

# The Currency Denomination of Debt and Government Spending Shocks

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November 23, 2015

# Motivation

Fiscal policy issues in open economy have not been investigated in depth by either the empirical or the theoretical literature.

- Focus on the role of public debt policies
- Take into account the currency denomination of debt

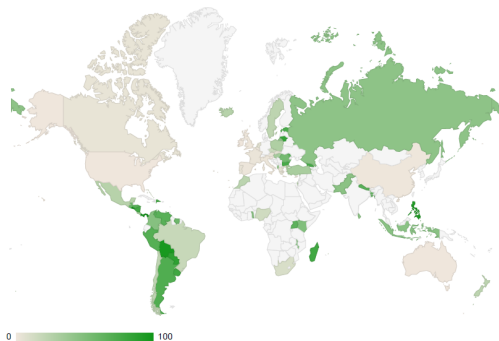


Figure: % of public debt denominated in foreign currency [Data](#)

# Research question

Taking into account the currency denomination of public debt, we study

- the consequences of fiscal stimulus
- the transmission of government spending shocks

# What I do

- **Document empirical evidence:**

- Use panel structure VAR analysis to document empirical differences in dynamic effects of government spending shocks.
- Allow the level of debt depends on other endogenous macroeconomic variables.
- Follow the iterative bootstrap procedure in Everaert and Pozzi (2007) to compute bias-corrected error bands for the estimated impulse responses.

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- **Propose a theoretical explanation:**

- Build a small open economy model and compare two model specifications that differ in the currency denomination of debt.
- Introduce a feedback from the expected currency depreciation to the risk premium on the debt denominated in foreign currency.

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- **Propose a generalized model:**

- Propose a generalized model that accommodates both types of debts and still allows us to replicate the empirical findings.
- Allow for the positive correlation between the share of foreign currency denominated debt and the feedback from the expected nominal exchange rate depreciation to the risk premium.

# Literature: Empirical research

- VAR techniques are widely used to analyze the dynamic effects of fiscal policy.
  - Blanchard and Perotti (2002), Corsetti and Müller (2006), Kim and Roubini (2008), Monacelli and Perotti (2010), and Ravn et al. (2012).
- Allow for a feedback from debt to the endogenous macroeconomic variables.
  - Favero and Giavazzi (2007) and Ilzetzi (2011)
- Shift the focus to emerging and less developed countries.
  - Ilzetzi (2011), Ilzetzi et al. (2013)

# Literature: Theoretical research

- Conventional New Open Economy Macroeconomics (NOEM) models do not allow detailed considerations of fiscal issues because of
  - the assumptions of complete financial markets
  - Ricardian equivalence holding
- Few attempts have been made to study the transmission of fiscal shocks.
  - Ganelli (2005) introduces an overlapping generations structure in a NOEM model.
  - Galí et al. (2007) introduces hand-to-mouth households to a closed economy analysis.
  - Corsetti et al. (2012) introduces a feedback from debt to government spending.
- Extend a small open economy New Keynesian model in Galí and Monacelli (2005) to include a public sector.
  - price rigidities in the form of price adjustment cost
  - deviations from PPP in the form of home bias in consumption
  - endogenous monetary policy reaction given by an interest rate rule



# Part I:

## Empirical evidence

# Data

Country	FC debt share	Sample Period
<i>HFC:</i>		
ARG	64%	2003Q4 – 2012Q1
PER	66%	2003Q1 – 2011Q4
URY	77%	2003Q1 – 2011Q2
 <i>LFC:</i>		
BRA	10%	2003Q1 – 2011Q3
COL	45%	2003Q1 – 2011Q4
MEX	23%	2003Q1 – 2011Q2

# Empirical model

$$A_0 \cdot Y_{j,t} = A_j + B(L) Y_{j,t-1} + C(L) d_{j,t-1} + u_{j,t}$$

$$d_{j,t} = \underbrace{\frac{(1 + i_{j,t}) [\delta \cdot (1 + \Delta s_{j,t}) + (1 - \delta)]}{(1 + \pi_{j,t}) (1 + \hat{y}_{j,t} - \hat{y}_{j,t-1})}}_{\text{total debt payment to GDP}} d_{j,t-1} + \underbrace{\frac{\exp(\hat{g}_{j,t}) - \exp(\hat{\tau}_{j,t})}{\exp(\hat{y}_{j,t})}}_{\text{primary deficit to GDP}}$$

- $\hat{g}_{j,t}$ : government spending
- $\hat{\tau}_{j,t}$ : implicit fiscal revenues
  - We first construct a measure of fiscal revenue that is the difference between government consumption expenditure and primary deficit so we have  $\hat{g}_{j,t} - \hat{\tau}_{j,t}$  approximate the detrended primary deficit.
- $\hat{y}_{j,t}$ : output
- $\hat{c}_{j,t}$ : consumption
- $\pi_{j,t}$ : the rate of inflation
- $i_{j,t}$ : the average interest rate faced by government
- $\Delta s_{j,t}$ : the rate of nominal exchange rate depreciation
  - $\delta$  is the ratio of debt denominated in foreign currency.  
We have  $\delta_{HFC} = 0.71$  and  $\delta_{LFC} = 0.28$ .

# Identification strategy

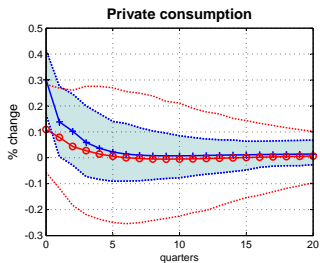
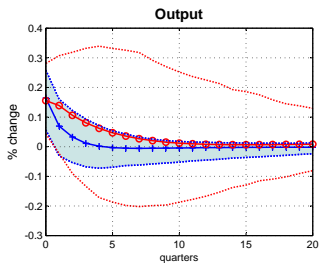
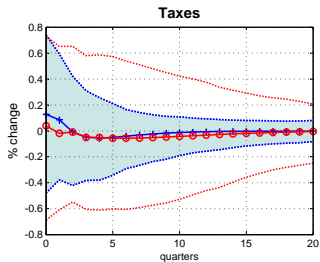
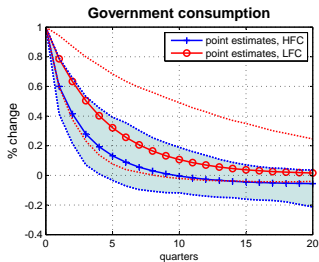
$$A_0 \cdot Y_{j,t} = A_j + B(L) Y_{j,t-1} + C(L) d_{j,t-1} + u_{j,t}$$

- $A_0$  is a lower triangular matrix.
- The identification problem does not change when debt is included in the model.
  - The number of shocks remains the same.
  - There are no parameters to be estimated in the debt-accumulation equation.
- Estimate a reduced form VAR model and compute the Cholesky factorization of the VAR covariance matrix

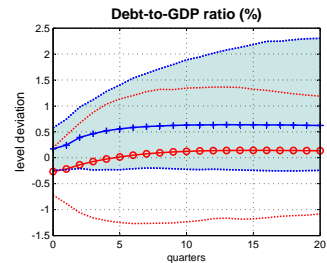
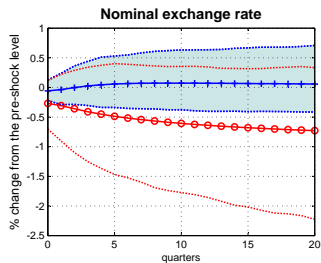
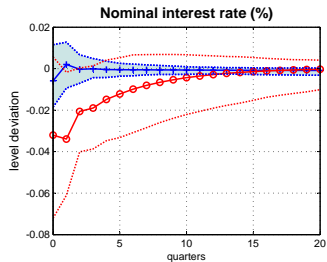
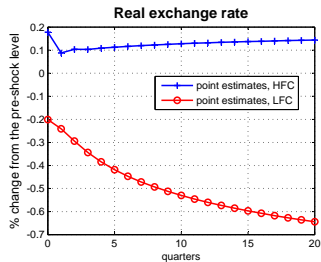
$$Y_{j,t} = D_{j,c} + D(L) Y_{j,t-1} + E(L) d_{j,t-1} + e_{j,t}$$

$$d_{j,t} = \frac{(1 + i_{j,t}) [\delta \cdot (1 + \Delta s_{j,t}) + (1 - \delta)]}{(1 + \pi_{j,t}) (1 + \hat{y}_{j,t} - \hat{y}_{j,t-1})} d_{j,t-1} + \frac{\exp(\hat{g}_{j,t}) - \exp(\hat{\tau}_{j,t})}{\exp(\hat{y}_{j,t})}$$

# Empirical evidence



# Empirical evidence



# Empirical evidence

	HFC	LFC
Real exchange rate	depreciation	appreciation
Debt-to-GDP	larger $\uparrow$	smaller $\uparrow$
Debt accumulation	longer	shorter
Output	$\uparrow$	$\uparrow$
Consumption	$\uparrow$	$\uparrow$

# Alternative models

- Also estimate two separate SVAR models which include changes in a world price index and in a measure of world real economic activities, respectively.
  - world price: the World Bank non-energy commodity price index  
▶ IRFs, M2
  - world output: the transformation of Killian (2009) index  
▶ IRFs, M3
- Assume that the world variable does not depend on the level and lagged values of domestic variables while domestic variables immediately respond to innovations in the world variable.
  - World variables follow a simple univariate AR(1) process.
  - Compute the part of impulse responses to government spending shocks orthogonal to the effects of world shocks.



# Part II:

## Theoretical explanation

# Theoretical model

## Assumptions:

- Ricardian equivalence does not hold.
  - A fraction ( $\lambda$ ) of households cannot borrow or lend.
- Financial markets are incomplete.
  - Bonds are only assets traded domestically and internationally.
- In the FB (DB) economy, all public debt is issued in foreign (domestic) currency.
  - In either specification, the households are indifferent between investing in domestic and foreign currency denominated bonds.
- There is a home bias in consumption.
- There is a government spending reversal.
- In the FB, there is a feedback from the exchange rate depreciation to the country-specific risk premium; in the DB, this feedback is absent.

# Households

## Optimizing households:

- Maximize her expected lifetime utility

$$E_0 \left[ \sum_{t=0}^{\infty} \beta^t U(C_t^o, N_t^o) \right], \text{ where } U(C_t^o, N_t^o) = \frac{(C_t^o)^{1-\rho}}{1-\rho} - \frac{(N_t^o)^{1+\varphi}}{1+\varphi}$$

- subject to the sequence of period budget constraints

$$(1 + \tau_c) P_t C_t^o + \varepsilon_t D_{F,t+1} + T_t^{LS} \leq (1 - \tau_w) W_t N_t^o + (1 + \tau_b) R_{F,t-1} \varepsilon_t D_{F,t} + \Gamma_t$$

## Hand-to-mouth households:

- Maximize her period utility flow

$$U(C_t^h, N_t^h) = \frac{(C_t^h)^{1-\rho}}{1-\rho} - \frac{(N_t^h)^{1+\varphi}}{1+\varphi}$$

- subject to her period budget constraint in each period

$$(1 + \tau_c) P_t C_t^h = (1 - \tau_w) W_t N_t^h$$

# Firms

## Intermediate goods firms:

- Produce differentiated goods
- Follow a linear production technology, using domestic labor services:

$$Y_t(i) = A_t N_t(i)$$

- Pay a price adjustment cost in terms of its product:

$$\frac{\theta}{2} \left( \frac{P_{H,t}(i)}{P_{H,t-1}(i)} - 1 \right)^2$$

## Final goods firms:

- Produce domestically
- Follow a CES production technology, using the bundles of domestically produced and imported intermediate goods
- Trade in a perfectly competitive market

# Government

## Fiscal authority:

- period budget constraint:

$$P_{H,t}G_t + \varepsilon_t B_{F,t} R_{F,t-1} = T_t + \varepsilon_t B_{F,t+1}$$

- total tax receipts:

$$T_t = \tau_c P_t C_t + \tau_w W_t N_t - \tau_b (1 - \lambda) R_{F,t-1} \varepsilon_t D_{F,t} + T_t^{LS}$$

- government spending:

$$\log(G_t) = (1 - \psi_{gg}) \log(G_{t-1}) + \psi_{gd} (d_{F,t} - \bar{d}) + \nu_t^g$$

## Central bank:

- domestic-currency interest rate:

$$\log\left(\frac{R_t}{\bar{R}}\right) = \phi_\pi \log\left(\frac{\Pi_t}{\bar{\Pi}}\right)$$

# Country-specific risk premium

Country-specific foreign currency interest rate is given by

$$R_{F,t} \cdot E_t \left[ \frac{ner_{t+1}}{\Pi_{t+1}} \right] = R_{F,t}^* \cdot E_t \left[ \frac{ner_{t+1}}{\Pi_{t+1}} \right] + \mathbf{RP}_t,$$

where  $\mathbf{RP}_t \equiv \underbrace{\chi[\exp \{ [(BR_{F,t+1} - \overline{BR}) - (1 - \lambda)(DR_{F,t+1} - \overline{DR})] \} - 1]}_{\text{a debt-elastic component}}$

$$+ \underbrace{\xi[\exp \{ (ner_{t+1} \cdot ner_t - \overline{ner}) \} - 1]}_{\text{a forward-looking component}}$$

**is the country-specific risk premium.**

Assume

- $\xi > 0$  in the FB economy.
- $\xi = 0$  in the DB economy.

The optimizing households' first-order conditions for their intertemporal consumption-saving problem yield:

- (for foreign currency denominated bonds)

$$c_t^o = \rho^{-1} q_t - \sum_{s=0}^{\infty} E_t \left[ \underbrace{(i_{F,t+s}^* - \pi_{t+1+s}^*)}_{\text{foreign real interest rates}} + \underbrace{(i_{F,t+s} - i_{F,t+s}^*)}_{\text{risk premia}} \right],$$

where  $i_{F,t} - i_{F,t}^* = \chi (a_{F,t+1} - \bar{a}) + \xi (E_t \widehat{ner}_{t+1} + \widehat{ner}_t)$

is an approximation of country-specific risk premium  $RP_t$ .

- (for domestic currency denominated bonds)

$$c_t^o = -\rho^{-1} \sum_{s=0}^{\infty} E_t \underbrace{[i_{t+s} - \pi_{t+1+s}]}_{\text{domestic real interest rates}}$$

# Real exchange rate

$$q_t = -\Theta_t + \Lambda_t$$

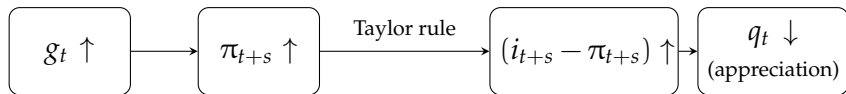
, where  $\Theta_t \equiv \sum_{s=0}^{\infty} E_t [ \underbrace{(i_{t+s} - \pi_{t+1+s})}_{\text{domestic real interest rate}} - (i_{F,t+s}^* - \pi_{t+1+s}^*) ]$ , and

$$\Lambda_t \equiv \sum_{s=0}^{\infty} E_t \underbrace{[i_{F,t+s} - i_{F,t+s}^*]}_{\text{contry risk premium}} .$$



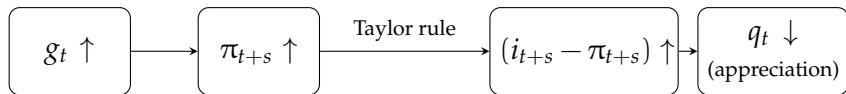
# Key mechanism

In the DB economy:

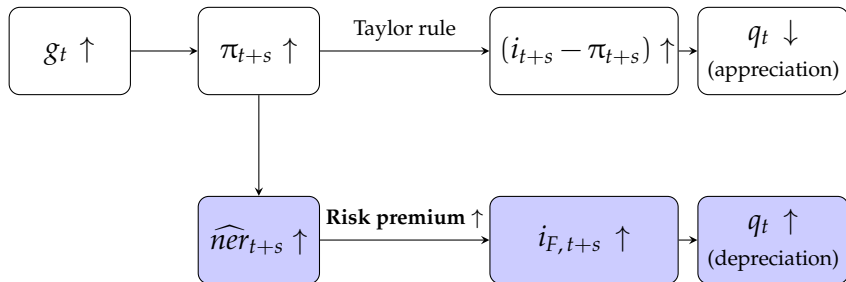


# Key mechanism

In the DB economy:



In the FB economy:



dominates if  $\xi > \frac{\phi_{\pi}-1}{2}$

# Calibration

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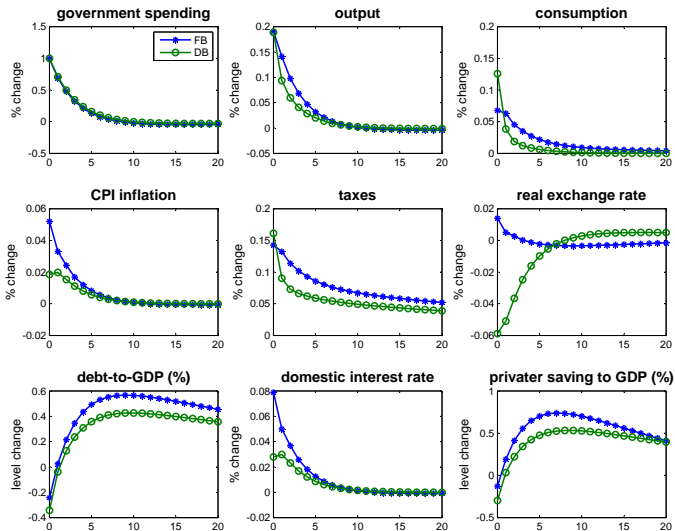
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$\alpha$	0.2	the share of imports in home output
$\alpha^*$	0.2	the share of exports in home output
$\eta$	1.5	the elasticity of substitution between home and foreign goods
$\theta$	192.31	the degree of price stickiness
$\lambda$	0.5	the relative size of hand-to-mouth households
$\varphi$	1	the inverse of Frisch labor supply elasticity
$\rho$	1	the coefficient of risk aversion
$\beta$	0.99	the discount factor (quarter basis) in home
$R_F^*$	1.0101	the steady state level of world interest rate
$\chi$	0.0001	the debt elasticity of risk premium
$\xi$	0.6	the marginal effect of expected depreciation on risk premium
$\psi_{gg}$	0.70	persistence coefficient of the log government spending
$\psi_{gb}$	-0.024	the sensitivity of the log government spending to the debt-to-GDP
$\phi_\pi$	1.5	the weight on inflation in the interest rate feedback rule

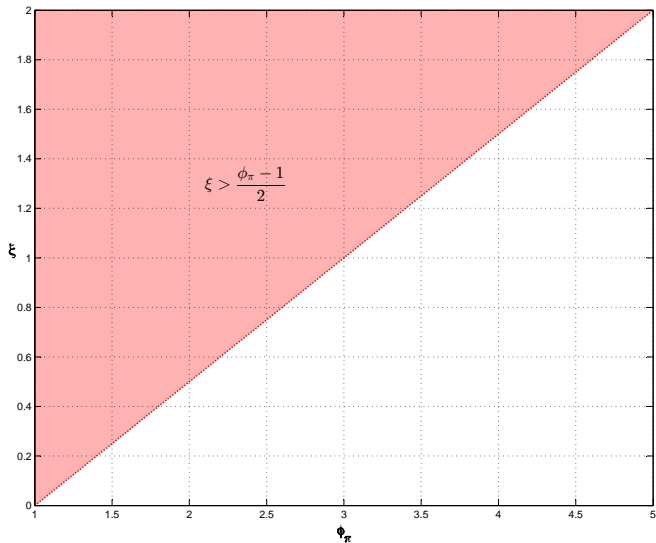
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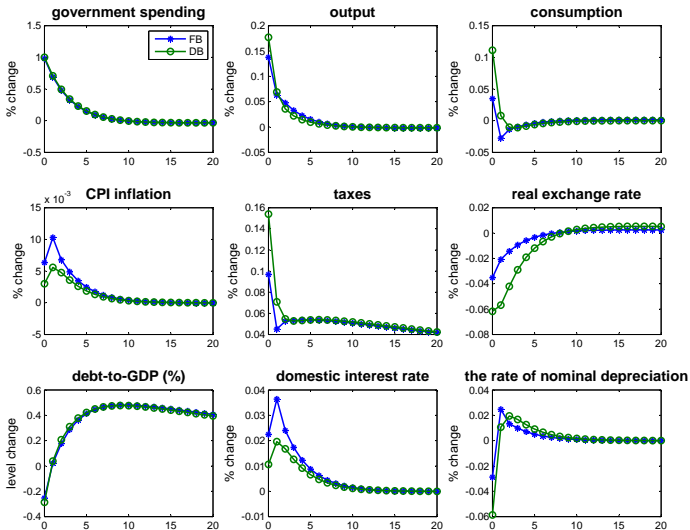
# Baseline results



# Monetary policy vs. Risk premium



# Stronger monetary policy: $\phi_\pi = 3.5$



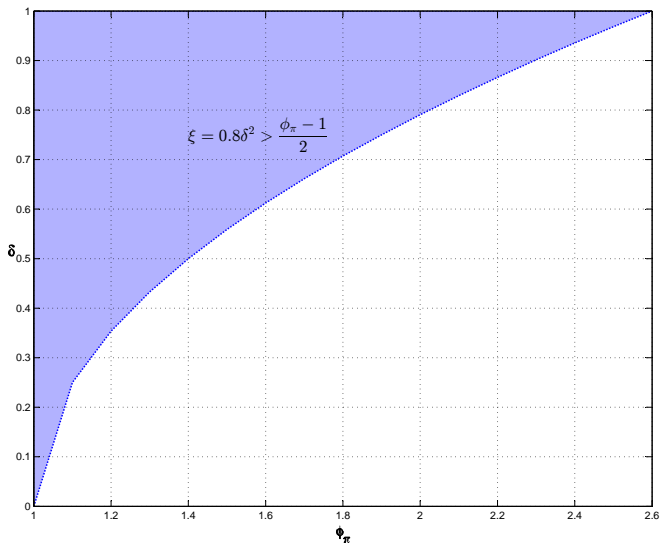
# Generalized model

What is different:

- Foreign currency and domestic currency denominated debt coexist:  
 $0 < \delta < 1$
- Domestic bond market: domestic currency;  
International bond market: foreign currency
- Only lending in the domestic market is subsidized.
- The feedback of expected nominal depreciation to country risk premium depends on the share of public debt denominated in foreign currency:

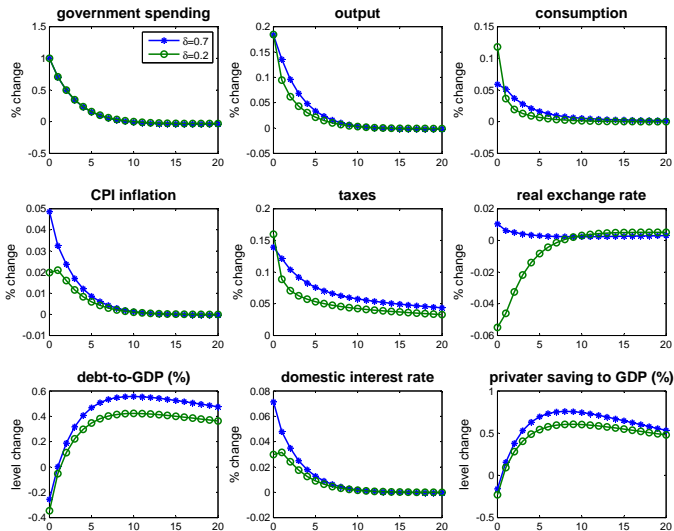
$$\xi = 0.8\delta^2$$

# Monetary policy vs. The share of foreign-currency debt





# Generalized model: Results



# Conclusion

- Empirically document the differences in dynamic effects of government spending shocks conditional on the currency denomination of public debt.
  - In the economy with a relatively larger share of foreign currency debt, there is a real appreciation and a larger increase in debt-to-GDP, following a government spending shock.
- Propose a theoretical explanation for the observed patterns, using a small open economy NK model.
  - Introduce a feedback loop between expected nominal depreciation and risk premium for the economy where its public debt is issued in foreign currency.
  - As the effects of expected future inflation dominate the effects of monetary policy, a real depreciation is induced by a government spending shock.
  - The mechanism that works toward a real depreciation is stronger as the share of foreign currency debt is larger.

Thank you very much!

**Figure:** The percentage of public debt denominated in foreign currency

<b>Albania</b> (2009-2012)	40.8	<b>Dominican Republic</b> (2011-2012)	72.9	<b>Malawi</b> (2011-2012)	52.3	<b>Romania</b> (2009-2012)	55.3
<b>Argentina</b> (2000-2004)	84.6	<b>El Salvador</b> (2011-2012)	100.0	<b>Malta</b> (2011-2012)	0.0	<b>Russian Federation</b> (2000-2012)	43.3
<b>Australia</b> (2008-2012)	0.0	<b>Estonia</b> (2000-2012)	73.6	<b>Mauritius</b> (2009-2012)	15.1	<b>Seychelles</b> (2009-2012)	60.5
<b>Austria</b> (2008-2012)	2.8	<b>France</b> (2004-2012)	2.2	<b>Mexico</b> (2000-2004)	33.2	<b>Slovak Republic</b> (2008-2012)	5.7
<b>Bahamas</b> (2000-2004)	13.2	<b>Georgia</b> (2009-2012)	76.0	<b>Moldova</b> (2009-2012)	69.8	<b>Slovenia</b> (2010-2012)	0.2
<b>Bangladesh</b> (2009-2012)	62.4	<b>Greece</b> (2007-2012)	3.9	<b>Morocco</b> (2009-2012)	23.1	<b>South Africa</b> (2009-2012)	10.2
<b>Barbados</b> (2000-2004)	33.6	<b>Guatemala</b> (2009-2012)	60.5	<b>Nepal</b> (2009-2012)	67.3	<b>Spain</b> (2000-2012)	1.2
<b>Belgium</b> (2000-2012)	1.2	<b>Honduras</b> (2000-2012)	68.0	<b>Netherlands</b> (2009-2012)	5.5	<b>Sri Lanka</b> (2010-2012)	42.9
<b>Bolivia</b> (2000-2004)	96.3	<b>Hungary</b> (2000-2012)	33.2	<b>Nigeria</b> (2009-2012)	14.2	<b>Suriname</b> (2011-2012)	58.4
<b>Brazil</b> (2000-2004)	42.0	<b>Iceland</b> (2004-2012)	25.5	<b>New Zealand</b> (2000-2004)	22.2	<b>Sweden</b> (2000-2012)	22.2
<b>Bulgaria</b> (2008-2012)	74.8	<b>Indonesia</b> (2010-2012)	45.1	<b>Nicaragua</b> (2000-2004)	77.0	<b>Togo</b> (2011)	45.3
<b>Canada</b> (2000-2012)	3.0	<b>Ireland</b> (2000-2012)	0.0	<b>Pakistan</b> (2000-2012)	44.8	<b>Tonga</b> (2009-2012)	89.4
<b>Chile</b> (2000-2004)	21.4	<b>Israel</b> (2000-2012)	22.8	<b>Panama</b> (2000-2004)	100.0	<b>Turkey</b> (2005-2012)	31.5
<b>China</b> (2009-2012)	0.6	<b>Italy</b> (2000-2012)	1.4	<b>Paraguay</b> (2011-2012)	86.5	<b>Uganda</b> (2009-2012)	65.4
<b>Colombia</b> (2000-2004)	61.2	<b>Kenya</b> (2009-2012)	49.2	<b>Peru</b> (2000-2004)	85.2	<b>United Kingdom</b> (2000-2012)	0.5
<b>Costa Rica</b> (2000-2012)	32.5	<b>Lithuania</b> (2000-2012)	85.4	<b>Philippines</b> (2010-2012)	94.2	<b>United States</b> (2000-2012)	0.0
<b>Cyprus</b> (2011-2012)	1.1	<b>Luxembourg</b> (2000-2012)	0.7	<b>Poland</b> (2009-2012)	28.9	<b>Uruguay</b> (2006-2012)	70.6
<b>Czech Republic</b> (2009-2011)	17.0	<b>Madagascar</b> (2011-2012)	78.1	<b>Portugal</b> (2000-2012)	3.2	<b>Venezuela</b> (2000-2004)	67.4

Data Sources: World Bank Public Sector Debt Statistics, CLYPS dataset on public debt level and composition in Latin America (Cowan, Levy Yeyati, Panizza, and Sturzenegger, 2006), Inter-American Development Bank LAC Debt Group standardized sovereign debt database (2012)

