THE GRADUATE INSTITUTE | GENEVA

INSTITUT DE HAUTES ETUDES
INTERNATIONALES ET DU DÉVELOPPEMENT

GRADUATE INSTITUTE OF INTERNATIONAL
AND DEVELOPMENT STUDIES

HEID Working Paper No: 01/2010

Limits of Floats: The Role of Foreign Currency Debt and Import Structure

Pascal Towbin
Graduate Institute of International Studies
Sebastian Weber
Graduate Institute of International Studies

Abstract

A traditional argument in favor of flexible exchange rates is that they insulate output better from real shocks, because the exchange rate can adjust and stabilize demand for domestic goods through expenditure switching. This argument is weakened in a model with high foreign currency debt and low exchange rate pass through to import prices. We analyze the transmission of real external shocks to the domestic economy under fixed and flexible exchange rate regimes for a broad sample of countries in a Panel VAR and let the responses vary with foreign currency indebtedness and import structure. We find that flexible exchange rates do not insulate output better from external shocks if the country imports mainly low pass-through goods and can even amplify the output response if foreign indebtedness is high.

Limits of Floats: The Role of Foreign Currency Debt and Import Structure

Pascal Towbin Sebastian Weber*

February 2010

Abstract

A traditional argument in favor of flexible exchange rates is that they insulate output better from real shocks, because the exchange rate can adjust and stabilize demand for domestic goods through expenditure switching. This argument is weakened in a model with high foreign currency debt and low exchange rate pass through to import prices. We analyze the transmission of real external shocks to the domestic economy under fixed and flexible exchange rate regimes for a broad sample of countries in a Panel VAR and let the responses vary with foreign currency indebtedness and import structure. We find that flexible exchange rates do not insulate output better from external shocks if the country imports mainly low pass-through goods and can even amplify the output response if foreign indebtedness is high.

Keywords: Exchange Rate Regimes, Balance Sheet Effects, Pass-through, Interacted Panel VAR, External Shocks

JEL Classification: E30, F33, F34, F41

---

*Graduate Institute of International and Development Studies, Avenue de la Paix 11A, CH-1202 Geneva, E-mail: Pascal.Towbin@graduateinstitute.ch. Sebastian.Weber@graduateinstitute.ch. We thank Domenico Giannone, Cédric Tille, Charles Wyplosz, and participants at the SSES Annual Congress 2009 for helpful comments. We also like to thank Atish Ghosh and Harald Anderson for help with the dejure IMF classification. Funding from the Swiss National Science Foundation is gratefully acknowledged.

1 Introduction

Traditional arguments for flexible exchange rate regimes, as advanced by Friedman (1953) or Mundell (1961) and Fleming (1962), emphasize the expenditure switching effect. When a country faces an adverse real shock, authorities can stabilize output with a nominal depreciation that boosts net exports. Since then the theoretical literature has cast doubt on the effectiveness of flexible exchange rates to stabilize output when there is high foreign currency debt or limited exchange rate pass-through.

This study investigates how import structure and foreign currency debt affect the stabilization properties of exchange rate regimes. We first synthesize the theoretical literature on the effects of foreign currency debt and exchange rate pass-through in a stylized micro-founded IS-LM-BP model, extending previous work by Céspedes et al. (2003). The model allows us to analyze the response of investment and output under different monetary policy regimes. A depreciation increases a firms's foreign currency debt and reduces its net worth. Because of financial frictions, a lower firm value leads to tighter credit conditions and to a drop in investment and output. The contractionary balance sheet effects weaken and can even overturn the expansionary expenditure switching effect of the depreciation.[1] The effects are reinforced if the country imports differentiated goods of producers that have some market power and price in domestic currency. If prices are sticky, a higher share of differentiated imports implies a lower overall exchange rate pass-through. A higher exchange rate depreciation is required to obtain the same level of expenditure switching.[2] This can aggravate the output contraction in the presence of balance sheet effects, making a float potentially destabilizing.

We introduce an Interacted Panel Vector Autoregression (IPVAR) as a framework to test how country characteristics affect the response of the economy to shocks. Using a sample of 101 countries we estimate a Panel VAR and augment it with interaction terms that allow the VAR coefficients to vary with foreign currency debt and import structure. With this technique we can directly analyze how the response of output and investment to external shocks varies with external debt, import structure and exchange rate regime. In line with the theoretical predictions our results indicate that the insulating properties of flexible exchange rate regimes are strong in economies where the import share of high pass-through goods is large and foreign currency debt is low. With a small share of homogeneous imports and a high degree of foreign currency debt fixed exchange rates display better stabilization properties, as limited pass-through hinders the adjustment of relative prices under a float and contractionary balance sheet effects dominate.

In the remainder Section 2 briefly discusses earlier work. Section 3 synthesizes the relevant theory on balance sheet effects and the link between import structure and pass-through in a simple model. Section 4 and 5 explain the data and the estimation technique.

[1] See Céspedes et al. (2004), Choi and Cook (2004), Cook (2004), Devereux et al. (2006), Gertler et al. (2007), and Tovar (2005) for previous theoretical studies on exchange rate fluctuations and balance sheet effects. Eichengreen et al. (2003) proclaim the inability to borrow in domestic currency as the "original sin" problem.

[2] See e.g. Krugman (1986) and Devereux and Engel (2003).

Section 6 discusses the main results. Section 7 concludes.

2 Literature

The empirical literature on the stabilization properties of fixed and flexible exchange rate regimes has a long tradition. Early empirical studies compare the unconditional volatility of macroeconomic variables under the Bretton Woods system of fixed exchange rates and under the post Bretton Woods system of floating exchange rates (Baxter and Stockman, 1989; Flood and Rose, 1995). They find little differences across the the two periods, except for the well known fact that the real exchange rate is substantially more volatile under floating exchange rate regimes (Mussa, 1986). According to a study by Ghosh et al. (1997) output volatility is lower under flexible regimes, whereas inflation volatility is higher. The studies do not discriminate between real and nominal shocks, whereas Mundell-Fleming logic suggests that fixed exchange rates are preferable if nominal disturbances dominate and flexible exchange rates are preferable if real disturbances dominate. To identify real shocks, a series of studies take advantage of the fact that the rest of the world is virtually not affected by domestic conditions in small countries. For small economies a number of variables can therefore be treated as exogenous. Several authors compare the response of GDP to an exogenous variable under different exchange rate regimes in a single equation framework. They find that under a flexible exchange rate regime the output growth rate is less sensitive to variations in the terms of trade (Edwards and Levy Yeyati, 2005), world interest rates (di Giovanni and Shambaugh, 2008), and natural disasters (Ramcharan, 2007). A drawback of the single equation approach is that it does not look at the response to a true, unexpected, shock and its transmission, but at the sensitivity of output to contemporaneous values of a specific exogenous variable. Broda (2004) and Broda and Tille (2003) tackle this issue with a Panel VAR approach and treat the terms of trade as a block exogenous variable. They look at the response of real GDP to a terms of trade shock in a sample of developing countries and find that output responds stronger under a peg. Also within a Panel VAR framework, Hoffmann (2007) finds that flexible exchange rates insulate better from shocks to world output and world real interest rates. Miniane and Rogers (2007) provide evidence that the nominal interest rate in countries with fixed exchange rates respond more to U.S money shocks.

None of the studies accounts for country characteristics apart from the monetary policy regime such as import structure and foreign currency debt. There is a literature that investigates the link between the effects of exchange rate depreciations and the level of foreign currency debt.[3] Bebczuk et al. (2006) find that depreciations tend to be contractionary when foreign currency debt is high. Cavallo et al. (2004) show that in currency crises highly indebted countries have overshooting real exchange rates that lead to larger output

[3]Hausmann et al. (2001) find that "fear of floating" occurs more often in countries with high foreign currency debt. Authorities limit exchange fluctuations, although they declare themselves officially as floaters. This can be interpreted as indirect evidence of the favorability of fixed exchange rate regimes under such circumstances.

contractions. Galindo et al. (2003) provide a survey of micro evidence on contractionary devaluations. These studies use exchange rate fluctuations as an explanatory variable, whereas we look at output responses conditional on an exogenous shock. We are not aware of any study that investigates the role of import structure for the adjustment to external shocks.

Researchers routinely use interaction terms in single equation empirics to explore how effects vary with country characteristics, but studies that employ interaction terms in VARs are few. Loayza and Raddatz (2007) are closest to our empirical approach, but only let the coefficients on exogenous variables vary and impose homogeneity on the dynamics of endogenous variables.

3 Theory

3.1 Setup

Our framework builds on Céspedes et al. (2003) microfounded IS-LM-BP model with sticky prices, wages, and a financial accelerator mechanism as in Bernanke et al. (1998). We extend Céspedes et al. (2003) by investigating the consequences of limited exchange rate pass-through. Furthermore, to have a meaningful expenditure switching effect, we abandon the assumption of a unit elasticity of substitution between domestic and foreign goods. The model consists of a small open economy with two periods, 1 and 2. There are two types of agents: workers and entrepreneurs. We analyze the consequences of an adverse external demand shock in the initial period under different exchange regimes. In the second period no further shocks occur.

3.1.1 Workers

A worker's utility depends on consumption (C_t), labor (L_t) and real money holdings (M_t/Q_t) in periods 1 and 2

$$U = \sum_{t=1}^{2} \beta^t \left[\log C_t - \frac{\sigma - 1}{\sigma} \frac{1}{\upsilon} L_t^{\upsilon} + \log \left(\frac{M_t}{Q_t} \right) \right].$$

Workers choose consumption and money holdings. They supply labor in a monopolistically competitive market. They set their wage one period in advance and then supply the amount of labor demanded by firms at the wage set. Log utility in consumption implies that expected labor supply will always be one $E_{t-1}L_t = 1$. Consumption is an aggregate over domestic ($C_{H,t}$) and foreign goods ($C_{F,t}$)

$$C_t = \upsilon \left[\gamma C_{H,t}^{1-\phi} + (1-\gamma) C_{F,t}^{1-\phi} \right]^{\frac{1}{1-\phi}},$$

where ϕ is the elasticity of substitution, γ is a preference parameter related to the expenditure share of domestic goods and $\upsilon = \gamma^{-\gamma} (1-\gamma)^{-(1-\gamma)}$ is a constant. Foreign goods are a Cobb-Douglas composite of homogeneous goods ($C^{HOM}_{F,t}$) with expenditure share ω and differentiated products ($C^{HET}_{F,t}$) with share $1-\omega$.[4]

$$C_{F,t} = \left(C^{HOM}_{F,t}\right)^{\omega}\left(C^{HET}_{F,t}\right)^{1-\omega},$$

The only asset workers can hold is money and the worker's budget constraint is

$$Q_t C_t = W_t L_t + M_{t-1} - M_t + T_t \tag{1}$$

Seignorage is rebated via lump sum transfers T_t such that workers spend all income on consumption in equilibrium. The expenditure minimizing price index of the consumption bundle is

$$Q_t = \left[\gamma P^{1-\phi}_{H,t} + (1-\gamma)\left\{\left(P^{HOM}_{F,t}\right)^{\omega}\left(P^{HET}_{Ft}\right)^{1-\omega}\right\}^{1-\phi}\right]^{\frac{1}{1-\phi}}$$

where $P_{H,t}$ and $P^{HET}_{F,t}$ are the expenditure minimizing price indices for home and foreign differentiated goods.

3.1.2 Production and Price Setting

Domestic varieties are produced by a continuum of firms j with production function

$$Y_{jt} = AK^{\alpha}_{jt}L^{1-\alpha}_{jt},$$

where K_{jt} is the firms's capital and composite labor is

$$L_{jt} = \left[\int_0^1 L_{ijt}^{\frac{\sigma-1}{\sigma}}\, di\right]^{\frac{\sigma}{\sigma-1}}.$$

Firm j maximizes profits $\Pi_{jt} = P_{jt}Y_{jt} - \int_0^1 W_{it}L_{ijt}di - R_tK_{jt}$ and sets prices in advance. Profit maximization implies a constant markup over expected marginal costs $MC_{H,t}$.

$$P_{H,t} = \frac{\theta}{\theta-1}E_{t-1}MC_{H,t}$$

The market for foreign homogeneous goods is perfectly competitive. We normalize the foreign currency price of foreign homogeneous goods to one. The price in domestic currency is therefore the nominal exchange rate

$$P^{HOM}_{F,t} = S_t\ .$$

[4]Both $C_{H,t} = \left[\int_0^1 C_{H,jt}^{\frac{\theta-1}{\theta}}dj\right]^{\frac{\theta}{\theta-1}}$ and $C^{HET}_{F,t} = \left[\int_0^1 \left(C^{HET}_{F,jt}\right)^{\frac{\theta-1}{\theta}} dj\right]^{\frac{\theta}{\theta-1}}$ are CES aggregates over varieties with elasticity of substitution θ.

Foreign firms producing differentiated goods set their price in domestic currency one period in advance at a mark-up over their expected marginal costs resulting in the price index[5]

$$P_{F,t}^{HET} = \frac{\theta}{\theta - 1} E_{t-1} S_t MC_{F,t}.$$

If a shock occurs, the exchange rate reacts, but because differentiated goods are priced in domestic currency, exchange rate pass-through to import prices will be limited.[6]

3.1.3 Entrepreneurs

Entrepreneurs own domestic firms and provide capital. They start with a given amount of capital K_1 and a given external debt. The external debt can be denominated in foreign currency (D_1^*) or domestic currency (D_1). The investment good has the same composition as the consumption bundle and firms buy it at price Q_1. Capital depreciates completely after one period, so that investment is the capital stock in the next period. In the first period entrepreneurs buy capital. In the second period they use their profits to buy foreign goods. Entrepreneurs finance investment through their net worth and external debt.

$$P_1 N_1 + S_1 D_2^* + D_2 = Q_1 I_1$$

Entrepreneur's net worth is the return on capital plus profits minus debt repayment

$$P_1 N_1 = R_1 K_1 + \Pi_1 - S_1 D_1^* - D_1 = P_1 Y_1 - W_1 L_1 - S_1 D_1^* - D_1$$

Because of capital market imperfections entrepreneurs pay a premium (η_1) that increases with the ratio of investment over net worth. μ is a measure for the strength of imperfections.[7]

$$1 + \eta_1 = \left(\frac{Q_1 I_1}{P_1 N_1} \right)^{\mu}$$

Assuming entrepreneurs to be risk neutral, no arbitrage implies that the expected yield on capital equals the cost of foreign borrowing

$$\frac{R_2}{Q_1} = (1 + \rho)(1 + \eta_1) \frac{S_2}{S_1}$$

where ρ is the foreign interest rate.

[5] For simplicity we assume that their marginal costs in foreign currency MC_t^F are constant at $\frac{\theta - 1}{\theta}$, which implies that, if no shocks occur, all foreign goods will be supplied at the same price S_t .

[6] Campa and Goldberg (2005) show empirically that for OECD countries pass-through in the raw material and energy sector is higher than in other sectors. They find that a large fraction of the observed decline in pass-through can be explained with a change in the import structure away from primary commodities.

[7] Céspedes et al. (2004) provide a microfounded motivation for μ.

3.1.4 Monetary Policy

We consider three alternative monetary policies: an exchange rate peg, an exchange rate rule, and a constant money rule. Small letters denote log deviations from the no shock equilibrium. Under a peg the exchange rate is constant

$$s_t = 0. \tag{2}$$

Under the exchange rate rule, the monetary authority controls the exchange rate, but lets it depreciate when an adverse shock occurs

$$s_t = -\kappa y_t. \tag{3}$$

Under the constant money rule, the monetary authority keeps the money supply constant in the period where the shock occurs and lets the exchange rate adjust endogenously. Over the long term the authority cares about price stability and adjusts the money supply such that the price level in the second period stays constant.

$$m_1 = 0,\ p_2 = 0. \tag{4}$$

3.1.5 Market Clearing

In the initial period the demand for domestic goods comes from domestic consumption, domestic investment, and exports. Foreigners demand an exogenous amount of domestic goods denoted in foreign currency X.

$$Y_1 = \gamma \left(\frac{P_1}{Q_1} \right)^{-\theta} (I_1 + C_1) + \frac{S_1}{P_1} X_1 \tag{5}$$

In the second period, there is no further investment and, given that entrepreneurs consume only imports, the market clearing condition is

$$Y_2 = \gamma \left(\frac{P_2}{Q_2} \right)^{-\theta} C_2 + \frac{S_2}{P_2} X_2. \tag{6}$$

3.1.6 IS-LM-BP with foreign debt and incomplete pass-through

We log linearize the model around its no shock equilibrium. As detailed in the Appendix, the model can be reduced to a system of three equations that correspond to the familiar IS-LM-BP model. The IS equation is

$$y_1 \left(\frac{1-\alpha}{1-\tau\alpha} \right) = \lambda i_1 + (1-\lambda)\, x_1 + \left[(1-\lambda) + \omega \cdot \lambda g\left(\phi\right) \right] s_1, \tag{7}$$

where $\lambda < 1$ is the steady state share of investment demand in domestic output net of consumption and, correspondingly, $(1-\lambda)$ is the share of exports. $\tau > 1$ is the ratio of output to output net of consumption. A depreciation affects domestic output through two channels. The first term in brackets stands for the *export revenue effect.* A depreciation increases the amount of domestic currency output necessary to satisfy a given demand in foreign currency. The second term captures the *expenditure switching effect.* $g(\phi) = (1-\gamma_1')[\phi + (\phi-1)(\tau-1)/\lambda]$ is increasing in the substitution elasticity between domestic and foreign goods.[8] The strength of the expenditure switching effect increases with the share of homogeneous goods ω and therefore the exchange rate pass-through. If the country imports only differentiated goods $\omega = 0$, the expenditure switching channel is lost, since a depreciation cannot affect relative prices.

The BP curve pins down the demand for investment and reads[9]

$$i_1\left(\Phi^{-1}+\mu\right) = -\rho + \mu(1+\psi)\delta_y y_1 - \mu\left[\left(1-\gamma_1'\right)\omega + \psi\xi\right]s_1 + \left[1-\left(1-\gamma_1'\right)\omega\right]s_1 \quad (8)$$

The investment demand is a function of the borrowing cost from abroad and depends on the risk premium, the risk free rate, and the price of investment. A higher world interest rate ρ depresses investment.

The effect of output on demand depends on the degree of financial imperfection μ and the ratio of total debt over net worth $\psi = \frac{\bar{S}\bar{D}^*+\bar{D}}{\bar{P}\bar{N}}$. Higher output increases net worth. Higher net worth lowers the risk premium and raises investment. Higher leverage ψ amplifies the effects of output on investment demand. Whether an exchange rate depreciation increases or decreases investment depends on the extent of financial imperfections and leverage. Without imperfections ($\mu = 0$) a depreciation always increases investment since it decreases the domestic real risk free rate (*real risk free rate effect*). The expansionary effects that derive from the lower real risk free rate can be overturned by contractionary balance sheet effects. A depreciation can be contractionary because it increases the ratio of nominal investment to net worth. First, a depreciation increases the price of investment, which increases the numerator of the ratio (*investment cost effect*). Second, it increases the domestic currency value of foreign currency debt which decreases the denominator (*debt effect*). The strength of the effect on net worth depends on firms' leverage ψ and the share of foreign currency debt $\xi = \frac{\bar{S}\bar{D}^*}{\bar{S}\bar{D}^*+\bar{D}}$. The contractionary effects that derive from financial imperfections dominate if financial frictions μ, leverage ψ and the share of foreign currency debt ξ are high.[10]

[8] $\gamma_1' = 1-(1-\gamma)\left(\frac{\bar{S}_1}{\bar{Q}1}\right)^{(1-\phi)}$ is the no shock expenditure share of domestic goods in the first period.

[9] Where $\Phi^{-1} = 1-\alpha+\alpha\left[1+(\phi-1)(1-\gamma_2')\varkappa/(1-\varkappa)\right]^{-1} < 1$, $\varkappa = \gamma(1-\alpha)\left(1-\theta^{-1}\right)\left(\frac{\bar{P}_2}{\bar{Q}_2}\right)^{1-\phi}$ and, $\delta_y = \theta^{-1}\left[1-(1-\alpha)\left(1-\theta^{-1}\right)\right]^{-1}$

[10] While limited pass through diminishes expenditure switching in the IS curve, it also makes the effect of a depreciation on investment in the BP curve more positive, because it limits the increase in prices. The limited increase in prices reduces the contractionary investment cost effect and increases the expansionary real risk free rate effect. If foreign currency debt is large, the effect of limited pass-through on the price of investment in the BP curve becomes less important and the effect of diminished expenditure switching in the IS curve will dominate.

Finally the LM schedule is[11]

$$m_1 = \frac{y_1}{\zeta(1-\alpha)} - \left(\zeta^{-1} - 1\right)\alpha i_1 \tag{9}$$

where we assume $\zeta = 1 - \beta\bar{Q}\bar{C}/\bar{Q}_1\bar{C}_1$ to be positive.[12] Money demand increases with output and decreases with investment (for a given output more investment means less consumption, which depresses money demand). Under the constant money rule, the exchange rate adjusts, while under a exchange rate rule and under a peg money adjusts to achieve equilibrium.

3.2 Adjustment to an external demand shock

We focus on the adjustment to an external demand shock. Results for a world interest rate shock are similar and not discussed for brevity.

3.2.1 The peg

Under a peg the impact of an external demand shock on output and investment is determined by combining (7), (8) and (2), which yields:

$$\left.\frac{\partial y}{\partial x}\right|^{PEG} = \chi\left[\frac{(1-\alpha)\left(\Phi^{-1}+\mu\right)}{(1-\tau\alpha)} - \lambda\mu(1+\psi)\delta_y\right]^{-1} \tag{10}$$

$$\left.\frac{\partial i}{\partial x}\right|^{PEG} = \left.\frac{\partial y}{\partial x}\right|^{PEG}\frac{\mu(1+\psi)\delta_y}{(\Phi^{-1}+\mu)} \tag{11}$$

where $\chi = (1-\lambda)\left(\Phi^{-1}+\mu\right)$. Since the exchange rate does not move, the response of output and investment to an external demand shock is independent of the import share of differentiated goods and the level of foreign currency debt. The strength of the response increases with leverage ψ, as it amplifies the balance sheet effect related to a fall in output.[13] The investment response is a multiple of the the output response and increases with leverage and the level of financial imperfection. With no imperfection $\mu = 0$ investment does not respond, since financing costs do not move.[14]

[11] The LM curve is independent of the exchange rate due to the log in real money holdings. Allowing a more general framework does not affect the results.

[12] Upper bars denote the values in the no shock equilibrium.

[13] However, holding the domestic debt constant and allowing total debt to increase with the foreign currency debt (which corresponds to an increase in ψ) would render the response of output and investment under all monetary regimes stronger, since investment becomes more sensitive to the output drop caused by the negative external demand shock.

[14] With no capital market imperfections ($\mu = 0$) the solution simplifies to $\frac{\partial y}{\partial x} = (1-\lambda)(1-\tau\alpha)/(1-\alpha)$. Since investment is independent of output, the reaction of output remains only a function of the importance of the external demand in total output.

3.2.2 The exchange rate rule

We combine the IS and BP equation (7), (8) with the exchange rate rule $s_t = -\kappa y_t$. We can split the effect of the external shock on output in six separate components:

$$\left.\frac{\partial y}{\partial x}\right|^{EXR} = \chi \left[\begin{array}{c} \overbrace{\frac{(1-\alpha)\left(\Phi^{-1}+\mu\right)}{(1-\tau\alpha)}}^{1} - \mu\lambda(1+\psi)\delta_y + \overbrace{\left(\Phi^{-1}+\mu\right)\omega\lambda g\kappa}^{2} - \overbrace{\lambda\mu\psi\xi\kappa}^{3} \\ \overbrace{\left[\left(\Phi^{-1}+\mu\right)(1-\lambda)\right]\kappa}^{4} - \overbrace{\lambda\mu\left(1-\gamma_1'\right)\omega\kappa}^{5} + \overbrace{\lambda\left[1-\left(1-\gamma_1'\right)\omega\right]\kappa}^{6} \end{array} \right]^{-1} \tag{12}$$

The first effect is identical to the peg. The other terms are a function of the exchange rate rule parameter κ.[15] Accordingly, $\kappa = 0$ replicates the peg. The second and fourth terms stand for two channels that make depreciations expansionary. The second term reflects the expenditure switching effect: high pass-through (high ω) and high substitution elasticity (high g) dampen the effects of an external demand shock. The fourth term reflects the export value effect which is increasing in the export share $(1-\lambda)$. The third and fifth terms stem from financial imperfections and can make depreciations contractionary because they affect the ratio of investment over net worth. The third term is the balance sheet effect related to the share of foreign debt: the higher ξ the more destabilizing is a countercyclical exchange rate policy. The fifth term reflects the investment cost effect on the risk premium. The last term is the real risk free rate effect.

It follows that higher foreign currency debt and a lower share of homogeneous goods diminish the moderating effects of an exchange rate rule:

$$\frac{\partial\left(\frac{\partial y}{\partial x}\right)}{\partial\xi} = \left[\frac{\partial y}{\partial x}\right]^{-2} \frac{\lambda}{(1-\lambda)} \frac{\mu\kappa\psi}{\left(\Phi^{-1}+\mu\right)} > 0, \tag{13}$$

$$\frac{\partial\left(\frac{\partial y}{\partial x}\right)}{\partial\omega} = \left[\frac{\partial y}{\partial x}\right]^{-2} \left[\frac{(1+\mu)}{\left(\Phi^{-1}+\mu\right)}\left(1-\gamma_1'\right) - g\right] \frac{\lambda\kappa}{(1-\lambda)} < 0. \tag{14}$$

The inequality in (13) follows immediately from all coefficients being positive. For (14) the sign of the derivative depends on the second term in brackets, which reflects the relative importance of the real risk free rate and investment cost effect as opposed to the expenditure switching effect. In the appendix we proof that for $\phi > 1$ the second term is always negative.

The ability of a countercyclical exchange rate rule to stabilize the economy diminishes with the share of imported differentiated goods and the level of foreign currency debt. We can calculate the threshold for which such a policy becomes actually more destabilizing than a peg by setting the sum of all the terms that multiply κ in (12) equal to zero.

$$\xi_0 = \frac{\left[(1-\lambda)\left(\Phi^{-1}+\mu\right)+\lambda\right]}{\lambda\mu\psi} + \frac{\left[\left(\Phi^{-1}+\mu\right)\lambda g - \lambda(1+\mu)\left(1-\gamma_1'\right)\right]}{\lambda\mu\psi}\omega_0 \tag{15}$$

[15] We assume κ not too strong, such that $\partial y/\partial x > 0$.

	foreign curreny debt		import structure	
	$\frac{\partial y}{\partial x \partial \xi}$	$\frac{\partial i}{\partial x \partial \xi}$	$\frac{\partial y}{\partial x \partial \omega}$	$\frac{\partial i}{\partial x \partial \omega}$
Peg	$= 0$	$= 0$	$= 0$	$= 0$
Float	> 0	> 0	< 0	$<? > 0$

Table 1: Summary of Theoretical Predictions

An economy reaches the threshold foreign currency debt share more quickly if exchange rate pass-through ω_0 is low, such that the expenditure switching effects are small, and leverage and financial imperfections are strong. Note that the threshold is independent of the strength of countercyclicality κ.

The response of investment under the exchange rate rule is

$$\left.\frac{\partial i}{\partial x}\right|^{EXR} = \frac{\mu\left(1+\psi\right)\delta_y}{\left(\Phi^{-1}+\mu\right)}\left.\frac{\partial y}{\partial x}\right|^{PEG} - \frac{\mu\left(1+\psi\right)\delta_y}{\left(\Phi^{-1}+\mu\right)}\left[\left.\frac{\partial y}{\partial x}\right|^{PEG} - \left.\frac{\partial y}{\partial x}\right|^{EXR}\right] + \left[\frac{\mu\left[\left(1-\gamma_1'\right)\omega+\psi\xi\right]}{\left(\Phi^{-1}+\mu\right)} - \frac{\left[1-\left(1-\gamma_1'\right)\omega\right]}{\left(\Phi^{-1}+\mu\right)}\right]\kappa\left.\frac{\partial y}{\partial x}\right|^{EXR}$$

The first two terms capture the effect of a change in output on net worth and the external finance premium. The third term in brackets captures the additional effects that come from exchange rate changes, since $\frac{\partial s}{\partial x} = -\kappa\frac{\partial y}{\partial x}$. The first terms within the brackets stand for the effects of a depreciation on the risk premium, both via increasing the price of investment and by increasing the domestic currency value of foreign debt. The second part captures the effect on the domestic real risk free interest rate and is independent of the level of financial frictions. A higher share of foreign currency debt increases the response of investment. The effect of the import structure is ambiguous, because limited pass-through moderates the effect on prices, but increases the effect on output. With high leverage the effect on output ($\frac{\partial y}{\partial x}|^{PEG} - \frac{\partial y}{\partial x}|^{EXR}$) dominates. Table 1 summarizes the predicted effects of foreign currency debt and import structure on the response to external shocks under the different exchange rate regimes. To illustrate graphically how the response of investment and output change with the ratio of foreign currency debt and the share of homogeneous goods in total imports, we let the parameters ξ and ω vary for given values of the other parameters.. The share of home goods in total consumption is assumed to be $\gamma = 0.6$, the mark-up for differentiated products 10% ($\theta = 11$) and, the elasticity of substitution between foreign and home consumption goods is assumed to equal $\phi = 2$. The capital market imperfection is set to $\mu = 0.2$. We set $\kappa = 2$ and $\beta = 0.96$.[16] $\bar{K}_1$, $\bar{X}_1$, $\bar{X}_2$ are such that output growth $\frac{\bar{Y}_2}{\bar{Y}_1}$ and the real exchange rate in both periods $\frac{\bar{S}_1}{\bar{P}_1}$ and $\frac{\bar{S}_2}{\bar{P}_2}$ are one. We choose $\psi = 10.6$ such that ratio of external debt to GDP equals 36 %. Using these parameter values we allow

[16] Increasing κ lets the shape of the exchange rate response become increasingly concave.

the share of homogeneous good imports to vary from close to zero to 50% and the foreign currency debt to GDP ratio from zero to 36%, holding the overall debt level constant.[17]

Figure (1) depicts the joint role of foreign currency debt and import structure. It shows the difference in the fall of output to a negative external demand shock between a country with an exchange rate rule and a country with a peg ($\frac{\partial y}{\partial x}|^{EXR} - \frac{\partial y}{\partial x}|^{PEG}$). The response under a peg is smaller if foreign currency debt is high and the share of homogeneous goods is low.

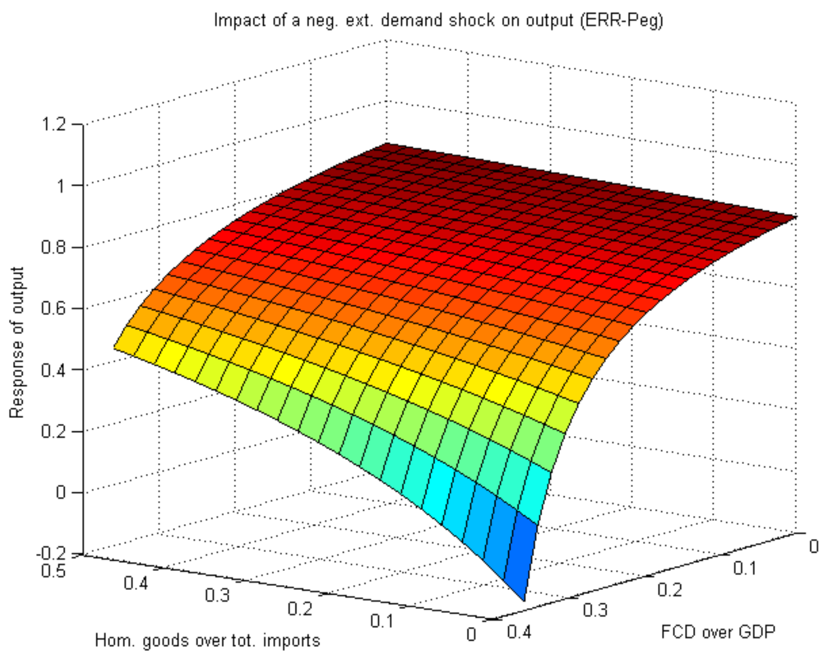

Figure 1: Output response to a negative external demand shock: Difference between exchange rate rule and peg.

3.2.3 The money rule

Results under the monetary rule (4) are similar to the exchange rate rule. The similarity is due to the fact that for an appropriately chosen $\kappa = \kappa(\xi, \omega)$ the exchange rate rule can replicate the float. However, the money rule generates endogenously a higher depreciation, if pass-through is lower $\left(\frac{\partial \kappa}{\partial \omega} < 0\right)$. This insulates output better, through stronger expenditure switching, if foreign debt is low. For the same reason the money rule insulates output worse if foreign debt is high and the share of differentiated goods in total imports is high, since

[17]There is a direct link in the model between the share of foreign debt to GDP and the parameter ξ which is derived in the appendix.

now the stronger depreciation amplifies the contractionary effects. Analytical results are relegated to the Appendix.

4 Data

We analyze the role of foreign currency debt and the import structure using a sample which covers yearly data for 101 countries from 1974-2007. We impose the following restrictions on the data: the sample does not include G7 countries, as the identifying assumption on the exogeneity of external shocks may not hold for large countries. Because of data quality concerns the study uses only countries for which we have more than five data points. We also discard very poor countries with a PPP adjusted GDP per capita of less than 1000 dollars in 2007, small countries with a population of less than 1 million and observations where the annual change in real GDP exceeds twenty percent. In line with previous studies we only consider observations where inflation was reasonably low (below fifty percent). Furthermore, we restrict the exchange rate regime to be in place at least one period, to avoid cross-contamination due to exchange rate regime transitions. Data come from various sources including the IMF's International Financial Statistics (IFS), the World Bank's World Development Indicators (WDI) and the Bank of International Settlements (BIS). For a detailed description see the Appendix.

Foreign Debt We employ three alternative measures. The first measure is short term external debt over GNI provided by the WDI. We prefer short term debt over total debt, since there is less of a roll over problem for long term debt and balance sheet effects are less immediate. As a robustness check we also report results for total external debt. The measure does not cover industrial countries. It is possible that part of the external debt is in domestic currency, but according to Lane and Shambaugh (2009)'s dataset almost hundred percent of external debt (as opposed to total external liabilities) is in foreign currency. As an alternative measure we use the claims on the domestic economy by foreign banks scaled by GDP from the BIS . The disadvantage of this dataset is that it starts only in 1983 and only covers claims of banks from reporting countries. To reduce sensitivity to outliers we use $\log(1 + debt)$, where *debt* is the corresponding debt measure expressed in percentage points.

Import Structure In line with findings by Campa and Goldberg (2005) we use the share of primary commodities in a country's total imports of goods and services to measure the extent to which a country imports high pass-through goods. The share of primary commodities in total imports is proxied by the sum of agricultural goods, fuels, ores and metals over total imports as provided by the WDI. Again we use $\log(1 + imp)$, where imp is the import share of raw material in percentage points.

Exchange Rate Regime The literature divides between de jure classification and de facto classification. According to Ghosh et al. (2002) the de jure classification may be understood as the intention of the authority, while the de facto classifications attempts to capture the actual behavior of the respective authority. Since we are interested in the actual conduct of exchange rate policy, our preferred exchange range classification is Levy-Yeyati and Sturzenegger (2005)'s de facto classification (LYS) which covers the period from 1974 to 2004. The authors use cluster analysis on exchange rate data and official reserves to infer the actual exchange rate policy. The main specification uses an exchange rate dummy that takes the value one for a peg. We will compare our results with estimates using the IMF's de jure classification (1974-2007).

Terms of Trade We derive our terms of trade measure from various sources. The choice of the source is guided by the length of the provided series. For most developed countries we use the IFS terms of trade, since it is available for a long enough period. For other nations we use UNCTAD's terms of trade measure. If also the latter was not available for a long enough period, we made use of the constant and current export and import values available from the WDI to construct the implied terms of trade.[18] For a detailed description and the respective measures employed see the Appendix.

Foreign Interest Rate To measure the real foreign interest rate we use the short term real interest rate of the reference country of relevance. The reference country is defined as in di Giovanni and Shambaugh (2008), essentially being the country by which a home country's monetary policy is influenced.[19] Depending on availability, the nominal short term rate is given by the money market or treasury bill rate and the real rate is obtained by subtracting CPI inflation from the nominal rate in reference country.

National Accounts Real GDP and investment in local currency are taken from the WDI.

5 Model and Estimation

5.1 Empirical Model and Identification

In order to examine the conditional response to external shocks we estimate a recursive Interacted Panel VAR of the form:

$$\begin{pmatrix} 1 & 0 & 0 \\ \alpha_{0,it}^{21} & 1 & 0 \\ \alpha_{0,it}^{31} & \alpha_{0,it}^{32} & 1 \end{pmatrix} \begin{pmatrix} \Delta EXV_{it} \\ \Delta INV_{it} \\ \Delta GDP_{it} \end{pmatrix} = \mu_i + \sum_{l=1}^{L} \begin{pmatrix} \alpha_{l,it}^{11} & 0 & 0 \\ \alpha_{l,it}^{21} & \alpha_{l,it}^{22} & \alpha_{l,it}^{23} \\ \alpha_{l,it}^{31} & \alpha_{l,it}^{32} & \alpha_{l,it}^{33} \end{pmatrix} \begin{pmatrix} \Delta EXV_{i,t-l} \\ \Delta INV_{i,t-l} \\ \Delta GDP_{i,t-l} \end{pmatrix} + U_{it} \qquad (16)$$

where $EXV_{i,t}$ is an external variable, either the log terms of trade or the foreign real interest rate, $GDP_{i,t}$ is log real GDP, and $INV_{i,t}$ is log real investment for country i in period

[18] Apart from few exceptions, if various measures were available, they tended to be identical or at least highly correlated.

[19] The original dataset is somewhat shorter than our sample. For missing countries we used the updated information provided by Reinhart and Rogoff (2004) on the partner country

t. $U_{i,t}$ is a vector of uncorrelated iid shocks, μ_i is a vector of country specific intercepts and L is the number of lags. $a^{jk}_{l,it}$ are deterministically varying coefficients.

We identify external shocks with a small open economy assumption. Small economies' actions have a negligible impact on goods' world prices and the foreign interest rate. The assumption implies that our two external variables do not depend on domestic conditions and implies therefore strict exogeneity, which amounts to $a^{12}_{l,it} = a^{13}_{l,it} = 0$ for all l. Various other authors found that the exogeneity assumption for terms of trade generally holds for developing countries (Broda, 2004; Raddatz, 2007; Loayza and Raddatz, 2007). Since we are only interested in the identification of the shock to the external variable, the described partial identification scheme is sufficient and the ordering of GDP and investment does not matter.[20]

5.2 Interaction Terms

In order to analyze how responses vary with country characteristics, we allow for interaction terms, such that the coefficients in (16) are given by:

$$\begin{aligned} a^{jk}_{l,it} &= \beta^{jk}_{l,1} + \beta^{jk}_{l,2} \cdot PEG_{it} + \beta^{jk}_{l,3} \cdot FCD_{it} + \beta^{jk}_{l,4} \cdot RAW_{it} \\ &\quad + \beta^{jk}_{l,5} \cdot FCD_{it} \cdot PEG_{it} + \beta^{jk}_{l,6} \cdot RAW_{it} \cdot PEG_{it} \end{aligned} \tag{17}$$

where PEG_{it} is the exchange rate regime dummy, FCD_{it} is the foreign currency debt measure and RAW_{it} is the share of raw materials.

Previous studies that investigate stabilization properties of exchange rate regimes have set $\beta^{jk}_{l,3} = \beta^{jk}_{l,4} = \beta^{jk}_{l,5} = \beta^{jk}_{l,6} = 0$. We start with the results for this specification for comparison purposes. We then look at the effects of import structure and foreign currency debt separately by either setting $\beta^{jk}_{l,3} = \beta^{jk}_{l,5} = 0$ or $\beta^{jk}_{l,4} = \beta^{jk}_{l,6} = 0$. Finally, we look at the most general case in which all coefficients are unrestricted. While we allow the coefficients to vary with country characteristics for output and investment, we restrict the external dynamics to be independent of country characteristics, i.e. $a^{11}_{l} = \beta^{11}_{l,1}$ for all l. A Wald test does not reject the null hypothesis and confirms the appropriateness of the assumption. As in every VAR single coefficients $a^{jk}_{l,it}$ cannot be interpreted. We can, however, evaluate the coefficients at specific values and then compute impulse responses.[21] While the exchange rate regime is a dummy variable, our measures of foreign currency debt and raw materials share are defined over a continuous range. As a benchmark we evaluate continuous variables

[20] Under the strict exogeneity assumption the model can equivalently be written in VARX form $Y_t = \sum_{l=1}^{L} C_l Y_{t-l} + \sum_{l=0}^{L} D_l \Delta EXVAR_{t-1} + E_t$ and $\Delta EXVAR_t = \sum_{l=1}^{L} F_l \Delta EXVAR_{t-l} + V_t$, where $Y_t = (INV_{i,t}, GDP_{i,t})'$ and V_t, E_t are reduced form error terms.

[21] Loayza and Raddatz (2007) apply a similar technique, but let only the coefficients on the external variable coefficients vary with country characteristics. The procedures leaves more degrees of freedom, but, assumes that there is only heterogeneity in the initial response, but not in the transmission. The authors find that less flexible labor markets and higher trade openness increase the response of a country's GDP to terms of trade shocks.

at a lower (20th) percentile and a higher (80th) percentile value.[22] For the exchange rate dummy the evaluation are taken at one (peg) and zero (float).

5.3 Estimation and Inference

Since the error terms are uncorrelated across equations by construction, we can estimate (16) equation by equation without loss in efficiency. In order to control for country specific intercepts we demean the data. We choose two lags following the Schwartz Criterion.[23]

Pesaran and Smith (1995) have shown that if there is heterogeneity in the slope coefficients across countries, estimates that impose a common slope are biased. The authors propose a mean group estimator. However, using Monte Carlo simulations, Rebucci (2003) shows that in typical macro panels fixed effects panel VAR estimators outperform mean group estimators unless slope heterogeneity is considerable. The reason is that the small sample bias may be more detrimental to the mean group estimator than the slope heterogeneity bias to the fixed effects estimator. Additionally, we are allowing slope coefficients to differ with country characteristics through the interaction terms. The use of interaction terms should therefore alleviate the bias from slope heterogeneity. We are interested in the differential slopes across exchange rate regimes conditional on country characteristics. Consequently, the mean-group estimator seems no viable alternative to us.

Since the impulse responses are a non linear function of the OLS estimates, analytical standard errors that rely on first order asymptotics may be inaccurate. To address this issue we use bootstrapped standard errors as proposed by Runkle (1987) adjusted for the fact that we are dealing with a Panel and make use of interaction terms.[24] The procedure may be described in the following way. 1) Estimate (16) by OLS 2) Draw errors $\hat{\varepsilon}_{i,\tilde{t}}$ from a normal distribution $N(0, \hat{\Sigma})$ where $\hat{\Sigma}$ is the estimated covariance matrix 3) use $\hat{\varepsilon}_{i,\tilde{t}}$ and the initial observations of the sample and the estimates of $\hat{a}^{jk}_{l,it}$ to simulate recursively $\hat{Y}_{i,1}$.[25] 4) After the first period is simulated for all variables in the system interact the variables with the interaction terms and now repeat 2 and 3 as many times as there are errors.[26] 5) The artificial sample, together with the interaction variables, is then used to re-estimate

[22] Alternatively, we can generate a dummy based on the division of country observations with high and low external debt level and high and low raw materials share. While the continuous indicator imposes that the response changes in a (log) linear manner with the indicator value, the dummy implies a threshold effect relationship. Results with dummies (not presented) underpin our findings.

[23] In the presence of fixed effects and lagged dependent variables, IV (or GMM) estimators are preferable from an asymptotic point of view if N is large and T is small. Fixed estimates are consistent for a large T.

[24] The programs to perform the estimation method as well as the programs to generate impulse responses and bootstrapped confidence intervals are available from the authors upon request.

[25] Different to the original procedure which was not described for the Panel VAR context, we draw initial observations panel specific and perform the simulation for each country.

[26] We simulated the response for each country over the entire sample length and eliminated at the end of the simulation those observations that where missing in the original sample to maintain the same weight for each country as in the initial data. Since the procedure requires the multiplication of the newly generated data with the interaction terms in the respective period, missing observations need to be filled by interpolation. These observations will however not be part of the newly generated data as explained above.

the coefficients of (16) and (cumulative) IRFs are computed. 6) The procedure (step 2 to 5) is repeated 500 times. The 90 % confidence interval is the minimum distance that covers 90 % of the simulated estimates.[27]

We test in two ways whether interactions with exchange rate regime, foreign currency debt, or raw material share have a statistically significant effect on the dynamics of the variables. The first way, as for example done by Broda (2004), is to check with a Wald test whether the interaction terms in the recursive VAR model are jointly significant. Such a procedure tests whether the interaction terms can explain a statistically significant fraction of the overall variation in the dependent variables. The test allows no direct inference on whether there are significant differences in the response to a specific shock, at a specific time horizon. To address this question we compare (cumulative) impulse response functions pairwise with a t-test.

$$t = \frac{IRF(PEG_1, RAW_1, FCD_1)_t - IRF(PEG_2, RAW_2, FCD_2)_t}{\sigma(IRF_{1,t} - IRF_{2,t})} \tag{18}$$

The null is that the response of two countries with given exchange rate regime, foreign currency debt, and import structure to a shock after t years is equal. The standard deviation of the difference between the two responses $\sigma(IRF_{1,t} - IRF_{2,t})$ is estimated from the bootstrap sample. [28]

6 Results

6.1 Floats versus Pegs

As a first step we contrast the response of output and investment under different exchange rate regimes, irrespective of the degree of foreign currency debt and of the import structure. Figure 2 shows the cumulative response of output and investment to a negative 10% terms of trade shock using the LYS exchange rate classification. With a peg output falls by about 1 % in two years, whereas under a float output falls by about 0.6 %. The result is therefore in line with the classic argument that flexible exchange rates are better suited to absorb real shocks and confirms previous empirical studies by Edwards and Levy Yeyati (2005) and Broda (2004). According to a Wald test the interaction terms are jointly significant. A t-test, however, finds the difference in the response to terms of trade shocks not statistically significant at any horizon. The responses of investment are similar and not statistically significantly different. Under a float the response is even slightly stronger.

Table 2 presents the results for alternative specifications. With the IMF's de jure exchange rate regime classification, we again find evidence that the output response under a float is smaller. The results for a shock to the foreign interest rate are similar to those for

[27] Kilian (1998) showed that the IRFs may still suffer from small sample bias. We find no evidence of such a bias in our results, since the mean of the bootstrapped responses tends to coincide with the point estimate, the difference between the two being the bias correction proposed by Kilian.

[28] An alternative to the t-test is to look directly at the empirical distribution of impulse response differences and evaluate which fraction lies above zero. Such a procedure gives very similar results.

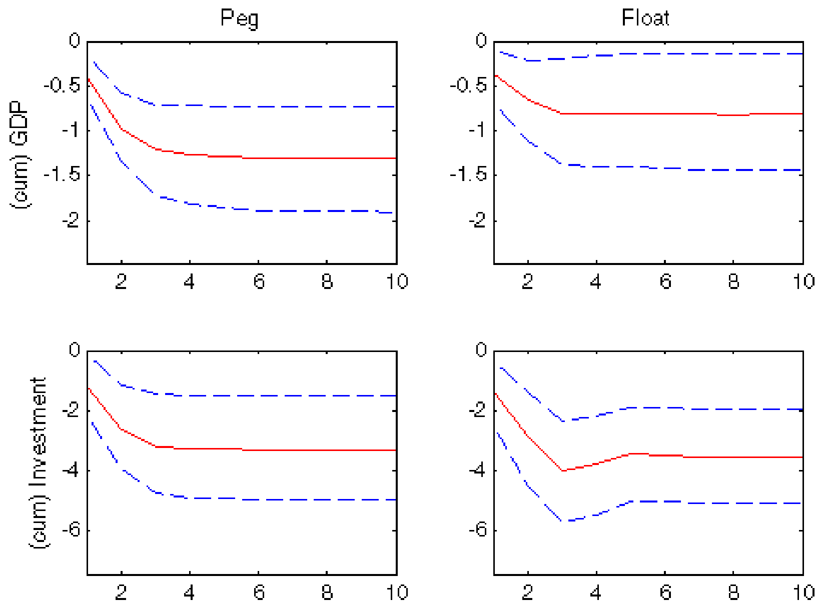

Figure 2: Impulse Responses for an initial 10% Terms of Trade Shock under LYS classification

	Output			Investment		
	1st year	2nd year	5th year	1st year	2nd year	5th year
10% ToT Shock, LYS						
Fix	-0.39	-0.98	-1.28	-1.21	-2.62	-3.28
Float	-0.37	-0.66	-0.8	-1.38	-2.88	-3.45
Wald Test	0.01					
10% ToT Shock, IMF						
Fix	-0.26	-0.73*	-1.22*	-1.46***	-2.92***	-4.13***
Float	-0.08	-0.35	-0.64	-0.02	-0.64	-1.4
Wald Test	0.00					
100bps foreign interest rate shock, LYS						
Fix	-0.01	-0.27	-0.51*	-0.03	-0.74	-1.87
Float	0.07	-0.02	-0.11	0.36	-0.49	-1.02
Wald Test	0.00					

Stars (*) stand for the t test statistic that compares pegs and floats. ***,**,* indicate the t-statistic lies below the 2.5%, 5%, 10% percentile and the response is therefore statistically significantly lower than for its counterpart. "Wald Test" reports the p-value of the test for the joint significance of all interaction terms.

Table 2: Output and Investment Response to External Shock, Conditional on the Exchange Rate Regime

the terms of trade shock. After a 100 bps shock output falls by about 0.4 % under a peg, whereas output under a float remains virtually unchanged.

6.2 The Role of Foreign Currency Debt

We proceed by looking at the response of output under different exchange rate regimes conditional on the degree of foreign currency indebtedness (Figure 3). Flexible exchange rates insulate better from terms of trade shocks if foreign debt is low: In the second year the output response under a flexible exchange rate is insignificant, while output has declined by more than one percent under a fixed exchange rate. The finding is reversed for high foreign debt: Under a peg the output response is of similar magnitude as under the low debt counterpart. The response under a float, however, is substantially stronger than in the low debt case and output declines by about 1.1 percent. A Wald test confirms the joint significance of all interaction terms. Pairwise t-tests find a significant difference in the output response between pegs and floats when foreign currency debt is low, but not if it is high. Under a float, there is also a significantly stronger output response with high foreign debt compared to low foreign debt.

The balance sheet effects theory suggests that the main reason for the difference between the output response of a float with high and low foreign currency debt is investment. With high foreign currency debt, a depreciation reduces firm's net worth more, which leads to tighter credit conditions and less investment. Figure 3 affirms the importance of investment, although the confidence bands are rather wide. With low foreign currency debt, investment behaves similarly under both exchange rate regimes. It declines by about 1.5 percent within two year. With high foreign currency debt, the investment response under a float is stronger: investment declines by 4.3 percent under a float compared to 3 percent under a peg.

With the estimates at hand, we can simulate the accumulated response of output to terms of trade shocks across various degrees of external indebtedness and define zones for which floats insulate output better from terms of trade shocks than pegs. Figure 4 shows the accumulated response of output after two years for varying degrees of indebtedness.[29] The response of output to the shock under fixed regimes shows no particular sensitivity to the extent of foreign currency debt, but under a float the response rises with higher debt. According to the estimates output responds less under a float up to a short term external debt to GNI ratio of 10 percent. Roughly 25 percent of all observations lie above this threshold. The investment response under a float is stronger for most levels of foreign currency debt and increases also faster with debt compared to a peg. The higher sensitivity of investment under a float is consistent with the idea that balance sheet effects play an important role.

Table 3 reports alternative specifications. Our results for output and investment with total external debt instead of short term debt are quantitatively similar, but not always significant because of higher parameter uncertainty, consistent with the idea there is less of a rolling over problem for long term debt. Using claims of foreign banks instead gives again

[29] The conclusion is similar if we use other horizons.

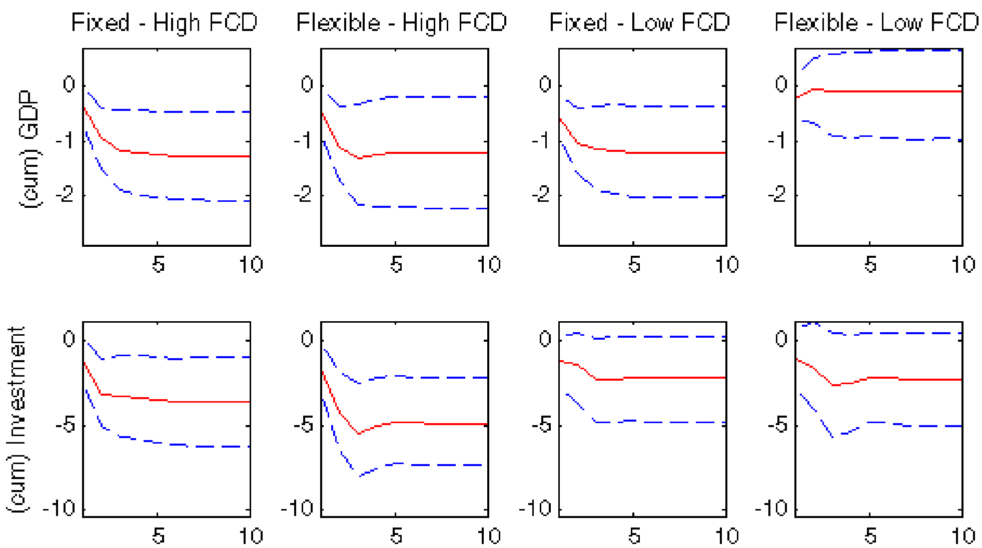

Figure 3: Impulse Responses for a negative 10% Terms of Trade Shock under LYS classification

similar results. Using the IMF's de jure exchange rate regime classification also confirms our findings. The results for responses to a foreign interest rate shock are a bit less clear. There are no statistically significant differences in pairwise comparison of impulse responses, even if a Wald test finds the interaction terms involving foreign debt to be jointly significant. Both with high and low debt, the response under a peg is slightly stronger. With high foreign debt the response of output and investment is again stronger, consistent with the interpretation that balance sheet effects become more important.

6.3 The Role of Import Structure

In a next step we attempt to shed some light on the role of import structure in the transmission of shocks. A Wald test indicates joint significance of all interaction terms. Figure 5 shows the response of output and investment in countries with a high and a low share of raw materials in total imports. With a high share of raw materials and therefore high pass-through, flexible exchange rates shield output better from terms of trade shocks. In countries that have a high raw material share and maintain a peg output falls by about 1.5 percent in two years, while it falls only by a bit more than 0.5% under a float. For countries with low pass-through the picture is reversed. Under a peg output falls by 0.5% and under a float it falls by about 1.5%. The differences are statistically significant in both cases. A potential explanation for the higher response under a float are balance sheet effects that can no longer by compensated with expenditure switching. The explanation is consistent with the response of investment. For observations with a low raw material share, investment falls

		Output			Investment	
	1st year	2nd year	5th year	1st year	2nd year	5th year
10% ToT Shock, LYS, Short term ext. debt						
Fix-HFCD	-0.32	-0.94	-1.25	-1.03	-3.14	-3.52
Float-HFCD	-0.42	-1.1$_{++}$	-1.2$_{+}$	-1.51	-4.3$_{+}$	-4.82
Fix-LFCD	-0.54	-1.04***	-1.2**	-1.2	-1.43	-2.18
Float-LFCD	-0.23	-0.04	-0.1	-1.02	-1.57	-2.18
Wald Test	0.00	0.00	0.03			
10% ToT Shock, IMF, Short term ext. debt						
Fix-HFCD	-0.24	-0.74	-1.02	-1.41	-3.39	-3.85
Float-HFCD	-0.38$_{+++}$	-1.00$_{+++}$	-1.55$_{+++}$	-0.87$_{++}$	-3.2$_{+++}$	-4.67$_{+++}$
Fix-LFCD	-0.29**	-0.69***	-1.19***	-1.73***	-2.81***	-4.08***
Float-LFCD	0.13	0.28	0.40	0.87	2.07	1.38
Wald Test	0.00	0.00	0.00			
10% ToT Shock, LYS, total ext. debt						
Fix-HFCD	-0.18	-0.9	-1.26	-0.67	-2.66	-3.47
Float-HFCD	-0.31	-0.66	-0.8	-1.32	-3.49	-3.83
Fix-LFCD	-0.42	-1.02	-1.2	-1.44	-2.79	-2.92
Float-LFCD	-0.31	-0.33	-0.44	-1.09	-1.51	-2.53
Wald Test	0.00	0.00	0.26			
10% ToT Shock, LYS, BIS						
Fix-HFCD	0.08	-0.93	-0.86	-0.31	-2.85$_{+}$	-1.9
Float-HFCD	-0.4*	-1.05	-1.15	-1.12	-3.62	-3.38
Fix-LFCD	-0.34$_{+++}$	-0.74	-0.94	-0.51	-1.2	-2.03
Float-LFCD	-0.57	-0.59	-0.79	-1.43	-2.4	-2.5
Wald Test	0.00	0.00	0.00			
100bps foreign interest rate shock, LYS, Short term ext. debt						
Fix-HFCD	-0.1$_{+}$	-0.39	-0.73	-0.74$^{**}_{++}$	-0.79	-2.86$_{++}$
Float-HFCD	0.08	-0.15	-0.35	0.55	-0.8	-1.9
Fix-LFCD	0.1	-0.1	-0.27	0.42	-0.24	-0.83
Float-LFCD	0.11	0.15	0.09	0.06	-0.58	-0.78
Wald Test	0	0	0.29			

HFCD and LFCD stand for High and Low Foreign Currency Debt. Stars (*) stand for the t test statistic that compares pegs and floats with the same level of FCD. Crosses (+) stand for t statistic that compares the response under the same regime for HFCD and LFCD. ***(+++),**(++),*(+) indicate the t-statistic lies below the 2.5%, 5%, 10% percentile and the response is therefore statistically significantly lower than for its counterpart. The first, second, and third column of "'Wald Test" report the p value of tests for the joint significance of all interaction terms, the joint significance of all interaction terms that involve FCD or FCD*PEG, the joint significance of all interaction terms that involve FCD*PEG.

Table 3: Output and Investment Response to External Shock, Conditional on Short Term External Debt and Exchange Rate Regime

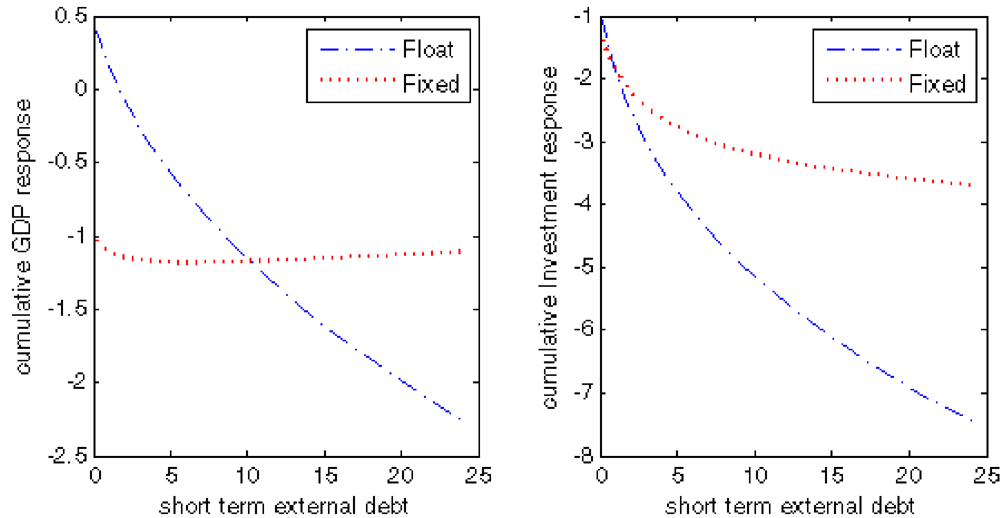

Figure 4: Cumulative Response of Output and Investment to a 10% ToT Shock in the second year as a function of foreign currency debt

by about 4 % under a float and only by about 2% under a peg.

As with foreign currency we can investigate how the respective exchange rate regime performs by evaluating the cumulative output response at different levels of our import structure measure. Figure 6 shows the accumulated response of output in the second year for varying shares of raw materials on total imports. As expected we find that the insulation ability of the float increases with the raw material share, when expenditure switching dominates the balance sheet effect. For fixed regimes on the other hand, the response of output to terms of trade shocks increases with the pass-through. The response of pegs and floats intersect at a raw material share of 14 %. Roughly 55 % of the observations lie below the threshold.

If we use the de jure exchange rate classification a similar picture emerges, but the differences in pairwise comparison of impulse responses are smaller and not statistically significant (Table 4). The result is in line with our argument that actual exchange rate policy is more important than declared policy. A Wald test finds joint significance of all interaction terms. If we analyze the response of output to a foreign interest rate shock, we again confirm the that flexible exchange rate insulates output only significantly better when raw material imports are relatively large.

6.4 The Joint Role of Foreign Currency Debt and Import Structure

Our results so far have shown that there is no empirical evidence that output responds generally less to a real shock under a float. Consistent with theoretical underpinnings we find the insulation properties of floats vanish for import structures associated with low

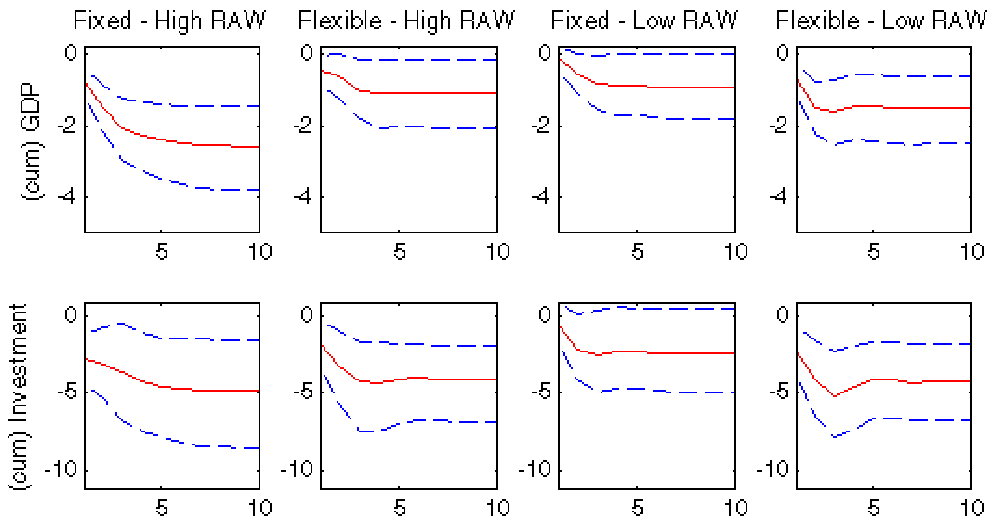

Figure 5: Impulse Responses for a Negative 10% Terms of Trade Shock under LYS classification

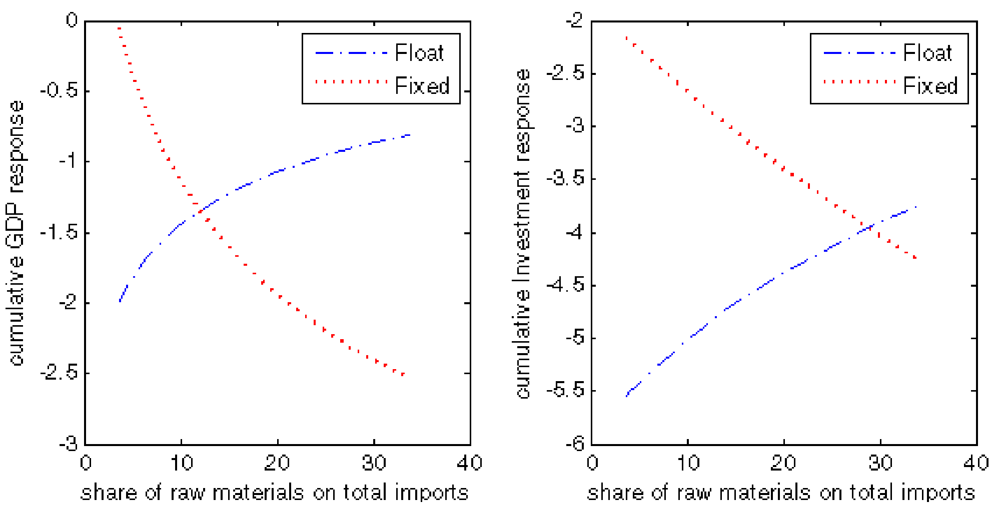

Figure 6: Cumulative Response of Output and Investment to a 10% ToT Shock in the second year as a function of raw material share in total imports

	Output			Investment		
	1st year	2nd year	5th year	1st year	2nd year	5th year
10% ToT Shock, LYS, Raw Material Share						
Fix-HRAW	-0.76_{+++}	-1.52^{**}_{+++}	-2.4^{*}_{+++}	-2.8_{+++}	-3.09	-4.56
Float-HRAW	-0.46	-0.61	-1.08	-1.78	-3.27	-4.09
Fix-LRAW	-0.12	-0.57	-0.9	-0.46	-2.12	-2.33
Float-LRAW	-0.64^{**}	-1.49^{**}_{++}	-1.47	-2.21^{*}	-4.14	-4.07
Wald Test	0	0	0.01			
10% ToT Shock, IMF, Raw Material Share						
Fix-HRAW	-0.31	-0.87	-1.58	-2.84^{*}_{+++}	-3.51	-4.87
Float-HRAW	-0.43	-0.44	-0.92	-1.49	-2.17	-3.41
Fix-LRAW	-0.12	-0.65	-1.45	-0.79	-2.8	-4.34
Float-LRAW	-0.2	-0.73	-0.81	-0.98	-1.63	-2.43
Wald Test	0	0	0			
100 bps foreign interest rate shock, LYS, Raw Material Share						
Fix-HRAW	-0.26^{*}_{++}	-0.73^{*}_{++}	-1.31^{**}_{+++}	-0.43	-1.36	-3.17^{*}
Float-HRAW	0_{+}	-0.21	-0.37	0.58	-0.6	-0.89
Fix-LRAW	0.04^{*}	-0.17	-0.29	-0.11^{**}	-0.76	-1.56
Float-LRAW	0.3	0.14	-0.2	1.1	0.3	-1.59
Wald Test	0	0	0.17			

HRAW and LRAW stand for High and Low share of raw materials in total imports. Stars (*) stand for the t test statistic that compares pegs and floats with the same level of FCD. Crosses (+) stand for t statistic that compares the response under the same regime for HRAW and LRAW. ***(+++),**(++),*(+) indicate the t-statistic lies below the 2.5%, 5%, 10% percentile and the response is therefore statistically significantly lower than for its counterpart. The first, second, and third column of "'Wald Test" report the p value of tests for the joint significance of all interaction terms, the joint significance of all interaction terms that involve RAW or RAW*PEG, the joint significance of all interaction terms that involve FCD*PEG.

Table 4: Output and Investment Response to External Shock, Conditional on Import Structure and Exchange Rate Regime

levels of pass-through and for high levels of foreign currency debt. We now turn to the complete specification and let the responses be a function of the exchange rate regime, foreign currency debt, and import structure.[30]

We take the value of the cumulated response of output within two years as a benchmark and simulate this response along the grid of possible constellations of foreign currency debt and import structures for fixed regimes and flexible regimes. Then we subtract the corresponding value of the peg from the float. A value below zero implies the response of output under the float is stronger. The lower the value the stronger is the relative response under a float. Figure 7 confirm the previous findings and resembles the shape of Figure 1 from the theoretical model. The output response under a float is weaker if the raw material share is high and foreign debt is low. The picture weakens and finally reverses if either the raw material share is low or foreign debt is high.

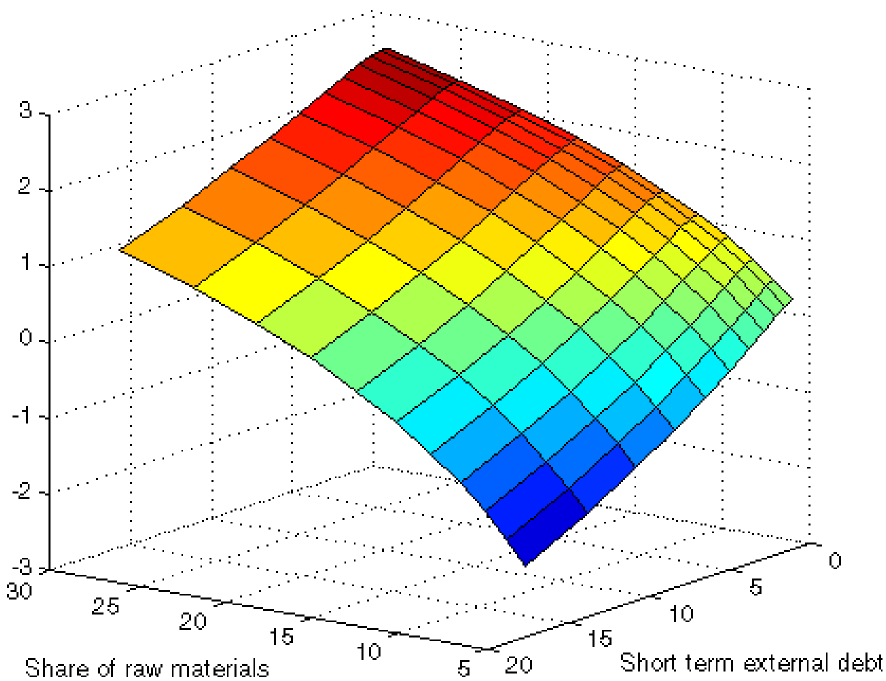

Figure 7: Output response to a negative 10 % terms of trade shock in the second year: Difference between float and peg.

[30]Clearly this leads to a significant loss in degrees of freedom, given that we employ two lags and work with three variables. Nevertheless, results are in line with the former findings and confidence intervals remain reasonably tight. To save space results are not reported but available from the authors.

7 Conclusion

Even though we are equipped with a battery of theoretical models about the implications of the choice of the exchange rate regime under various rigidities and institutional frameworks, empirical work has lagged behind. Previous studies have either not distinguished between the various shocks that hit the economy or not accounted for differences in the frictions or the economic structure that affect the response to shocks. In the present study we synthesize theoretical considerations in a stylized three equation model to analyze how limited pass-through and foreign currency debt affect the buffer property of a flexible exchange rate. We show that flexible exchange rates do not necessarily shield output better from real external shocks than pegs. With high foreign currency debt and low pass-through contractionary balance sheet effects dominate expansionary expenditure switching effects. Using an Interacted Panel VAR for a large sample of countries we test and confirm the predictions of the extended IS-LM-BP model by allowing the response of output and investment to an external shock vary with the exchange rate regime, the foreign currency debt and the import structure.

Our analysis focuses on how the exchange rate regime affects macroeconomic adjustment to real external shocks. Policy makers will also care about other aspects when choosing an exchange rate regime, such as its effects on inflation, trade volumes, long term growth or on the likelihood of financial crises. Our results suggest that *ceteris paribus* the case for a float weakens if a country has high foreign currency debt and imports mainly low pass-through goods.

References

Baxter, Marianne, and Alan C. Stockman (1989) 'Business cycles and the exchange-rate regime : Some international evidence.' *Journal of Monetary Economics* 23(3), 377–400

Bebczuk, Ricardo N., Ugo Panizza, and Arturo Galindo (2006) 'An evaluation of the contractionary devaluation hypothesis.' RES Working Papers 4486, Inter-American Development Bank, Research Department, July

Bernanke, Ben, Mark Gertler, and Simon Gilchrist (1998) 'The financial accelerator in a quantitative business cycle framework.' NBER Working Papers 6455, National Bureau of Economic Research, Inc, March

Broda, Christian (2004) 'Terms of trade and exchange rate regimes in developing countries.' *Journal of International Economics* 63(1), 31–58

Broda, Christian, and Cedric Tille (2003) 'Coping with terms-of-trade shocks in developing countries.' *Current Issues in Economics and Finance*

Campa, Jos Manuel, and Linda S. Goldberg (2005) 'Exchange rate pass-through into import prices.' *The Review of Economics and Statistics* 87(4), 679–690

Cavallo, Michele, Kate Kisselev, Fabrizio Perri, and Nouriel Roubini (2004) 'Exchange rate overshooting and the costs of floating.' *Proceedings*

Céspedes, Luis Felipe, Roberto Chang, and Andres Vélasco (2004) 'Balance sheets and exchange rate policy.' *American Economic Review* 94(4), 1183–1193

Céspedes, Luis Felipe, Roberto Chang, and Andrs Velasco (2003) 'Must original sin cause macroeconomic damnation?' Working Papers Central Bank of Chile 234, Central Bank of Chile, October

Choi, Woon Gyu, and David Cook (2004) 'Liability dollarization and the bank balance sheet channel.' *Journal of International Economics* 64(2), 247–275

Cook, David (2004) 'Monetary policy in emerging markets: Can liability dollarization explain contractionary devaluations?' *Journal of Monetary Economics* 51(6), 1155–1181

Devereux, Michael B., and Charles Engel (2003) 'Monetary policy in the open economy revisited: Price setting and exchange-rate flexibility.' *Review of Economic Studies* 70(4), 765–783

Devereux, Michael B., Philip R. Lane, and Juanyi Xu (2006) 'Exchange rates and monetary policy in emerging market economies.' *Economic Journal* 116(511), 478–506

di Giovanni, Julian, and Jay C. Shambaugh (2008) 'The impact of foreign interest rates on the economy: The role of the exchange rate regime.' *Journal of International Economics* 74(2), 341–361

Edwards, Sebastian, and Eduardo Levy Yeyati (2005) 'Flexible exchange rates as shock absorbers.' *European Economic Review* 49(8), 2079–2105

Eichengreen, Barry, Ricardo Hausmann, and Ugo Panizza (2003) 'Currency mismatches, debt intolerance and original sin: Why they are not the same and why it matters.' NBER Working Papers 10036, National Bureau of Economic Research, Inc, October

Fleming, John M. (1962) 'Domestic financial policies under fixed and under. floating exchange rates.' IMF StaffPapers 9, IMF StaffPapers, November

Flood, Robert P., and Andrew K. Rose (1995) 'Fixing exchange rates a virtual quest for fundamentals.' *Journal of Monetary Economics* 36(1), 3–37

Friedman, Milton (1953) 'The case for flexible exchange ratess.' Technical Report

Galindo, Arturo, Ugo Panizza, and Fabio Schiantarelli (2003) 'Debt composition and balance sheet effects of currency depreciation: a summary of the micro evidence.' *Emerging Markets Review* 4(4), 330–339

Gertler, Mark, Simon Gilchrist, and Fabio M. Natalucci (2007) 'External constraints on monetary policy and the financial accelerator.' *Journal of Money, Credit and Banking* 39(2-3), 295–330

Ghosh, A.R., A.M. Gulde, and H.C. Wolf (2002) *Exchange Rate Regimes: Choices and Consequences* (MIT Press)

Ghosh, Atish R., Anne-Marie Gulde, Jonathan D. Ostry, and Holger C. Wolf (1997) 'Does the nominal exchange rate regime matter?' NBER Working Papers 5874, National Bureau of Economic Research, Inc, January

Hausmann, Ricardo, Ugo Panizza, and Ernesto Stein (2001) 'Why do countries float the way they float?' *Journal of Development Economics* 66(2), 387–414

Hoffmann, Mathias (2007) 'Fixed versus flexible exchange rates: Evidence from developing countries.' *Economica* 74(295), 425–449

Kehoe, Timothy J., and Kim J. Ruhl (2008) 'Are shocks to the terms of trade shocks to productivity?' *Review of Economic Dynamics* 11(4), 804–819

Kilian, Lutz (1998) 'Small-sample confidence intervals for impulse response functions.' *The Review of Economics and Statistics* 80(2), 218–230

Krugman, Paul (1986) 'Pricing to market when the exchange rate changes.' NBER Working Papers 1926, National Bureau of Economic Research, Inc, May

Lane, Philip, and Jay Shambaugh (2009) 'Financial exchange rates and international currency exposures.' *American Economic Review*

Levy-Yeyati, Eduardo, and Federico Sturzenegger (2005) 'Classifying exchange rate regimes: Deeds vs. words.' *European Economic Review* 49(6), 1603–1635

Loayza, Norman, and Claudio E. Raddatz (2007) 'The structural determinants of external vulnerability.' *The World Bank Economic Review* 21(3), 359–387

Miniane, Jacques, and John H. Rogers (2007) 'Capital controls and the international transmission of u.s. money shocks.' *Journal of Money, Credit and Banking* 39(5), 1003–1035

Mundell, Robert A. (1961) 'A theory of optimum currency areas.' *American Economic Review* (51), 657–665

Mussa, Michael (1986) 'Nominal exchange rate regimes and the behavior of real exchange rates: Evidence and implications.' *Carnegie-Rochester Conference Series on Public Policy* 25(1), 117–214

Pesaran, M. Hashem, and Ron Smith (1995) 'Estimating long-run relationships from dynamic heterogeneous panels.' *Journal of Econometrics* 68(1), 79–113

Raddatz, Claudio (2007) 'Are external shocks responsible for the instability of output in low-income countries?' *Journal of Development Economics* 84(1), 155–187

Ramcharan, Rodney (2007) 'Does the exchange rate regime matter for real shocks? evidence from windstorms and earthquakes.' *Journal of International Economics* 73(1), 31–47

Rebucci, Alessandro (2003) 'On the heterogeneity bias of pooled estimators in stationary var specifications.' IMF Working Papers 03/73, International Monetary Fund, April

Reinhart, Carmen M., and Kenneth S. Rogoff (2004) 'The modern history of exchange rate arrangements: A reinterpretation.' *The Quarterly Journal of Economics* 119(1), 1–48

Runkle, David E. (1987) 'Vector autoregressions and reality.' Staff Report 107, Federal Reserve Bank of Minneapolis

Tovar, Camilo E (2005) 'The mechanics of devaluations and the output response in a dsge model: how relevant is the balance sheet effect?' BIS Working Papers 192, Bank for International Settlements, November

A Derivation of the Model

The steps follow closely Céspedes et al. (2003) and are therefore brief.

A.1 IS Curve

Using the pricing rule and the fact that workers consume all income, the log linear version of the market clearing condition in period 2 (6) is

$$y_2 = \varkappa \left[(\phi - 1)(q_2 - p_2) + y_2 \right] + (1 - \varkappa)(s_2 - p_2) \tag{19}$$

where $\varkappa = \gamma (1-\alpha) \left(1 - \theta^{-1}\right) \left(\frac{\bar{P}_2}{\bar{Q}_2} \right)^{1-\phi}$.

The log linearized version of the price index in period 2 is

$$q_2 = \left(1 - \gamma_2'\right) s_2 + \gamma_2' p_2, \tag{20}$$

where $\gamma_2' = 1 - (1-\gamma) \left(\frac{\bar{S}_2}{\bar{Q}_2} \right)^{(1-\phi)}$.[31] Using equations (19) and (20) gives output as a function of the real exchange rate

$$y_2 = \Xi \left(s_2 - p_2\right), \tag{21}$$

where $\Xi = \left[1 + (\phi - 1)\left(1 - \gamma_2'\right) \varkappa / (1 - \varkappa)\right] \geq 1$.

Using (21) in the log linear version of (1) the consumption level in period 2 is given by

$$c_2 = y_2 - (q_2 - p_2) \tag{22}$$

Since no shock occurs in the second period $l = 0$, output deviations in the second period are driven by investment.

$$y_2 = \alpha i_1 \tag{23}$$

The linearized version of the market clearing condition in the first period (5) is

$$\tau y_1 + (1 - \tau)\left[c_1 + \phi q_1\right] = \lambda \left[i_1 + \phi q_1\right] + (1 - \lambda)(s_1 + x_1) \tag{24}$$

where $\tau = \frac{1}{1 - \gamma \left(\frac{\bar{P}_1}{\bar{Q}_1} \right)^{-\phi} (1-\alpha)(1-\theta^{-1})} > 1$ and $\lambda = \frac{\gamma \left(\frac{\bar{P}_1}{\bar{Q}_1} \right)^{-\phi} \bar{I}_1}{\gamma \left(\frac{\bar{P}}{\bar{Q}} \right)^{-\phi} \bar{I}_1 + \frac{\bar{S}_1}{\bar{P}_1} \bar{X}_1} < 1$.

Since capital is predetermined and wages are preset we have from the workers budget constraint (1).

$$q_1 + c_1 = \frac{y_1}{1 - \alpha} \tag{25}$$

The price index in period 1 is

$$q_1 = \left(1 - \gamma_1'\right) \omega s_1 \tag{26}$$

[31] The share of differentiated goods plays no role, because no shocks occur in the second period and foreign producers of differentiated goods take shocks in the initial period into account.

where $\gamma_1' = 1 - (1-\gamma)\left(\frac{\bar{S}_1}{\bar{Q}1}\right)^{(1-\phi)}$. Combining (24), (25) and (26) gives the IS curve

$$y_1\left(\frac{1-\tau\alpha}{1-\alpha}\right) = \lambda i_1 + (1-\lambda)\,x_1 + \left\{(1-\lambda) + \lambda\left(1-\gamma_1'\right)\omega\left[\phi + \frac{(\tau-1)}{\lambda}(\phi-1)\right]\right\} s_1$$

A.2 LM: Money Demand

From the consumer maximization problem we have that the log linear version of money demand in period one and two is respectively

$$\zeta\,(m_1 - q_1) + (1-\zeta)\,(c_2 + q_2 - q_1) = c_1 \tag{27}$$
$$\zeta\,(m_2 - q_2) = c_2 \tag{28}$$

where $\zeta = 1 - \beta\bar{Q}_1\bar{C}_1/\bar{Q}_2\bar{C}_2$, which is assumed to be positive. Combining the above equation with (22), (23), (25), and (26) gives

$$m_1 = \frac{1}{\zeta}\frac{y_1}{1-\alpha} - \frac{(1-\zeta)}{\zeta}\alpha i_1 - \frac{(1-\zeta)}{\zeta}p_2$$

A.3 BP: Entrepreneurs

The return on investment must satisfy the arbitrage condition with foreign returns adjusted by a risk premium

$$r_2 - q_1 - p_2 = \rho + \eta_1 + (s_2 - p_2) - s_1 \tag{29}$$

The marginal product of capital is given by $r_2 - p_2 = -i_1\,(1-\alpha)$. Using this result, (26) and (21) gives:

$$i_1\Phi^{-1} = -\,(\rho + \eta_1) + [1 - (1-\gamma)\,\omega]\,s_1 \tag{30}$$

where $\Phi = \frac{\Xi}{\Xi(1-\alpha)+\alpha} \geq 1$.

The log linear version of the risk premium is

$$\eta_1 = \mu\,[q_1 + i_1 - n_1] \tag{31}$$

The log linear version of net worth equation

$$n_1 = (1+\psi)\,\delta_y y_1 - \psi\xi s_1 \tag{32}$$

where $\delta_y = \theta^{-1}\left[1 - (1-\alpha)\left(1-\theta^{-1}\right)\right]^{-1}$.

Using (31) in (32) gives:

$$\eta = \mu\,\{i - \delta_y y + [(1-\gamma)\,\omega + \delta_s]\,s\}$$

which can be used in (30) to derive the BP schedule:

$$i_1\left(\Phi^{-1} + \mu\right) = -\rho + \mu\,(1+\psi)\,\delta_y y_1 - \mu\,[(1-\gamma)\,\omega + \psi\xi]\,s_1 + [1 - (1-\gamma)\,\omega]\,s_1$$

Note also that there is a direct link between ψ and the share of debt to GDP. To see this note that

$$\begin{aligned}\frac{\bar{P}_1\bar{N}_1}{\bar{P}_1\bar{Y}_1} &= \frac{\bar{R}_1\bar{K}_1+\bar{\Pi}_1}{\bar{P}_1\bar{Y}_1}-\frac{\bar{S}_1\bar{D}_1^*}{\bar{P}_1\bar{Y}_1}-\frac{\bar{D}_1}{\bar{P}_1\bar{Y}_1}\\ &= \frac{\bar{P}_1\bar{Y}_1-\bar{W}_1\bar{L}_1}{\bar{P}_1\bar{Y}_1}-\frac{\bar{S}_1\bar{D}_1^*}{\bar{P}_1\bar{Y}_1}-\frac{\bar{D}_1}{\bar{P}_1\bar{Y}_1}\end{aligned}$$

Using the standard pricing rule $\frac{\bar{W}_1\bar{L}}{\bar{P}_1\bar{Y}_1}=(1-\alpha)\frac{\theta-1}{\theta}$ this implies

$$\frac{\bar{P}_1\bar{N}_1}{\bar{P}_1\bar{Y}_1}=1-(1-\alpha)\left(1-\theta^{-1}\right)-\frac{\bar{S}_1\bar{D}_1^*+\bar{D}_1}{\bar{P}_1\bar{Y}_1}$$

Varying the share of foreign currency debt to GDP ratio $\left(\bar{S}_1\bar{D}_1^*/\bar{P}_1\bar{Y}_1\right)$ gives the implied $\left(\bar{P}_1\bar{N}_1/\bar{P}_1\bar{Y}_1\right)$ ratio (for a given level of domestic debt $\bar{D}_1/\bar{P}_1\bar{Y}_1$), which in turn allows to determine the total debt to net worth ratio $\psi=\left(S_1D_1^*+D_1\right)/P_1N_1$ and the implied foreign currency share in total debt ratio $\xi=\bar{S}_1\bar{D}_1^*/\left(\bar{S}_1\bar{D}_1^*+\bar{D}_1\right)$. Consider the standard parametrization $\theta=11$ and $\alpha=1/3$ then we have for a domestic debt to GDP ratio of 12% and a foreign debt to GDP ratio of 24% that $\bar{P}_1\bar{N}_1/\bar{P}_1\bar{Y}_1=0.04$ and $\psi=9$ and $\xi=2/3$.

B Solving the system

In the following we use equations (7), (8) and (9) and combine them with the monetary policy - peg, exchange rate rule or float - to determine the respective implied response of output and investment to an external demand shock.

B.1 The Peg

Under a peg monetary policy is given by $s=0$. This simplifies the system which determines output and investment to the following two equations:

$$y\left(\frac{1-\alpha}{1-\tau\alpha}\right)=\lambda i+(1-\lambda)x \tag{33}$$

$$i\left(\Phi^{-1}+\mu\right)=-\rho+\mu(1+\psi)\delta_y y \tag{34}$$

The impact of a terms of trade shock on output and investment is determined by solving the system which yields equation (10) and (11) in the text:

$$\frac{\partial y}{\partial x}=\left[\frac{1-\alpha}{(1-\lambda)(1-\tau\alpha)}-\frac{\lambda\mu(1+\psi)\delta_y}{(1-\lambda)\left(\Phi^{-1}+\mu\right)}\right]^{-1}$$

$$i=\frac{\partial y}{\partial x}\frac{\mu(1+\psi)\delta_y}{\left(\Phi^{-1}+\mu\right)}$$

B.2 The Exchange Rate Rule

Under the exchange rate rule we have that $s = -\kappa y$, which we use to substitute out for the exchange rate yielding the following two equation system.

$$y\left(\frac{1-\alpha}{1-\tau\alpha}\right) = \lambda i + (1-\lambda)\, x - \left[(1-\lambda) + \omega\lambda g\right]\kappa y \tag{35}$$

$$i = \frac{\mu\,(1+\psi)\,\delta_y + \mu\left[(1-\gamma_1')\,\omega + \psi\xi\right]\kappa - \left[1-(1-\gamma_1')\,\omega\right]\kappa}{(\Phi^{-1}+\mu)} y$$

Combining the two equations we can solve for output, which yields:

$$\frac{\partial y}{\partial x} = \chi\left[\begin{array}{c}\frac{(1-\alpha)\left(\Phi^{-1}+\mu\right)}{(1-\tau\alpha)} - \mu\lambda\,(1+\psi)\,\delta_y + \left(\Phi^{-1}+\mu\right)\omega\lambda g\kappa - \lambda\,(1-\gamma_1')\,\omega\kappa \\ -\lambda\mu\psi\xi\kappa - \lambda\mu\,(1-\gamma_1')\,\omega\kappa + \left[(1-\lambda)\left(\Phi^{-1}+\mu\right)+\lambda\right]\kappa\end{array}\right]^{-1}$$

where $\chi = (1-\lambda)\left(\Phi^{-1}+\mu\right)$. This is equation (12) in the text. Investment is given by

$$\frac{\partial i}{\partial x} = \frac{\mu\,(1+\psi)\,\delta_y + \mu\left[(1-\gamma_1')\,\omega + \psi\xi\right]\kappa - \left[1-(1-\gamma_1')\,\omega\right]\kappa}{(\Phi^{-1}+\mu)}\frac{\partial y}{\partial x}$$

The derivative with respect to ω is

$$\left.\frac{\partial i}{\partial x\partial\omega}\right|^{EXR} = \frac{\mu\,(1+\psi)\,\delta_y}{(\Phi^{-1}+\mu)}\left.\frac{\partial y}{\partial x\partial\omega}\right|^{EXR} + \left[\frac{\mu\left[(1-\gamma')\,\omega+\psi\xi\right]}{(\Phi^{-1}+\mu)} - \frac{\left[1-(1-\gamma')\,\omega\right]}{(\Phi^{-1}+\mu)}\right]\kappa\left.\frac{\partial y}{\partial x\partial\omega}\right|^{EXR}$$
$$+\frac{\mu\left[(1-\gamma')\right]+(1-\gamma')}{(\Phi^{-1}+\mu)}\kappa\left.\frac{\partial y}{\partial x}\right|^{EXR}$$

For $\mu > 0$ the first term is unambiguously negative, the third term is unambiguously positive, and the sign of the second term is ambiguous, which makes the sign of the overall expression ambiguous.

B.2.1 Evaluating the response of $\partial^2 y/\partial x\partial\omega$

To proof that the derivative $\partial^2 y/\partial x\partial\omega < 0$ we proceed in two steps. First, we show that for $\mu = 0$ we obtain a negative value for the derivative. Second, we show that the value is continuously decreasing in μ. Thus, the derivative can only be positive if $\mu < 0$ which is not in the possible set of values.

Consider the term in brackets in (14) . Substituting out $g\,(\phi) = (1-\gamma_1')\left[\phi + (\phi-1)\,(\tau-1)\,/\lambda\right]$ we can write.

$$\frac{(1+\mu)}{(\Phi^{-1}+\mu)}\left(1-\gamma_1'\right) - g = \left(1-\gamma_1'\right)\left\{\frac{(1+\mu)}{(\Phi^{-1}+\mu)} - \left[\phi + (\phi-1)\,(\tau-1)\,/\lambda\right]\right\}, \tag{36}$$

since $(1-\gamma_1') > 0$, it is sufficient to determine the sign of the term in curly brackets.

Now consider $\mu = 0$. Since $\Phi = \frac{\Xi}{\Xi(1-\alpha)+\alpha} \geqslant 1$, multiplying all terms with Φ^{-1} will not change the sign of term in curly brackets and we have:

$$1 - \alpha \frac{\left[\phi + (\phi - 1)\frac{\tau-1}{\lambda}\right]}{\Xi} - (1-\alpha)\left[\phi + (\phi - 1)\frac{\tau - 1}{\lambda}\right] \leq 0$$

The inequality follows form the fact that for $\phi = 1$, we have $\Xi = 1$ and thus the entire term is zero. For any value of $\phi > 1$ the term is negative since $\frac{\left[\phi+(\phi-1)\frac{\tau-1}{\lambda}\right]}{\Xi}$ and $\left[\phi + (\phi - 1)\frac{\tau-1}{\lambda}\right]$ are increasing in ϕ.The last step is to show that the (36) is decreasing in μ. This is quickly seen by recognizing that g and γ_1' are independent of μ and $\frac{\partial\left[(1+\mu)/\left(\Phi^{-1}+\mu\right)\right]}{\partial\mu} < 0$ since $\Phi^{-1} < 1$ for $\phi > 1$.

B.2.2 The Money Rule

The constant money rule implies for the LM that

$$i = \frac{1}{(1-\zeta)(1-\alpha)\alpha} y \tag{37}$$

Using this result in the BP yields:

$$s = -\kappa(\omega, \xi) y \tag{38}$$

where $\kappa(\omega, \xi) = B\left[(1+\mu)(1-\gamma')\omega + \mu\psi\xi - 1\right]^{-1}$ and $B = \left(\Phi^{-1} + \mu\right)\left[(1-\zeta)(1-\alpha)\alpha\right]^{-1} - \mu(1+\psi)\delta_y$. The system is completed by the IS equation (35). Using in the exchange rate rule the particular value $\kappa = \kappa(\omega, \xi)$ gives $\left.\frac{\partial y}{\partial x}\right|^{CMR}$ and demonstrates the equivalence between the constant money rule and the exchange rate rule if κ adjusts endogenously to reestablish the equilibrium in the money market. The solution for investment under the constant money rule reads:

$$\left.\frac{\partial i}{\partial x}\right|^{CMR} = \frac{1}{(1-\zeta)(1-\alpha)\alpha} \left.\frac{\partial y}{\partial x}\right|^{CMR}$$

C Data Sources

In the following we describe the indices and transformations which we applied to the data:

Exchange Rate Regimes: The de jure classification needed to be unified since it is based on the changing IMF Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). The classification went through four distinct phases of change. It is possible to group the countries consistently into 3 broad categories, floating, intermediate and fixed regimes. The original IMF classification is coded in four taxonomies: Taxonomy 1 from 1975 to 1976 includes: "Pegged to a single currency" (1), "Pegged to a composite (including the SDR)" (2), "Floating - adjusted according to a set of indicators" (3), "Floating - common margins" (4) and "Floating - independently" (5). Taxonomy 2 from 1977 to 1981 distinguishes: "Pegged to a single currency" (1), "Pegged to a composite (including the SDR)" (2), "Adjusted according to a set of indicators" (3), "Cooperative exchange arrangements" (4), "Other" (5). Taxonomy 3 ranges from 1982 to 1998 with: "Pegged to a single currency" (1), "Pegged to a composite (including the SDR)" (2), "Flexibility limited vis-à-vis a single currency" (3), "Flexibility limited vis-à-vis a cooperative arrangement" (4), "Adjusted according to a set of indicators" (5), "Other managed floating" (6) and "Independently floating" (7). Taxonomy 4 from 1998 to today: "Exchange arrangement with no separate legal tender" (1), "Currency board arrangement" (2), "Conventional pegged arrangement" (3), "Conventional peg to a basket" (3,5), "Pegged exchange rate within horizontal bands" (4), "Crawling peg" (5), "Crawling band" (5), "Managed floating (7) and "Independently floating" (8). The "harmonized" IMF de jure classification that is employed here is based on the following mapping:

New	Former Classifications			
Unified	Tax 1	Tax 2	Tax 3	Tax 4
Peg	1,2	1,2	1,2	1,2,3,3,5
Interm	3,4	3,4,5*	3,4,5,6	4,5,6,7
Float	5	5*	7	8

Import Structure: The share of primary commodities in total imports is proxied by the sum of agricultural goods, fuels, ores and metals over total imports. We use the data on shares of imports according to various product groups as provided by the WDI. We rescale the shares in terms of total imports of goods and services rather than merchandise imports. Hence, the import structure measure is:

$$PASS = \log\left(1 + \frac{\sum raw\ material\ imports}{total\ imports} * 100\right)$$

where we take the log to limit the role of outliers.

Terms of Trade: Despite the fact that the IFS, the WDI (net barter terms of trade) and UNCTAD provide terms of trade data, they are not covering the entire sample. To enlarge the sample we constructed a proxy based on current and constant values of export and import data. In particular we used exports and imports in constant US dollars and current US dollars to construct the TOT proxy

$$ToT = \frac{\frac{EXPORTScur}{EXPORTScon}}{\frac{IMPORTScur}{IMPORTScon}}$$

which we scale to the base year 2000 to make the measure comparable to the IFS data.[32] Our final terms of trade measure uses this measure, if the other measures do not provide sufficiently large series. As a check we use consistently our ToT proxy for all countries.

The choice for the indicator employed follows the length of the available series using if possible IFS then UNCTAD and then the implied terms of trade from the WDI constant and current value of exports and imports. Whenever a country's terms of trade remains unchanged for three consecutive years or has breaks in the series an alternative classification is preferred. The respective countries in the sample and the term of trade measure used is given below:

[32] Other authors have used this approach before. See for instance Loayza and Raddatz (2007) or Kehoe and Ruhl (2008)

Albania	Ghana	Panama
Algeria	Greece[1]	Papua New Guinea
Argentina	Guatemala	Paraguay[2]
Australia[1]	Guinea[2]	Peru
Austria	Honduras	Philippines
Azerbaijan	Hong Kong, China[1]	Poland[1]
Bangladesh	Hungary	Portugal
Belarus	India	Romania
Belgium	Indonesia	Russian Federation
Benin	Iran, Islamic Rep.	Saudi Arabia [2]
Bolivia	Ireland[1]	Senegal
Botswana	Israel[1]	Singapore [1]
Brazil	Jordan[1]	Slovak Republic
Bulgaria	Kazakhstan	Slovenia
Burkina Faso	Kenya	South Africa
Cambodia	Korea, Rep.	Spain
Cameroon	Kuwait	Sri Lanka[1]
Chad	Kyrgyz Republic	Sweden[1]
Chile	Latvia	Switzerland
China	Lebanon	Syrian Arab Republic
Colombia	Lithuania	Tajikistan
Costa Rica	Malaysia	Tanzania[2]
Cote d'Ivoire	Mali	Thailand[1]
Croatia	Mauritania	Trinidad and Tobago
Czech Republic	Mauritius[1]	Tunisia
Denmark[1]	Mexico	Turkey[2]
Dominican Republic[2]	Moldova[2]	Ukraine
Ecuador	Morocco[1]	United Arab Emirates
Egypt, Arab Rep.	Netherlands[1]	Uruguay
El Salvador	New Zealand[1]	Venezuela, RB
Estonia	Nicaragua[2]	Vietnam
Finland[1]	Norway[1]	Zambia
Gabon	Oman[1]	Zimbabwe
Georgia	Pakistan	

[1] Uses IFS terms of trade [2] Uses UNCTAD/WDI (identical)

Table 5: Country sample

Variable	Source	Description
Exchange Rate Regime		
- LYS (defacto)	Levy-Yeyati and Sturzenegger (2005)	Broad 1 to 3 classification
- IMF (dejure)	provided by IMF staff	Various taxonomies
		harmonized by the authors
Import Data		
- Raw Material Trade	World Development Indicator	Share of agricultural, fuel,ores and metals
		fuel imp. in total merch imp.
Terms of Trade		
- ToT IFS	International Financial Statistics	Index, base year 2000 (=100)
- ToT	own calc. basded on data from WDI	see description below
- net barter ToT	World Development Indicator	Index, base year 2000 (=100)
-ToT UNCTAD	ToT UNCTAD	Index, base year 2000 (=100)
National Accounts		
- Gross Domestic Product	World Development Indicator	real, in local currency and current
- Gross Fixed Capital Form.	World Development Indicator	real, in local currency
Foreign Currency Debt		
- Total Foreign Currency Liab.	Bank of International Settlement and own calculation	in percnt of GDP
- (Short Term) External Debt	World Development Indicator	in percent of GNI
Interest Rates		
- Money Market or T-Bill	World Development Indicator and National Sources	in percent
- Base Country	Shambugh and supplemented with RR for recent per.	