0$), because with higher credibility we need to put a higher weight on the stable inflation policy. Since the LC debt share also increases with credibility, variation in credibility induces a non-negative relation between LC debt shares and inflation-output betas. This second channel is larger if effective investor risk aversion ϕ is high. The reason is that a high credibility government has a stronger incentive to limit inflation state-contingency, when risk premia are large.

The case $\phi = 0$ illustrates forcefully that limited commitment alone cannot generate the upward-sloping relation between inflation-output betas and LC debt shares in the data. In this case, the consumption-smoothing motive dominates risk premium considerations, so a high credibility government optimally follows a countercylical inflation policy and the first term in (44) is negative. Intuitively, the consumption-smoothing benefit from each percentage point of inflation increases with the amount of LC debt, leading to more countercyclical inflation when the LC debt share is high. Moreover, the second term in (44) equals zero, because with risk-neutral investors a high credibility government has no incentive to provide safe debt for investors. With risk-neutral investors, the model hence implies a downward-sloping relation between inflation-output betas and LC debt shares, counter to the empirical evidence. Risk-averse investors, therefore, are essential to matching the downward-sloping empirical relation between inflation-output betas and LC debt shares.[8]

4 Calibrating the Model

In this section, we calibrate the model to examine whether the forces discussed in section 3 can quantitatively replicate the empirical patterns of inflation cyclicality and the local currency debt share. The analytic solution helps us select parameter values without an expensive grid search. We then use global solution methods to approximate the full non-linear solution (i.e. not the analytic solution). Table 3 reports calibration parameters and Table 4 compares model and empirical moments.

We solve the model for two calibrations, that differ only in terms of credibility p. The high credibility calibration uses $p_H = 1$, corresponding to full credibility, while the low credibility calibration has $p_L < 1$. We choose the low credibility calibration to target the difference in empirical moments between emerging markets and developed markets, reported in the leftmost column of Table 3. The model is solved using global solution methods.[9]

We set the government's borrowing need to 13% of GDP, corresponding to the average share of external sovereign debt in emerging markets. We set exchange rate volatility to $\sigma_\varepsilon = 14\%$ to match the median annual volatility of emerging market exchange rate returns since 1990. A substantial cost of borrowing in foreign currency implies that the share of local currency debt falls relatively slowly with respect to p in equilibrium, ensuring that even low credibility countries have some local currency debt.

[8] One might wonder whether, on the other hand, a government with more LC debt optimally chooses to attain the same degree of consumption-smoothing with less inflation variability. However, this countervailing force is dominated if consumption is far from perfectly constant and the incentive to improve consumption-hedging therefore large. If the debt-to-GDP ratio is sufficiently small, as is the case for the numerical model solution at empirically plausible emerging market debt-to-GDP ratios, the domestic consumption-stream is far from perfectly hedged. Formally, we capture limited consumption-smoothing in the analytic solution by taking an expansion with $\bar{D}^3$ small. For a solution that keeps third-order terms in $\bar{D}$, see Appendix A.

[9] We minimize the Euler equation error for the inflation policy function in the no-commitment state over the no-commitment policy function. We then minimize the loss function over the commitment policy function and the local currency debt share. Both commitment- and no-commitment policy functions for log inflation are quadratic in log output. For details and a sensitivity analysis of model moments to individual parameters see Appendix A.

With (37) and (39), we have that $E_1\pi_{2,L} = (1-p_L)E_1\pi^{nc}_{2,L}$. Identifying $E_1\pi_{2,L}$ with average emerging market survey inflation in excess of developed market survey inflation and $E_1\pi_{2,L}$ with maximum emerging market survey inflation in excess of average developed market survey inflation pins down $p_L = 1 - \frac{2.00\%}{6.07\%} = 0.67$. We calibrate the inflation cost to match average emerging market survey inflation in excess of developed market survey inflation of 2.0%. With (39) we obtain:

$$\alpha = \frac{(1-p_L)s_{1,L}\bar{D}}{2E_1\pi_{2,L}} = \frac{0.33 \times 0.5 \times 0.13}{2 \times 0.02} = 0.5. \tag{45}$$

We explore model implications for a wide range of values for ϕ. We set $\phi = \gamma$ for our benchmark calibration. The benchmark case of equal government and effective investor risk aversion has appealing implications. It implies that a full credibility issuer chooses an all LC debt portfolio and perfect inflation targeting, with no inflation variability, similarly to developed countries in our sample.[10] We choose government and effective investor risk aversion (γ and ϕ) to match the empirical difference in inflation-output betas of -0.21. We substitute into (41):

$$\begin{aligned} Beta_L(\pi_2, x_2) - Beta_H(\pi_2, x_2) &= -\frac{\gamma \bar{D} s_{1,L}}{2\alpha}(1-p_L), && (46)\\ &= -\frac{\gamma \times 0.13 \times 0.5}{2 \times 0.5} \times 0.33, && (47)\\ &= -\gamma \times 0.0215, && (48) \end{aligned}$$

indicating that we need risk aversion on the order of $\gamma = 10$ to match the empirical difference in inflation-output betas across emerging and developed markets. While a risk aversion parameter of 10 is high, it is at the upper end of values considered plausible by Mehra and Prescott (1985).

Finally, high output volatility $\sigma_y = 8\%$ is needed to generate a plausible level for the

[10] In our sample, the mean beta of local equity returns on US equity returns is .97 and the mean beta of local GDP growth on US GDP growth .86. Therefore, assuming equal risk aversion ($\gamma = \theta$) between the government and investors, the benchmark of $\gamma \approx \phi$ is natural.

equity premium. While this volatility is higher than emerging market output volatility in our sample, a higher volatility may be priced into asset markets if emerging markets are subject to crashes and crises. We do not attempt to explain the equity volatility puzzle (Shiller, 1981; LeRoy and Porter, 1981), which can be resolved if consumption and dividend growth contain a time-varying long-run component (e.g., Bansal and Yaron (2004)) or if preferences induce persistent fluctuations in risk premia (e.g., Campbell and Cochrane (1999)).

Table 4 shows that the calibration matches the empirical moments quite well. We obtain average low commitment inflation of around 3% and maximum no-commitment inflation of 8%. The inflation-output beta for the low credibility calibration is -0.27 compared to a high credibility beta of 0, matching the difference in betas in the data. The small difference between the global and analytic solutions reassures us that our approximations capture the main forces at play.

4.1 Policy Functions

Figure 3 contrasts government policy functions for inflation and real debt repayments as functions of log output. The top two panels show log inflation (left) and the conditional expected real debt portfolio excess excess return (right), averaged across commitment and no-commitment states. Blue solid lines correspond to low credibility and red dashed lines correspond to high credibility. All policy functions in Figure 3 use numerical solution methods.

The left panels of Figure 3 illustrate the inflation policy function features discussed in section 3.5. The top left panel shows that the low credibility government implements a state-contingent inflation policy function, that is higher on average than for the high credibility government, and especially so during low output states. The middle and lower panels of Figure 3 decompose the differences between high and low credibility governments across commitment- and no-commitment states. In the commitment state, the low credibility government sets inflation to zero similarly to the high credibility government. In the no-commitment state, the low credibility government inflates away its local currency debt and chooses especially high inflation in low output states. The low credibility government reaches the no-commitment state with positive probability $1 - p_L > 0$, while the high credibility government reaches it with probability 0, so the average inflation profile for the low credibility government is higher and more countercyclical.

The right panels of Figure 3 show real debt portfolio excess returns, which are related to inflation by taking the expectation of (24) with respect to ε_2. The top right panel shows that countercyclical inflation translates into procyclical real debt repayments for the low credibility country. This is intuitive, because surprise inflation lowers real debt repayments on LC debt in low output states.

Even in the commitment state, credibility affects real excess returns of the sovereign bond portfolio, even though inflation in this state is close to zero. Credibility enters because ex-ante LC bond prices reflect non-zero inflation expectations and inflation risk premia, which can raise the cost of repaying LC debt ex-post. The low credibility government's real debt repayments are highest in the commitment state, because this is a state of surprisingly low inflation relative to ex-ante investor expectations. With high average inflation expectations, the low credibility government has to issue a large face value of LC debt to raise a given amount of real resources, so in a state of low realized inflation real debt repayments are high. In the no-commitment state, real debt portfolio excess returns are close to zero on average, reflecting higher average inflation, and lowest in recessions, when inflation is high.

The analytic solution provides intuition regarding the average level of debt portfolio excess returns in the top right panel of Figure 3. Taking expectations of (35) over ε_2 and $\pi_2(x_2)$ and substituting $\phi = \gamma$ into (41), the analytic average debt portfolio excess return equals:

$$E_1\left[xr_2^d + \frac{1}{2}Var_1 xr_2^d\right] = (1 - s_1)\,\sigma_\varepsilon^2 + (1 - p)\,\frac{s_1^2 \bar{D}}{2\alpha}\gamma^2\sigma_x^2. \tag{49}$$

The average debt portfolio excess return equals the FC debt share times the expected excess return required on FC debt plus the LC debt share times the LC bond risk premium. Investors understand that LC bonds issued by a high credibility government provide better hedging and require lower returns in excess of the real risk-free rate. This drives home a key insight of the model, namely that low credibility countries have an incentive to inflate away their local currency debt during states of the world that investors also value most, which leads those governments to pay more in expectation on their debt portfolios. Importantly, the average inflationary bias does not enter in (49) and does not lead to higher debt repayments and lower consumption on average. The reason is that bond prices adjust one-for-one with expected inflation and only the comovement between inflation and investor marginal utility commands a risk premium.

We use the approximate analytic expression (49) for a simple back-of-the-envelope calculation. In the top right panel of Figure 3, the average gap in debt portfolio excess returns between low and high credibility governments is 1.75 percentage points. With LC bond risk premia of approximately $RP_L = -\phi \times Beta(\pi_2, x_2)_L \times \sigma_x^2 = 1.73$ percentage points, about $s_L \times RP_L = 0.54 \times 1.73 = 0.93$ percentage points of the gap in average excess returns is due to local currency bond risk premia, with the remainder due to real exchange rate volatility and the expected excess return on foreign currency debt.

4.2 Comparative Statics

In this section, we analyze how local currency debt issuance, inflation, inflation-output betas, and local currency risk premia vary with credibility and investor risk aversion.

4.2.1 Credibility

Figure 4 shows that changes in credibility, or the probability of honoring the previously announced inflation plan, can explain substantial differences along key dimensions. An increase in credibility makes it less likely that the government will be tempted to inflate away the debt, leading to lower inflation expectations. A low credibility government is especially tempted to inflate away the debt during recessions, generating an upward-sloping relation between inflation-output betas and credibility. Risk-averse international investors require a return premium for holding local currency bonds that lose value precisely when marginal utility is high, driving up local currency risk premia for low credibility governments. Finally, low credibility governments issue a smaller share of local currency debt, to constrain themselves from inflating in low output states, thereby reducing the real costs of inflation and risk premia.

4.2.2 Investor Risk Aversion

Figure 5 shows that model predictions vary substantially with investor risk aversion. In the case with risk neutral investors ($\phi = 0$), investors charge no risk premium for inflation-output covariances. In this case, the low credibility government has a high LC debt share, generates high inflation, and a strongly negative inflation-output beta. In fact, low and high credibility governments generate almost identical inflation-output betas, indicating clearly that this case cannot explain the cross-country variation in inflation cyclicality in the data.

While the benchmark calibration in Tables 3 and 4 replicates the empirical fact that inflation-output betas are greater in developed than emerging markets, it can only generate non-positive inflation-output betas. In the data, however, the US has a substantially positive inflation-output beta of 0.15. Figure 5 shows that the model can generate a positive inflation-output beta for the high credibility government, if investors are effectively more risk-averse than the government ($\phi = 12$). With highly risk-averse investors, it is the government that sells insurance to the global investor by issuing LC debt, rather than the risk-neutral investor insuring the government by buying it. Higher investor risk aversion than government risk aversion could be due to political economy reasons, that induce the government to not fully adjust for risk. For instance, the risk of losing elections may lead to a divergence between private and government incentives especially during low output states, much as in Aguiar and Amador (2011), where a lower discount factor driven by political economy forces can engender a bias toward more debt.

5 Testing Additional Empirical Implications

The model presented in the previous two sections highlights the importance of monetary policy credibility for the level and cyclicality of local currency risk and sovereign debt portfolios. This section tests additional model predictions and provides direct evidence for our proposed mechanism. We provide evidence for the following three predictions: First, countries with positive bond-stock betas should require higher LC bond risk premia. Second, low credibility countries should have higher LC bond risk premia. Third, LC debt shares should be inversely related to risk premia embedded in LC bonds.

5.1 Empirical Drivers of Risk Premia

In the model, bond risk premia act as an important channel linking monetary policy credibility, bond return cyclicality, and sovereign debt portfolios. We measure ex-ante risk premia for our cross-section of countries to correspond to the left-hand-side of (27):

$$\overline{RP} = \overline{y^{LC}} - \bar{\pi} + \frac{1}{2}Var\pi - \left(\overline{y^{US}} - \overline{\pi^{US}} + \frac{1}{2}Var\pi^{US}\right). \tag{50}$$

A bar indicates the mean from 2005-2014. Intuitively, (50) removes average local inflation from local currency bond yields to isolate the risk premium component. Unlike in the model, we correct for the fact that US inflation is non-zero. In Appendix B, we show that results are quantitatively and qualitatively robust to adjusting LC bond yields for default risk using synthetic default-free local currency bonds as in (Du and Schreger, 2016).[11]

[11]Due to our short sample, ex-post bond risk premia, measured as realized excess returns, are extremely noisy. We therefore prefer ex-ante measures, corresponding to those that governments see when making issuance decisions.

In the model, bond risk premia are driven by the comovement with international fundamentals. While comovement with international fundamentals is unlikely to explain all cross-sectional variation in LC bond risk premia, showing a qualitatively and quantitatively significant relation between bond risk premia and bond return comovements with US stock returns will provide important evidence for our proposed channel. We decompose each country's risk-premium into two components by estimating the following regression:

$$\overline{RP_i} = \alpha + \kappa b(bond, S\&P)_i + \varepsilon_i. \tag{51}$$

Here, US stock returns proxy for world stock returns if the US equity market is well integrated with the rest of the world.

Column (2) of Table 5 estimates regression (51) and finds a statistically significant and quantitatively meaningful estimate for κ. A one unit increase in the bond-S&P beta is associated with an increase in the risk premium of ten percentage points in annualized units, which is the same order of magnitude as the US equity premium. The bond-S&P beta not only carries an economically and statistically significant price of risk, it also explains a substantial portion of cross-sectional variation in LC bond risk premia, with an R-squared of more than 40%. The estimated slope coefficient is similar in column (1), where we use the beta with respect to the local stock market instead of the S&P, supporting the notion that LC bonds that are the best hedges for the issuer tend to require the highest risk premia.

Going back to the decomposition of effective investor risk aversion as the product of risk aversion and comovement of international and local fundamentals, one might be concerned that LC bond risk premia are driven by cross-country differences in the comovement of local and international fundamentals. Using the definition for ϕ in (15) and the inflation-output beta $Beta(\pi_2, x_2) = \frac{Cov_2(\pi_2, x_2)}{\sigma_{x^2}}$, we decompose approximate LC bond risk premia (27) as

$$y_1^{LC} - E_1\pi_2 + \frac{1}{2}Var_1\pi_2 - y_1^{FC} \approx \theta \left(\sigma^*\right)^2 \lambda Beta(\pi_2, x_2). \tag{52}$$

LC bond risk premia are the product of a factor $\theta\left(\sigma^{*}\right)^{2}$ that only depends on international investors' fundamental preferences and is the same across countries, and two factors that potentially differ across countries, the local-global output beta λ and the inflation-output beta $Beta(\pi_2, x_2)$. Column (3) of Table 5 interacts $b(bond, stock)$ with the beta of local stock returns onto US S&P stock returns and finds that the interaction $b(bond, stock) \times b(stock, S\&P)$ enters with a large and highly statistically significant coefficient similar to column (1). Column (4) regresses risk premia onto $b(stock, S\&P)$ and finds that on its own, this proxy for comovement between local and global fundamentals has no explanatory power for LC bond risk premia. The findings in columns (3) and (4) are reassuring in that they indicate that cross-country variation in LC bond risk premia are indeed primarily driven by differences in cyclicality of local monetary policy with respect to local fundamentals, consistent with the model mechanism.

Table 5 also provides evidence on the link between bond risk premia and monetary policy credibility using two de-facto measures that we construct. We prefer de-facto measures of central bank credibility to de-jure ones because recent measures of de-jure central bank independence have been found to be uncorrelated with average inflation (Crowe and Meade, 2007). Using Financial Times articles over the period 1995-2015, we construct the correlation between the key words "debt" and "inflation" for each country as a proxy for inverse inflation credibility. The intuition is that if inflation is solely determined by the central bank and debt is determined by the fiscal authority, these topics should be discussed separately, and the correlation should be low. On the other hand, if inflation and debt are determined by the same central government, we would expect newspaper articles to discuss both jointly, and the correlation should be high. We count the number of articles containing both keywords and the country name and divide them by the geometric average of the articles that contain one of the keywords combined with the country name. Consistent with the model, column (4) of Table 5 shows that this de-facto monetary policy credibility measure is strongly correlated with risk premia, with an R^2 of 42.4%.

Column (5) uses the gap between announced inflation targets and survey expectations to measure inverse inflation credibility. If credibility is low, we expect survey inflation to exceed announced inflation targets. We define the "Credibility Gap" as the greater of the average difference between the central bank inflation target and survey inflation expectations and zero. Over the past decade, on average, the emerging markets in the sample have a mean credibility gap of 0.6 percent, whereas the developed markets in the sample have a mean credibility gap of 0.1 percent. Column (5) suggests that a 0.5 percentage point increase in the credibility gap, corresponding to the average difference between emerging and developed countries, is associated with a two percentage point increase in LC bond risk premia, which is economically large and in line with model predictions.

5.2 Evidence on Bond Risk Premia and Debt Portfolio Choice

Next, we turn to the model prediction that LC debt shares are negatively related to LC bond risk premia, and in particular to the component of LC bond risk premia that derives from bond return comovements with the international investor's SDF. Consistent with this prediction, Table 6 shows a negative and statistically significant relation between LC debt shares on the left-hand-side and LC bond risk premia on the right-hand-side. LC bond risk premia explain a substantial 45% of variation in LC debt shares. A 2.4 percentage point increase in LC bond risk premia, roughly the average difference between emerging and developed countries, is associated with a $(2.4 \times 8.6 =)$ 21 percentage point decrease in the LC debt share. Next, we decompose the risk premium into a world CAPM component – the component explained by the bond-S&P beta – and the alpha with respect to the US S&P:

$$RP_{CAPM,i} = \hat{\kappa} b(bond, S\&P)_i, \tag{53}$$

$$a_{CAPM,i} = \overline{RP}_i - RP_{CAPM,i}, \tag{54}$$

where $\hat{\kappa}$ is the slope coefficient estimated in Table 5, column (2). The estimated alpha a_{CAPM} may reflect measurement error of the CAPM risk premium, for instance if the S&P is an imperfect proxy for the world portfolio, or pricing errors on the part of investors, so we would expect LC debt shares to decreases with both RP_{CAPM} and a_{CAPM}. Table 6 column (2) supports the notion that sovereign issuers reduce LC issuance in response to higher LC bond risk premia, and that the riskiness of LC bonds for US investors, as proxied by the bond-S&P beta, accounts for a substantial portion the downward-sloping relation between LC debt issuance and LC risk premia. Columns (2) and (3) show that while both components of the risk premium contribute significantly to the explanatory power of risk premia for local currency debt shares, our proxy for the CAPM component enters with a larger coefficient and explains more than half the R-squared in column (1). Columns (4) through (6) show that the relation between risk premia and LC debt shares is robust to controlling for size, foreign exchange rate regime, and inflation.

6 Conclusion

This paper argues that differences in monetary policy credibility, combined with investors that require a risk premium for holding positive-beta bonds, explain the relation between sovereign debt portfolios and government bond risks across countries. We document that sovereigns whose local currency bonds tend to depreciate during recessions and hence provide the borrower with consumption-smoothing benefits, issue little local currency debt. We explain this stylized fact with a model where risk-averse investors charge a premium for holding local currency bonds that lose value during recessions, thereby making local currency debt expensive for low credibility governments and driving them towards foreign currency debt issuance. Importantly, both limited commitment on the issuer's part and investor risk aversion are necessary to match the empirical evidence. The key contribution of the paper is to demonstrate how the interaction of lender risk aversion and monetary credibility can explain why countries with positive bond-stock betas, that would seemingly achieve most consumption-smoothing from issuing local currency debt, have the lowest local currency debt share. Our simple framework gives rise to a number of testable predictions on inflation, inflation-cyclicality, sovereign debt portfolios, and proxies of effective monetary policy credibility, which we verify in the data.

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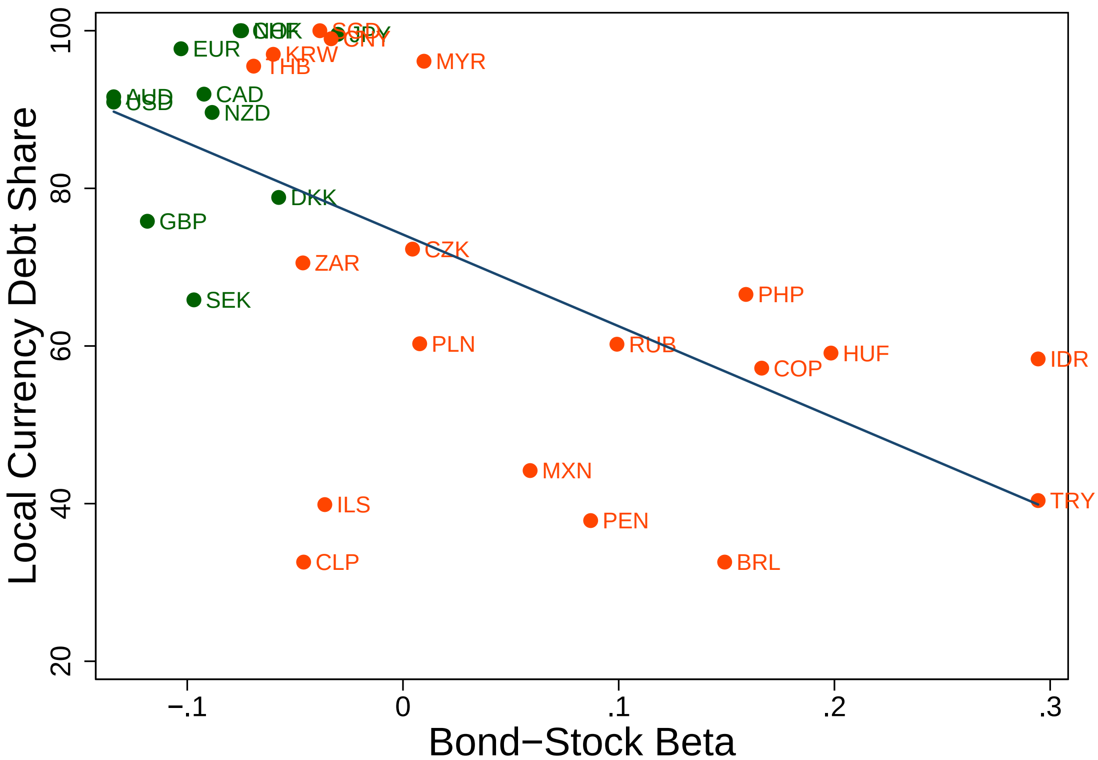
Figure 1: Local Currency Debt Shares and Bond Betas



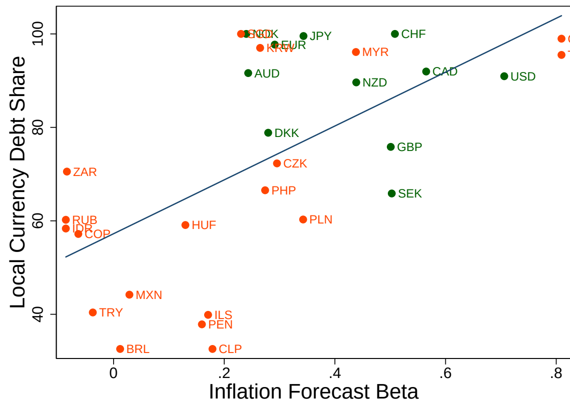
Note: This figure shows the share of local currency debt as a fraction of central government debt (in %) over the period 2005-2014. Bond-stock betas are estimated as the slope coefficient of quarterly local currency bond log excess returns onto local stock market log excess returns over the same time period

$$xr^{LC}_{t+\Delta t} = b_0 + b(bond, stock) \times xr^{m}_{t+\Delta t} + \epsilon_t.$$

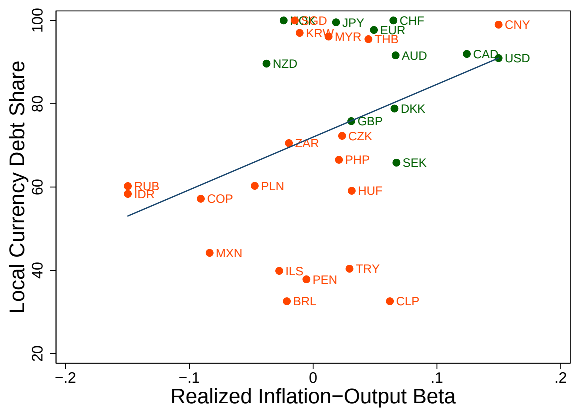
Three-letter codes indicate currencies. Emerging markets are shown in red and developed markets in green. The highest and lowest observation are winsorized.

Figure 2: Local Currency Debt Shares, Inflation Betas, and Local Currency Bond Betas

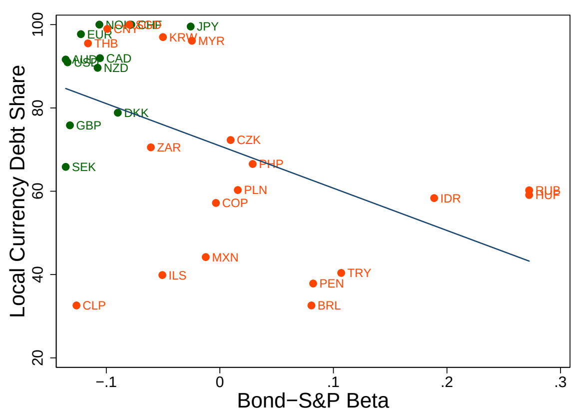
(A) Local Currency Debt Share vs. Inflation Forecast Beta



(B) Local Currency Debt Share vs. Realized Inflation-Output Beta

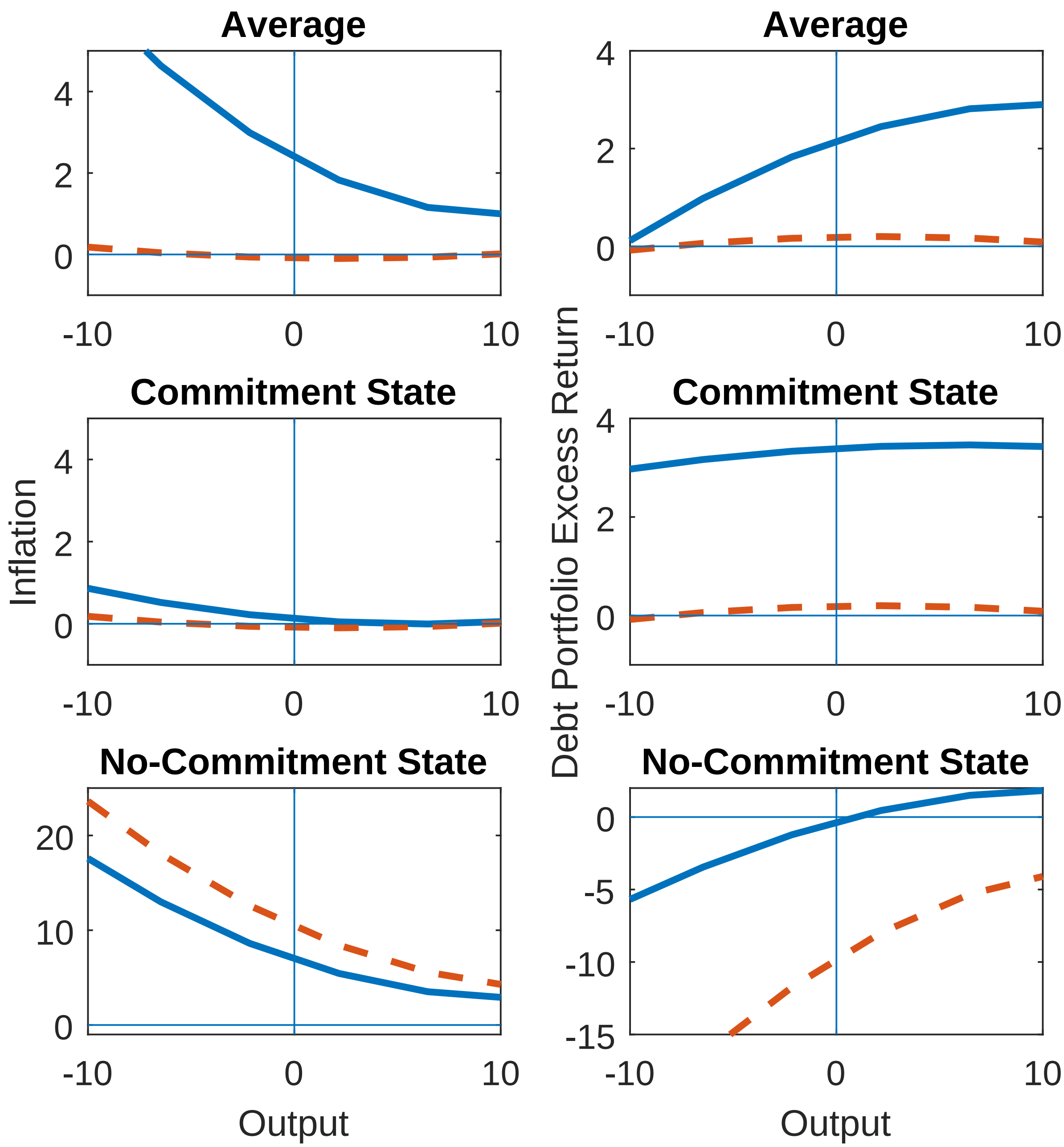


(C) Local Currency Debt Share vs. Bond-S&P Betas



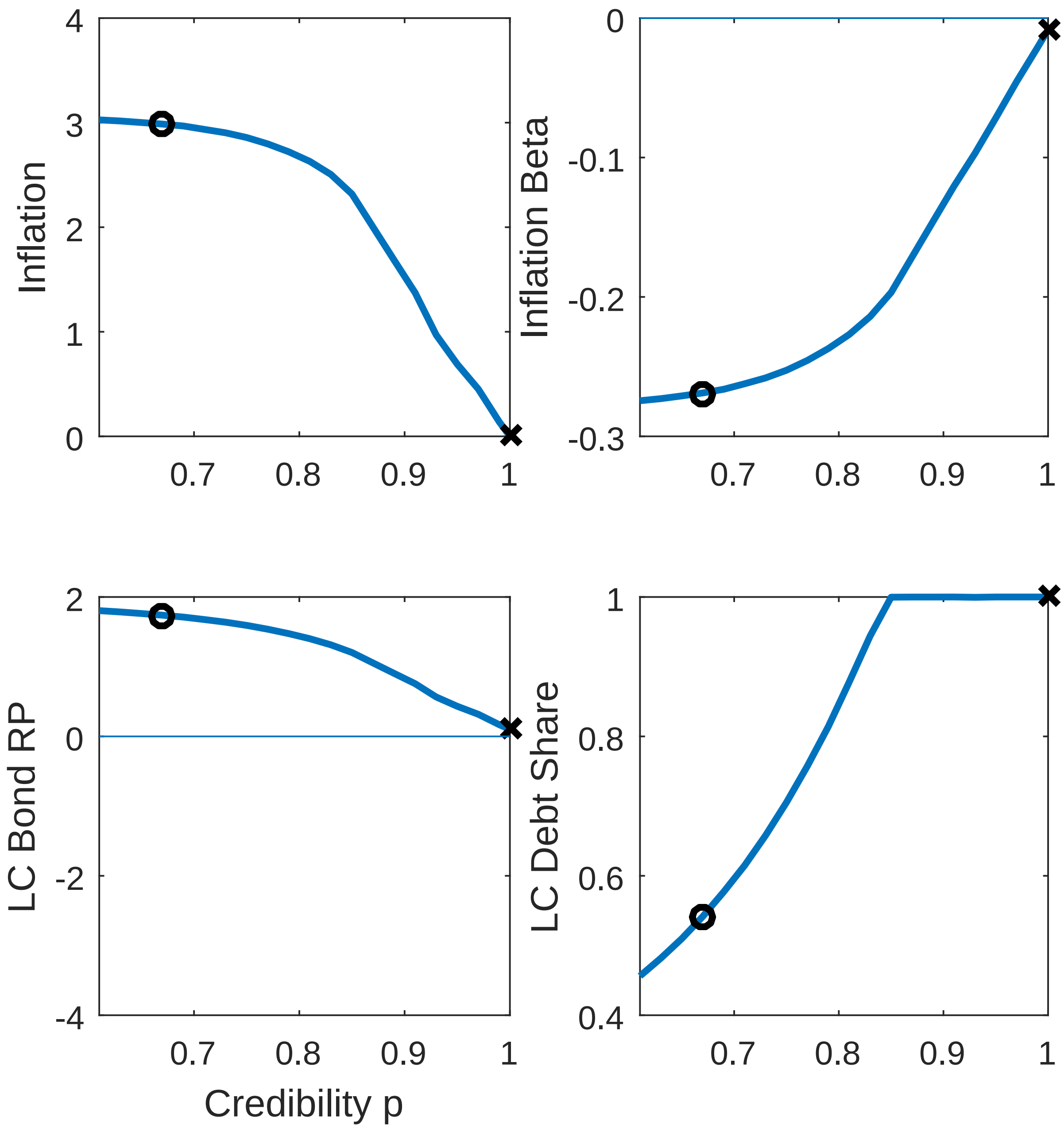
Note: Panels (A), (B), and (C) plot the share of local currency debt in the sovereign debt portfolio on the y-axis against expected inflation-output betas, realized inflation-output betas, and the beta of local currency bond returns with S&P returns, respectively. Developed markets are denoted by green dots and emerging markets are denoted by red dots. The three-letter currency code is used to label countries. The highest and lowest observation are winsorized. More details on variable definitions can be found in section 2.

Figure 3: Policy Functions



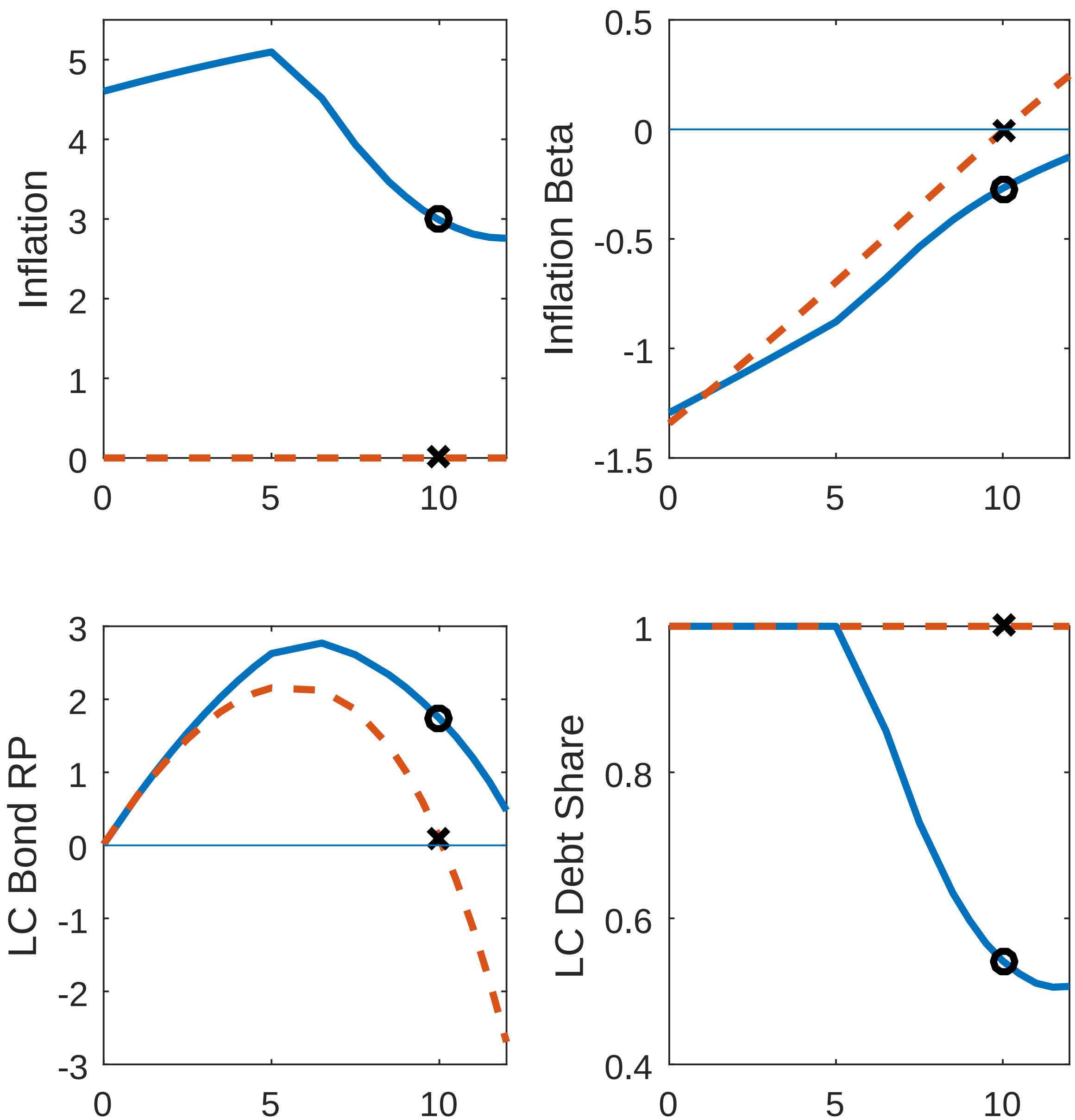
Note: Blue solid indicates the low credibility calibration, while red dashed indicates the high credibility calibration. Left panels show log inflation. Right panels show real debt portfolio excess returns in percent, following equation (24). The y-axis shows log output in percent deviations from the steady-state. "Average" refers to the weighted average across commitment and no-commitment states, where the weights are given by credibility p.

Figure 4: Varying Credibility



Note: This figure shows average inflation, the inflation-output beta, local currency bond risk premia, and the local currency debt share while varying credibility p. All other parameters are held constant at values shown in Table 3.

Figure 5: Varying Effective Investor Risk Aversion



Note: This figure shows average log inflation, the inflation-output beta, local currency bond risk premia, and the local currency debt share against effective investor risk aversion ϕ for low credibility (blue solid) and high credibility (red dashed) calibrations. All other parameters are held constant at values shown in Table 3.

Table 1: Summary Statistics for Developed and Emerging Markets (2005-2014)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	π	Survey π	$b(\tilde{\pi},\widetilde{gdp})$	$b(\pi, IP)$	y^{LC}	$b(bond, stock)$	s
(A) Developed Markets ($N = 11$)							
Mean	1.70	1.83	0.42	0.05	2.62	-0.10	89.27
S.d.	0.81	0.64	0.15	0.06	1.24	0.04	11.23
Max	2.68	2.68	0.71	0.15	4.87	-0.03	100.00
Min	0.26	0.32	0.24	-0.04	0.61	-0.18	65.85
(B) Emerging Markets ($N = 19$)							
Mean	4.09	3.83	0.20	-0.02	6.01	0.06	63.11
S.d.	2.05	1.66	0.32	0.15	2.91	0.12	25.58
Max	9.07	7.90	1.07	0.35	12.33	0.32	100.00
Min	2.05	2.06	-0.25	-0.50	1.67	-0.07	11.97
(C) Full Sample ($N = 30$)							
Mean	3.21	3.10	0.28	0.01	4.77	0.01	72.70
S.d.	2.05	1.68	0.28	0.13	2.92	0.13	24.78
Max	9.07	7.90	1.07	0.35	12.33	0.32	100.00
Min	0.26	0.32	-0.25	-0.50	0.61	-0.18	11.97
(D) Mean Difference between Emerging and Developed Markets							
Mean Diff.	-2.391***	-2.004***	0.215**	0.0736*	-3.388***	-0.160***	26.16***
	(0.531)	(0.428)	(0.0858)	(0.0388)	(0.767)	(0.0303)	(6.791)

Note: This table reports summary statistics for the cross-sectional mean of seven variables for developed and emerging market groups. The variables include (1) π, realized inflation (%), (2) Survey π, survey inflation (%), (3) $b(\tilde{\pi},\widetilde{gdp})$, inflation-output forecast beta, (4) $b(\pi, IP)$, realized inflation-output beta, (5) y^{LC}, five-year local currency LC bond yield, (6) $b(bond, stock)$, bond-stock beta, and (7) s, percentage share of local currency debt in total sovereign debt portfolios. Panel (A) reports results for developed markets. Panel (B) reports results for emerging markets. Panel (C) reports results for the pooled sample. Panel (D) tests the mean difference between developed and emerging markets. Robust standard errors are reported in parentheses. Significance levels are denoted by *** p<0.01, ** p<0.05, * p<0.1.

Table 2: Cross-Sectional Regression of Local Currency Debt Shares on Nominal Risk Betas

	(1)	(2)	(3)	(4)	(5)
Local Currency Debt Share	s	s	s	s	s
$b(bond, stock)$	-110.0***			-94.50**	-93.55**
	(20.45)			(36.85)	(37.02)
$b(\tilde{\pi}, \widetilde{gdp})$		50.35***			
		(8.872)			
$b(\pi, IP)$			58.91**		
			(21.50)		
log(GDP)				2.512	2.759
				(4.784)	(4.766)
FX Regime					-2.320
					(3.388)
Constant	73.33***	58.42***	72.36***	49.40	53.72
	(3.854)	(5.191)	(4.376)	(47.43)	(49.65)
Observations	30	30	30	30	30
R-squared	0.310	0.334	0.094	0.317	0.322

Note: This table shows the cross-country regression results of the local currency debt share, s (between 0 and 1), on measures of inflation cyclicality. The independent variables in the first three columns are the bond-stock beta ($b(bond, stock)$), the inflation forecast beta ($b(\tilde{\pi}, \widetilde{gdp})$) and the realized inflation- output beta ($b(\pi, IP)$), respectively. In Column (4), we control for the mean log per capita GDP level between 2005 and 2014, log(GDP). In Column (5), we control for the average exchange rate classification used in Reinhart and Rogoff (2004), FX regime. More details on variable definitions can be found in section 2. Robust standard errors are used in all regressions with the significance level indicated by *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Calibration Parameters

Parameter		Low Credibility	High Credibility
Credibility	p	0.67	1.00
Inflation Cost	α	0.50	
Output Vol.	σ_x	0.08	
Government Risk Aversion	γ	10	
Effective Investor Risk Aversion	ϕ	10	
Debt/GDP	$\bar{D}$	0.13	
Exchange Rate Vol.	σ_ε	0.14	

Note: All parameters are in annualized natural units.

Table 4: Empirical and Model Moments

	Data	Model	
	Emerging-Developed	Low Credibility	High Credibility
Average Inflation	2.00	2.99	0.00
No-Commitment Inflation	6.07	8.48	12.00
Inflation Beta	-0.21	-0.27	-0.01
LC Debt Share	0.63	0.54	1.00
Equity Risk Premium	6.35	6.25	6.25

Note: All moments are in annualized natural units. The empirical moment for average inflation is the difference between average survey inflation for emerging and developed markets in Table 1. The empirical inflation-output beta is computed as the difference between average expected inflation-output betas in emerging and developed markets. The empirical no-commitment inflation is computed as the difference between maximum emerging market survey inflation and average developed market survey inflation in Table 1. The equity risk premium is the average local equity excess return in our sample. All model moments are computed using global solution methods.

Table 5: Empirical Drivers of Bond Risk Premia

	(1)	(2)	(3)	(4)	(5)	(6)
LC Bond Risk Premium	RP	RP	RP	RP	RP	RP
$b(bond, stock)$	12.01***					
	(1.678)					
$b(bond, S\&P)$		10.03***				
		(2.296)				
$b(bond, stock) \times b(stock, S\&P)$			11.31***			
			(1.613)			
$b(stock, S\&P)$				0.0704		
				(1.472)		
News Correlation					26.04***	
					(5.738)	
Credibility Gap						4.017***
						(0.890)
Constant	1.563***	1.888***	1.478***	1.572	-3.721***	0.163
	(0.200)	(0.265)	(0.204)	(1.475)	(1.209)	(0.442)
Observations	30	30	30	30	30	22
R-squared	0.646	0.405	0.637	0.000	0.424	0.505

Note: This table regresses the empirical risk premium proxy (50) on bond-stock betas and measures of monetary policy credibility. $b(bond, stock)$ is the beta of LC bond excess returns with respect to the local stock market. $b(bond, S\&P)$ is the beta of LC bond returns with respect to US S&P returns. $b(bond, stock) \times b(stock, S\&P)$ is the interaction of bond-local stock return betas and the beta of local on US equity returns. $b(stock, S\&P)$ is the beta of local on US equity returns. "News Count" is the correlation of the keywords "debt" and "inflation" in Financial Times articles 1996-2015 from ProQuest Historical Newspapers. We compute the correlation as the number of articles mentioning both "debt" and "inflation" divided by the geometric average of articles that mention either "debt" or "inflation". We require articles to also mention the country name. The inflation credibility gap is measured as the mean difference between the survey inflation expectations from Consensus Economics and the announced inflation target since 2005. Robust standard errors are used in all regressions with the significance level indicated by *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Local Currency Debt Share and Bond Risk Premia

	(1)	(2)	(3)	(4)	(5)	(6)
Local Currency Debt Share	s	s	s	s	s	s
Risk Premium	-8.604***			-9.731***	-7.155***	-8.497***
	(1.481)			(2.511)	(1.951)	(2.526)
RP_{CAPM}		-10.12***	-10.12***			
		(2.946)	(2.629)			
a_{CAPM}			-7.568***			
			(2.180)			
Log (GDP)				-2.036		-3.163
				(4.423)		(4.555)
FX Regime				3.174		3.402
				(3.096)		(2.981)
Average Inflation					-1.901	-2.309
					(1.603)	(1.725)
Constant	87.50***	70.88***	85.17***	99.55**	91.17***	114.9**
	(3.766)	(3.739)	(4.639)	(46.66)	(5.528)	(50.19)
Observations	30	30	30	30	30	30
R-squared	0.448	0.251	0.457	0.458	0.460	0.475

Note: This table regresses the average local currency debt share onto our empirical risk premium proxy, defined in Equation (50). RP_{CAPM} is the risk premium component explained by the bond-S&P beta and a_{CAPM} is the corresponding alpha, as defined in (53) and (54). The FX Regime is from Reinhart and Rogoff (2004). Robust standard errors are used in all regressions with the significance level indicated by *** p<0.01, ** p<0.05, * p<0.1.