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Automatic Stabilizer Feature of Fixed Exchange Rate Regimes in Emerging Markets

Uluc Aysun
University of Connecticut

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341 Mansfield Road, Unit 1063
Storrs, CT 06269–1063
Phone: (860) 486–3022
Fax: (860) 486–4463
http://www.econ.uconn.edu/

Abstract

This paper shows that countries characterized by a financial accelerator mechanism may reverse the usual finding of the literature – flexible exchange rate regimes do a worse job of insulating open economies from external shocks. I obtain this result with a calibrated small open economy model that endogenizes foreign interest rates by linking them to the banking sector's foreign currency leverage. This relationship renders exchange rate policy more important compared to the usual exogeneity assumption. I find empirical support for this prediction using the Local Projections method. Finally, 2nd order approximation to the model finds larger welfare losses under flexible exchange rate regimes.

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1 Introduction

In the late 90's, emerging market countries have faced severe financial crises, resulting in large costs of bank restructuring, extended periods of contraction, and high unemployment. Theoretical and empirical studies have blamed the inability of pegged regimes to withstand speculative attacks, especially with rapidly growing international financial activity during this period. Advocates of this view have advised countries to float their currency. Despite these developments, emerging market economies have been reluctant to float freely due to several reasons.[1] Among these are the lack of central bank credibility, large terms of trade shocks, high inflation due to exchange rate pass through, and liability dollarization.

The effects of liability dollarization have been analyzed extensively by the "Balance Sheet Effects" literature.[2] These studies argue that the chance of a financial crisis increases with high levels of foreign currency denominated liabilities, maturity mismatches, and bad loans.[3] Despite the benefits of tight exchange rate regimes in limiting the fluctuations of the net foreign liability component of bank balance sheets, consensus in the literature is that the involuntary interest rate adjustments under these regimes, in response to external shocks, exacerbate the financial distress, and outweigh the positive effects on balance sheets.

This paper compares the relative strength of the aforementioned two effects and measures the performance of different exchange rate regimes.[4] It formulates a small open economy dynamic stochastic general equilibrium (DSGE) model where terms of foreign credit depends on the balance sheet of domestic banks, and there is a financial accelerator mechanism.

The financial accelerator framework of Bernanke, Gertler and Gilchrist (1999) (BGG) is a convenient starting point for the purposes mentioned above for two reasons. First, it allows for the effects

[1] Countries that declared their commitment to floating exchange rate regimes have not allowed their currency to float freely. The literature has analyzed this concept under the "Fear of Floating" heading.

[2] See Chang and Velasco (1998), Calvo (2001), Eichengreen and Hausman (1999), Cepedes Chang and Velasco (2001), Scheider and Tornell (2004).

[3] Table 1 reports the change in exchange rates and real GDPs for the period before and after the crises together with the foreign currency leverage of the banking sector for countries that have had financial crisis and countries that have financial and trade linkages with these countries. The important observation is that in most of the cases, large depreciations coupled with high bank leverage have caused a decline in output, whereas countries that have banking sectors with low or negative leverage like Uruguay, Philippines, Vietnam and Mexico have recorded either an increase or a mild drop in output after the crises.

[4] Different exchange rate regimes correspond to Taylor rules with different exponents of the exchange rate term. Empirical studies suggest that interest rates are sufficiently important instruments for exchange rate manipulation in emerging markets, Calvo and Reinhart (2000).

of various shocks to be amplified through its effects on firms' balance sheets, which in turn provides a better fit of the model's output to the actual data[5]. Second, the model includes a domestic financial sector which facilitates the analysis of balance sheet effects and foreign creditor behavior when the contract between the domestic banking system and the foreign creditors is defined.

Gertler, Gilchrist and Natalucci (2007) (GGN) extend this model to a small open economy setting and show how the central bank has to peg the interest rates to the foreign interest rates under a fixed regime, and thereby cause a hike in real interest rates in response to adverse external shocks. The recession caused by these shocks is less profound under flexible exchange rate regimes where a part of the negative effect of the external shock is absorbed by the depreciation of the currency. Furthermore, this contrast between the performances of different exchange rate regimes becomes more apparent when the financial accelerator mechanism is included due to its implicit amplification mechanism.

Analysis in this paper alters the standard financial accelerator framework in two ways. First, domestic banks are only able to diversify the idiosyncratic shocks but are vulnerable to systematic ones. This is in contrast to the standard model where the banks are able to diversify the aggregate risk and always collect the market rate of return by integrating the shock into an ex-post contract with the firm. This alteration provides a better representation of the actual functioning of the market and also allows banks' net worth to fluctuate over time, which in turn has a crucial effect on the foreign interest rate premium. [6]

Second, instead of assuming foreign interest rate premiums are purely exogenous (as in the standard model), the role of the foreign sector is defined more rigorously by deriving the relationship between the domestic banks' balance sheet positions and the interest rate charged on loans by foreign creditors. As a result, foreign interest rate premium is derived endogenously, and it is governed by a financial accelerator mechanism similar to the one between the domestic banks and the firms. In particular, the contract between domestic banks and foreign creditors is such that if the banks become more leveraged, interest rates charged by foreign creditors increase. Moreover, the assumption of one hundred

[5] BGG use this model to create the large amplification mechanism missing in standard RBC models.
[6] The terms of the ex-ante contract in this paper are determined before the realization of the technology or foreign interest rate shock.

percent foreign currency denominated debt renders central bank exchange rate policy more important since exchange rate fluctuations have a direct impact on the translational exposure of the domestic banks, and thus on foreign interest rates in this setting.

Impulse responses obtained from a calibrated and log-linearized model show, contrary to the majority of the literature that foreign interest rate shocks and technology shocks lead to greater output volatility under flexible exchange rate regimes when a country risk premium mechanism is included in the model. The results exhibit how economies become highly leveraged when asset prices increase, and how price fluctuations increase (decrease) the amplitude of output response under flexible (fixed) regimes[7]. It is important to state that these findings do not imply the superiority of pegged regimes. A better interpretation would be that for countries in need of foreign finance to develop, a stable domestic financial market is essential, and that a pure float exchange rate regime is not appropriate in this setting. This model should be construed as a non crisis framework since the linearization technique employed is not suitable to capture the dynamics governing crisis periods. Nevertheless, the comparison of exchange rate regimes within this framework has crisis implications provided that the deteriorating domestic financial conditions eventually initiate large capital reversals.

First order approximation methods are not capable of capturing the effect of risk on the behavior of agents. Hence, a welfare analysis with unconditional moments is conducted using the second order approximation algorithm of Schmitt-Grohe and Uribe to measure the significance of a country risk premium on the economy. The results are in line with those of the first order approximation findings, and show that fixed exchange rate regimes reduce; flexible exchange rate regimes increase welfare costs when a country risk premium is included. Therefore, the risk premium constitutes an automatic stabilizer under fixed exchange rate regimes as it dampens the effect of the initial shock. Welfare effects are also measured using conditional moments since unconditional computations do not account for the welfare effects during the transition period from one steady state to another. Results are similar.

[7] Leverage is defined by the ratio of domestic bank net foreign liabilities to their net worth.

Finally, the paper investigates if there is an empirical support for the theoretical results using the Local Projections method (Jorda, 2005) of obtaining impulse responses. In contrast to the literature, I include Emerging Market Bond Indices (EMBI) instead of average advanced country lending rates as a proxy for foreign interest rates. Results show that output responses to external shocks are smaller with relatively fixed exchange rate regimes. Following the literature, I also include a weighted average of advanced country lending rates and fail to distinguish the difference in output responses under the two regimes.

The remainder of the paper is organized as follows. Section 2 explains the model. Section 3 describes the effects of the financial accelerator mechanism and different exchange rate regimes, defines the foreign sector and the contract with the domestic banks, and shows how the results differ from a replicated version of GGN. Section 4 discusses the methodology and the results of the welfare analysis. Section 5 reports the empirical findings. Section 6 concludes.

2 The Model

The framework utilized is a small open economy DSGE model with price rigidities. Households in the economy consume domestic and foreign goods, supply labor, and save. The production side of the economy has three types of agents: capital producers, perfectly competitive entrepreneurs, and monopolistically competitive retailers. Entrepreneurs purchase capital from capital producers, hire labor, and produce identical wholesale goods, which are in turn sold to the retailers. Retailers package wholesale goods at no resource cost, and sell the final output. Retailers are the source of price stickiness and their pricing scheme follows that of Calvo.

The financial side of the economy consists of a domestic banking sector, referred to as the banking system throughout the paper, foreign creditors, and a central bank. The banking system - wholesale firm relationship is characterized by a financial accelerator mechanism. According to this mechanism, demand for capital depends on the entrepreneur’s net worth, and capital investment affects the net worth of entrepreneurs by altering asset prices.

Foreign creditors lend to the banking system. By the nature of the contract, it is found that interest rate premiums on the loan depend negatively on the net worth of the banking system and positively on foreign debt.[8]

Central bank's goal is to stabilize output and prices. For this purpose the bank conducts monetary policy governed by a Taylor rule.

Aside from the financial contracts, the model is characterized by a standard Dynamic New Keynesian (DNK) setup. The details of the economy are outlined in Appendix A. Instead, in the following sections, I focus on the financial contracts between the banking system, entrepreneurs and foreign creditors. These contracts along with central bank exchange rate policy determine the relative strength of balance sheet effects and external constraints on monetary policy, and lie at the heart of the analysis.

2.1 The Contract between the Banking System and an Entrepreneur

The model includes a continuum of entrepreneurs with insufficient net worth to internally finance their investments. Entrepreneurs borrow the difference between their desired investment and net worth from the domestic banking system. Entrepreneur's return on investment is subject to an idiosyncratic shock, and the financial contract between the banking system and the entrepreneurs is defined by the following two equations:

$$\left[1-F\left(\bar{A}_{it}\right)\right]\left(R_t + x_{it}\right)\frac{B_{it}}{P_t} + (1-\mu)\left[\int_0^{\bar{A}_{it}} A_{it} R_t^k Q_{t-1} K_{it} \delta F\left(A_{it}\right)\right] = \frac{R_t B_{it}}{P_t} \tag{2.1}$$

$$\bar{A}_{it} E^a\left(R_t^k\right) Q_{t-1} K_{it} = \left(R_t + x_{it}\right)\frac{B_{it}}{P_t} \tag{2.2}$$

$\bar{A}_{it}$, is the expected (contract) cutoff value of the firm specific shock below which the firm is unable to pay back its debt to the banking system. The idiosyncratic shock is a log-normally, i.i.d variable

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[8] To simplify the analysis, I assume that the baking system comprises identical banks and foreigner creditors consider the aggregate leverage of the banking system in determining interest rate premiums.

with a continuous and differentiable c.d.f., $F(A_i)$. R_t^k denotes the gross return on capital averaged across firms, and is given by, $R_t^k = \left(\dfrac{\alpha \dfrac{P_t^w A_t K_t^{\alpha-1} L_t^{1-\alpha}}{P_t} + (1-\delta)\dfrac{Q_t}{P_t}}{\dfrac{Q_{t-1}}{P_{t-1}}} \right)$

where $\dfrac{P_t}{P_t^w}$ is the markup rate and Q_t is the nominal price of capital. With a slight abuse of notation I assume that $E^a\left(R_t^k\right) = \left(\dfrac{\alpha \dfrac{P_t^w E_{t-1}\left(A_t\right) K_t^{\alpha-1} L_t^{1-\alpha}}{P_t} + (1-\delta)\dfrac{Q_t}{P_t}}{\dfrac{Q_{t-1}}{P_{t-1}}} \right)$.

B_{it}, x_{it}, K_{it}, and R_t represent the amount borrowed by firm *i*, the interest rate premium on the loan, capital stock of firm *i*, and the risk free rate respectively. The parameter μ denotes the monitoring cost coefficient. This coefficient is a critical component of the financial accelerator framework that creates the financial friction needed to amplify impulse responses in the model.

Equation (2.1) illustrates how the banking system equates expected revenues to opportunity costs. The first term on the left hand side is the principal and the interest collected from a firm if it does not fail. If the firm defaults, banks acquire whatever the firm has, but they have to pay a monitoring cost; this is represented by the second term. The right hand side is the opportunity cost of the banking sector.

$\overline{A}_{it}$ and x_{it} are determined simultaneously using equations (2.1) and (2.2). According to the latter, if A_{it} is less than $\overline{A}_{it}$, the firm is expected to default. $E^a\left(R_t^k\right)$ denotes the returns the capital expected by banks in period *t-1* . The banking system makes their projections based on their expectations of the aggregate technology shock, A_t. Since there is a continuum of firms, banks are able to diversify the firm specific risk, and receive the market rate of return when there is no aggregate shock to output. $\overline{A}_{it}$ is the contract value of the shock, and it is different from the actual cutoff value of $\overline{A}_{it}^*$ which will be discussed in the next section. The banking system is assumed to be risk neutral, and they do not include aggregate technology shocks in the contract[9]. This assumption is different from the standard financial accelerator framework where as a part of the ex-post contract, aggregate risks are transferred from the risk averse consumers to the risk neutral entrepreneurs. In my model, aggregate technology shocks are absorbed by both the banking system and the entrepreneurs. Therefore, despite the ability to diversify idiosyncratic risks the banking system is exposed to changes in aggregate technology, while entrepreneurs are affected by both idiosyncratic and aggregate shocks. The resulting volatility of banks' net worth is a key component of the endogenous relationship between foreign interest rate premiums and bank balance sheets explained below.

From the revenue maximization problem of the firm, subject to equation (2.1), it can be shown that,

$$Q_{t-1}K_{it} = \varphi(s_t)N_{it} \qquad \varphi'(\bullet) > 0 \tag{2.3}$$

where $s_t = \dfrac{E^a\left(R_t^k\right)}{R_t}$

This equation is an important part of the financial accelerator mechanism. It shows that as the returns to capital increase relative to the risk free rate, firms become more leveraged by taking out more loans, and investing more. Furthermore since relative returns to capital are the same for every firm, leverage of these firms will also be the same, which in turn is useful for aggregation purposes. Thus, the demand for capital in the economy is obtained from the aggregation of demand over all entrepreneurs as,

$$Q_{t-1}K_t = v\left(\frac{E^a\left(R_t^k\right)}{R_t}\right)N_t \tag{2.5}$$

According to this relation, the wedge between expected returns to capital and the risk free interest rate determine the level of investment.

2.2 Evolution of the Entrepreneurs' Net Worth

[9] Risk neutral banks are needed to simplify the financial contract. Assuming otherwise, extremely complicates and the model, thereby, preventing a solution. Banks are vulnerable to aggregate shocks that affect returns to capital. This setup provides a better representation of the ex ante property of the actual contracts in the market. Assuming that the country faces an adverse aggregate shock, the standard financial accelerator framework implies, unrealistically, that banks collect more from the entrepreneurs that survive to compensate for the losses from bad loans. In my model the net worth of the banking sector drops as a result of the adverse shock.

The second equation added to a standard DNK framework is related to the evolution of entrepreneurs' net worth:

$$N_{it+1} = \gamma^e V_{it} + \frac{W_t^e}{P_t} \tag{2.6}$$

where W_t^e is the nominal wage paid to entrepreneurs, and V_{it} denotes the returns to capital net of borrowing costs, and is given by,

$$V_{it} = \left(\int_{\overline{A}_{it}^*}^{\infty} A_{it} R_t^k Q_{t-1} K_{it} df\left(A_{it}\right)\right) - \left[1 - F\left(\overline{A}_{it}^*\right)\right]\overline{A}_{it}^* R_t^k Q_{t-1} K_{it} \tag{2.7}$$

$\overline{A}_{it}^*$ represents the actual cutoff value of the firm specific shock. The first term on the right hand side of equation (2.7) represents the returns to capital given that the firm does not go bankrupt. The second term is the expected debt payment. The survival probability of the entrepreneur, γ^e is needed to prevent the entrepreneurs from building up enough net worth and becoming self sufficient. [10]

It is important to point out that $\overline{A}_{it}^*$ is different from the contract cutoff value $\overline{A}_{it}$, and is determined from the following,

$$\overline{A}_{it}^* R_t^k Q_{t-1} K_{it} = \left(R_t + x_{it}\right)\frac{B_{it}}{P_t} = \overline{A}_{it} E^a\left(R_t^k\right) Q_{t-1} K_{it} \tag{2.8}$$

as, $$\overline{A}_{it}^* = \frac{\overline{A}_{it} E^a\left(R_t^k\right)}{R_t^k} \tag{2.9}$$

$\overline{A}_{it}^*$ represents the minimum value of the firm specific shock that is needed for a firm to pay back its debt. This value depends on the aggregate technology shock. If the aggregate technology shock is low, R_t^k would decrease , and the firm would need a higher returns to capital shock to stay afloat.

Since $\overline{A}_{it}$ and A_t are the same for every firm, $\overline{A}_{it}^*$ is also the same. Thus, equation (2.7) can be aggregated to find the evolution of total net worth.

$$V_t = \left(\int_{\overline{A}_{it}^*}^{\infty} A_{it} R_t^k Q_{t-1} K_t dF\left(A_{it}\right)\right) - \left[1 - F\left(\overline{A}_{it}\right)\right]\overline{A}_{it}^* R_t^k Q_{t-1} K_t \tag{2.10}$$

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[10] Since internal finance is cheaper.

The evolution of net worth derived by combining equations (2.6) and (2.10) reveals the relationship between asset prices and net worth. More specifically, an increase in asset prices inflates the returns to capital; thereby, increasing firms' net worth[11].

If entrepreneurs do not survive, they consume the returns to capital net of debt payments.

$$C_t^e = \left(1-\gamma^e\right)V_t \tag{2.11}$$

where C_t^e is the entrepreneurs' consumption. Demand for households' and entrepreneurs' labor is given by equations (2.12) and (2.13) respectively,

$$\left(1-\alpha\right)\omega\frac{Y_t}{L_t} = \mu_1\frac{W_t^h}{P_t} \tag{2.12}$$

$$\left(1-\alpha\right)\left(1-\omega\right)\frac{Y_t}{L_t} = \mu_1\frac{W_t^e}{P_t} \tag{2.13}$$

where μ_1 is the markup on wholesale goods or the relative price of retail goods, ω is the share of household labor in a composite labor input, and W_t^h is the nominal wage paid to the entrepreneurs.

2.3 The Contract Between the Foreign Creditors and the Domestic Banking System

The financial accelerator framework relies on the assumption that banks are able to transfer systematic risks such as technology shocks to borrowers and always collect the risk free rate of return. This is a reasonable assumption in the absence of large perturbations to the system. However, it is a well known fact that the banking sector in emerging markets suffered large losses and banks' equities fluctuated significantly following the capital reversals of the late 90's.

The alterations to the standard model made in equation (2.2), and the corresponding modified versions of the demand for capital and the evolution of net worth represented by equations (2.5) and (2.6) respectively imply that the banking system's net worth is affected by aggregate technology shocks. This modification enables the model to replicate the aforementioned facts, and more importantly, allows the derivation of a country risk premium that depends on banking system's balance sheets and the exchange

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[11] Equation (2.10) can be used to show that $\frac{dV_t}{dQ_t} > 0$.

rate. Later in the paper, it is shown that this modification is crucial in comparing the ability of exchange rate regimes to insulate economies from external shocks. More specifically, conclusions of the standard model are reversed when banking systems net worth fluctuates.

In order to derive the country risk premium, I start by discussing the evolution of the banking system's net worth, and then define the contract between foreign creditors and the banking system. The budget constraint of the banking system is given by,

$$Q_{t-1}K_t - N_t = \frac{B_t}{P_t} = NW_t + \frac{e_t F_t + D_t}{P_t} \tag{2.13}$$

In the calibrated model, banking system's net worth, NW_t and domestic deposits, D_t are not sufficient, and foreign funding, F_t is needed to finance the borrowing requirement of the real sector. [12] Banking system's net worth is equal to their net returns from the firms minus debt payments.

$$NW_{t+1} = VB_t - \frac{e_t\left(R_t^* + h_t\right)F_t - R_t D_t}{P_t} \tag{2.14}$$

where h_t is the country risk premium, and the expected returns from the firms, VB_t is given by,

$$VB_t = \left[(1-\mu)\left(\int_0^{\overline{A}_{it}^*} A_{it} f\left(A_{it}\right)dA_{it}\right)\right]R_t^k Q_{t-1}K_t + \left[1 - F\left(\overline{A}_{it}^*\right)\right]\overline{A}_{it}^* R_t^k Q_{t-1}K_t \tag{2.15}$$

It is assumed that if the returns from the firms fall short of the foreign debt obligation, the banking system fails to pay back its debt, and the foreign creditors receive the returns from the entrepreneurs after paying a monitoring cost. [13] This contract between the banking system and the foreign creditors is similar in essence to the contract between the banking system and the entrepreneurs. Foreign creditors have a perfectly diversified portfolio in the world, and a contract with each country. Therefore, they are able to

[12] I assume that foreign funds are one hundred percent foreign currency denominated. In the model it is not important whether foreigners or domestic residents provide the foreign currency denominated funds. In either case the opportunity cost for the lender is the risk free foreign interest rate. With a slight abuse of notation, I refer to foreign currency denominated borrowing as foreign borrowing. Albeit, related literature (Eichengreen et al., 2002 ; Hausmann and Panizza, 2003) predominantly finds that most countries are unable to borrow from abroad in their own currency, a phenomenon known as (external) original sin.

[13] In the model, foreigners have a priority in receiving their claims. Therefore, when calculating the cutoff value of the technology shock in equation (2.16) they omit domestic deposits. Assuming otherwise, complicates the solution, however does not change the results significantly. Furthermore, domestic deposits are insured hundred percent, and domestic depositors are not exposed to the risk of bank default.
There is evidence in the literature (e.g. Iacoviello, Minetti, 2006; Rajan and Zingales, 1998; Hermalin and Rose, 1999) suggesting that foreign creditors face higher recovery costs when there is default. Nevertheless, since there is no benchmark for the difference in costs that these agents face I assumed that in the contract monitoring cost coefficient is the same as before. Using higher bankruptcy cost coefficients in my simulations produced results that made the main conclusion in the paper more apparent.

diversify country specific risks and receive an expected return equal to the opportunity cost of their investment. Thus, the two following two equations define the contract.

$$VB_t\left(\overline{A}_t\right) = \frac{\left(R_t^* + h_t\right)F_t e_t}{P_t} \tag{2.16}$$

$$\left[1 - F\left(\overline{A}_t\right)\right]VB_t\left(\overline{A}_t\right) + (1-\mu)\int_0^{\overline{A}_t} VB_t\left(A_t\right)dF(A_t) = \frac{R_t^* F_t e_t}{P_t} \tag{2.17}$$

Equation (2.16) shows how the banking system defaults if the technology shock is below the critical value, $\overline{A}_t$. Foreign creditors set their expected returns on their loans to what they can earn in the world at the foreign interest rate, R_t^* according to equation (2.17). Expected returns consist of the principal and the interest payments if the banking system does not default, and the returns from the firms net of monitoring costs, if the banking system can not pay back its debt.[14]

This setup produces a relationship between country risk premium and bank leverage similar to the relationship between the domestic finance premium and a firm's leverage discussed earlier. In particular, using equation (2.16) and (2.17), one can show that there is a positive relationship between a country's risk premium and the leverage of the domestic banking system.[15]

$$h_t = h\left(\frac{e_t F_t}{NW_t}\right) \qquad h'(\bullet) > 0 \tag{2.18}$$[16]

This equation shows that as the banking system borrows more from abroad given a certain amount of net worth, the cutoff value of the technology shock and the country risk premium increases to compensate for the higher probability of default. In addition, since borrowing is denominated in foreign currency, a depreciation of the domestic currency increases leverage and the risk premium. The increase in net worth however, has the opposite effect on risk premium as it decreases the required amount of external borrowing.

2.3 Central Bank's Exchange Rate Policy

[14] If the banking sector fails, foreign creditors continue to lend. When the net worth equals zero, the foreign interest rate equals its upper limit in the linearized model.
[15] The derivation of this relationship is provided in Appendix C.
[16] A similar expression can be written in terms of VB_t.

I assume that the central bank follows different exchange rate regimes according to the Taylor rule below. Under a fixed exchange rate regime, γ_e takes on arbitrarily large values, and equals zero for flexible exchange rate regimes.

$$R_t = \left[rr^{ss} \left(\frac{P_t}{P_{t-1}} \right)^{\gamma_\pi} \left(\frac{Y_t^H}{Y_t^{ss}} \right)^{\gamma_y} \left(\frac{e_t}{e^{ss}} \right)^{\gamma_e} \right]^{1-\tau} (R_{t-1})^{\tau} \tag{2.19}$$

The last item on the right hand side is the interest rate smoothing term. Y_t^{ss}, rr^{ss} and e^{ss} are the steady state levels of output, real interest rate and exchange rate respectively.

Central bank has a direct effect on the net worth of the domestic banking sector by changing the value of foreign liabilities in domestic currency units. The exchange rate also affects exports, imports, and the profits accrued to the consumers as it changes the relative price of the domestic good.

2.6 Parameterization

Due to data availability, I calibrated the model mostly to Brazil. When Brazilian data was not available, I chose parameter values used for emerging market countries or that are standard in the literature.

Preferences and Technology

The quarterly discount factor β is set to 0.961 to match the annual T-Bill rate of 17.14%. The coefficient of relative risk aversion is $\Omega = 2$, which is standard in RBC models.[17] Since imports are 20% of consumption, I set the share parameter, γ, equal to 0.8. A significant number of studies assume that elasticity of substitution between home and foreign goods is equal to one in order to simplify the analysis of optimal monetary policy (c.f. Devereux and Engel, 2003; Clarida et al, 2002). However, empirical estimates of this parameter are usually greater than 1 and range between 5 and 6.[18] These relatively higher values also explain the home bias for domestic goods. Therefore, I assumed that $\rho = 5$.

[17] I considered different values for Ω in our sensitivity analysis including $\Omega = 1$ (logarithmic form). Results did not change significantly.

[18] Obstfeld and Rogoff (2000) find that the estimates range from 1.2 to 21.4. Anderson and Van Wincoop (2004) argue that the range of values lie between 5 and 6. Adolfson et al (2007), using a Bayesian estimation technique, state that values between 5 and 6 are preferable.

The two commonly used values for labor supply elasticity in emerging markets are 1.4 (Correia et al, 1995) and 2 (Mendoza, 1991). I follow the existing literature and choose the parameter κ in the utility function such that the labor supply elasticity is 2, and the average hours worked relative to the total hours available is 0.333. The habit persistence parameter b is initially equal to 0.85. Empirical estimates of this parameter range from 0.8 (Fuhrer, 2000; Constantinides, 1990) to 0.95 (Campell and Cochrane, 1995; Lettau and Uhlig, 2000). Values within this range explain the equity premium puzzle and help replicate the hump shaped response to shocks observed in the data. I test the sensitivity of the results to habit formation in consumption by setting this parameter equal to zero.

I follow Kanczuk (2004) and calibrate the Brazilian capital share parameter α to 0.41.[19] I find that the quarterly depreciation rate δ equals 3.1% when I assume that the investment/output ratio is 16%. Using the conventional value of 2.5% did not change the results significantly.

Empirical estimates of the elasticity of the price of capital with respect to the investment-capital ratio lie between 20 (Woodford, 2003) and 2 (Chirinko, 1993). Despite amplifying real rigidities and replicating the hump shaped response observed in the data, higher values of this elasticity yield implausible costs of capital. In our benchmark model I set this parameter equal to 2 following King and Wolman (1996).

As in Cespedes, Ochoa, and Soto (2005), I assume that the probability of an adjustment in retailer prices, $1-\theta$, is 0.35. Basu and Fernald (1993) find that markup rates for the U.S. lie between 1.15 and 1.23. Based on this result, studies that include imperfect competition calibrate the markup rate to 1.2. I could not find an empirical estimate of markups in Brazil. However, surveys of emerging market countries (e.g. Dobrinsky, Korosi, Markov and Halpern, 2006) suggest that $\eta = 1.2$ is a reasonable assumption. Finally, I set the price elasticity of export demand, ε, and the elasticity of marginal depreciation with respect to the utilization rate, *x*, equal to 1, consistent with GGN.

External Finance Premium

I calibrate the financial sector parameters to match the following:

[19] The sample period the author uses, 1980 to 2001, is different from ours. However, we could not find a more detailed estimate of the capital share parameter for Brazil.

- Annual business failure rate of 10%.
- Difference between lending rate and the risk free rate equal to 26 basis point (6).
- Leverage ratio, QK / N, equal to 2 or debt-net worth ratio of 1.

In order to obtain these steady state values I fixed the bankruptcy cost coefficient to 0.5, the quarterly survival rate of entrepreneurs to 0.9728, and assumed that the idiosyncratic productivity variable A_{it} is log-normally distributed with a variance equal to 0.078 and a mean of unity.

Most models of financial imperfections are calibrated to advanced countries. For example, the bankruptcy costs are chosen to be less than 30% of firm assets (e.g. Bernanke, Gertler and Gilchrist, 2000 use 12%; Carlstrom and Fuerst, 1997 use 20%). According to the World Bank's 2008 Doing Business report, bankruptcy costs are much larger for emerging market countries. For example, the low recovery rate reported for Brazil (85.4%) implies that bankruptcy costs are approximately 3.9 times those in advanced economies (21.7%). Therefore, $\mu = 0.5$ is a reasonable parameter value for Brazil.

I found evidence on the business failure rate for Brazil from a various sources. According to a survey conducted by Sebrae (Serviço Brasileiro de Apoio às Micro e Pequenas Empresas—Small Business Administration of Brazil) in 2004, Brazil has one of the highest business failure rates in the world and approximately half of the 470,000 small firms that open every year close down within two years. Instituto Brasileiro de Geografia e Estatistica (IBGE, Statistics Office of Brazil) reports that more than 99% of the firms in Brazil are small. Using these observations and the fact that there are approximately 4.5 million businesses in 2004, a steady state business failure rate of roughly 10% (much higher than the 3% level used in models calibrated to advanced countries) is reasonably consistent with data.[20]

The only empirical study I found related to leverage in Brazil was by Agrawal and Mohadi (2004). Authors find that the debt-equity ratio in Brazil between 1980 and 1997 averaged 1.01, implying a QK / N of approximately 2 consistent with our steady state leverage ratio. They use firm level data from Worldscope and the International Finance Corporation to obtain this figure.

[20] Statistics announced by Office of Advocacy show that bankruptcy rates are approximately 2.3% for the U.S.

Compared to spreads on the corporate credit operations, the steady state interest rate premium in the model is not too different from data. According to the "Lending Interest Rates and Bank Spreads" publication of Banco Central do Brazil, the average spread between lending and funding rates for the 2003-2006 period was equal to $R^k - R$, to 28.5 % for corporations.

In order to calibrate the part of the model related to the contract between the foreign lenders and the banking system, the monitoring cost coefficient in case of bank failure, the survival rate of banks, and the variance of the log-normally distributed aggregate technology shock variable is set equal to 0.12, 0.9825 and 0.08 respectively. These parameters generate a foreign borrowing to output ratio, a country risk premium, and a quarterly probability of bank failure of 0.56, 450 basis points, and 0.974% respectively[21].

Finally, I set the exponents of inflation and output (γ_π, γ_y, τ) in the central bank's policy rule equal to 2, 0.75, and 0 respectively, similar to Gertler, Gilchrist, and Natalucci (2007). The authors argue that these parameter values provide a reasonable approximation to the behavior of interest rate in an emerging market country such as Korea. Nevertheless, there is evidence that the standard Taylor rule is not a good representation of monetary policy in Brazil. For instance, Kanczuk (2004) argues that Brazil issues inflation-indexed bonds heavily and that the real interest rate is the actual monetary policy instrument. Therefore, the author estimates an interest rate rule that does not include inflation and finds that the interest rate smoothing term is 0.33 and the coefficient of the output gap is insignificant. Model output based on this specification did not change the results qualitatively. However, I found that the output response under this alternative policy rule was higher than the response corresponding to the rule described above.

3 Results

3. 1 Model Characteristics

[21] GDP weighted average foreign borrowing to GDP ratio and the risk premium of 21 emerging market countries were measured as 0.58 and 450 basis points respectively. Data source: IFS, Countries: Argentina, Brazil, Bulgaria, Colombia, Ecuador, Egypt, Korea, Malaysia, Mexico, Morocco, Nigeria, Panama, Peru, Poland, Qatar, Russia, S. Africa, Thailand, Turkey, Ukraine, Venezuela. EMBI index is used to calculate the average risk premium. The bankruptcy rate follows from Carlstrom Fuerst (1997). This was the benchmark value we could find in the literature.

In this section, I exclude the financial accelerator mechanism that produces the country risk premium, and measure the output response to a one percent technology shock and an annualized 100 basis point shock to the foreign risk free interest rate. I assume, similar to GGN that the foreign interest rate follows a first-order auto-regressive process with the quarterly persistence parameter equal to 0.95.

Results displayed in Figures 1A and 1B show that the deviation of output from its steady level is greater with a fixed regime than with a flexible regime. Faced with a positive technology shock, and an increase in output, the central bank is able to respond under a flexible regime and mitigate the effect of the shock by increasing interest rates. Under a fixed regime interest rates can not be adjusted. Hence, the increase in output is higher. A similar outcome is observed when the economy is exposed to foreign interest rate shocks: Under a fixed regime, a positive shock to foreign interest rates is fully absorbed by the change in the domestic interest rate. Since banks do not have foreign currency denominated liabilities, their balance sheets are not affected by higher exchange rate volatility under a flexible regime. As a result, the increase in the domestic interest rate leads to a fall in investment. This drop in investment causes asset prices to decrease, and the financial accelerator effect is observed. More specifically, the decrease in asset prices results in a drop in entrepreneurs' net worth, and prompts the banking system to charge a higher premium on loans. Therefore, investment decreases further, and the initial response is amplified. If the central bank adopts a flexible exchange rate regime however, it has the power to stimulate the economy when investment drops so that there is lower inflation, and a limited fall in output and investment. Moreover, an increase in net exports due to a depreciation of the currency helps mitigate the fall in output. The graphs also show that the difference in output volatility under different regimes is not as high when the financial accelerator mechanism is shut off consistent with the standard result of the financial accelerator framework.

3.2 Including the Foreign Lenders -- Technology Shock

So far, exchange rate fluctuations only affected the economy's trade balance, and balance sheets were insulated from these fluctuations since all of the borrowing was in domestic currency. This section tests the significance of exchange rate fluctuations on balance sheet effects by allowing the banking system to borrow from abroad. Figure 2 shows the responses to a positive technology shock and reveals that the main conclusion of the previous section is reversed when the contract with the foreign lenders is included. More specifically, the amplitude of the output response to a technology shock is greater under flexible exchange rate regimes than under fixed regimes.

Under both exchange rate regimes, the cutoff value of the idiosyncratic returns to capital shock decreases in response to a positive technology shock. Thus, there is a lower rate of default, and firms expand their production by borrowing more. The net worth of the banking system improves as returns increase, and the banking system borrows more from abroad to meet the higher funding requirement of the production sector.

Under a flexible exchange rate regime, despite the surge in foreign borrowing, debt deflation due to exchange rate appreciation increase net worth and causes a drop in leverage and the country risk premium in the calibrated model. As premiums decrease, domestic interest rates are lowered according to the interest rate parity condition, and there is a further increase in output. Therefore, with flexible exchange rates, the presence of a country risk premium exerts an accelerator effect via the contract between the foreign creditor and the domestic banking sector, similar to the contract between the domestic banks and the entrepreneur in the standard financial accelerator framework.

Under a fixed exchange rate regime, the exchange rate does not change, and foreign borrowing increases more than the banks' net worth, hence there is an increase in leverage and the country risk premium. In response the domestic interest rates are lowered and the initial increase in output is mitigated. Furthermore, I find that the decline in net exports due to an exchange rate appreciation is not enough to overturn the results.

3.3 Including the Foreign Lenders -- Foreign Interest Rate Shock

As depicted in Figure 3, and similar to the previous section, I find that output response is greater when the economy is exposed to an annualized 100 basis point positive foreign risk free rate shock. The functioning of the financial accelerator mechanism is similar to that in Section 3.2. The intuition behind the difference in the performance of exchange rate regimes however, is as follows: Under a fixed regime, the decrease in foreign borrowing is more than the decrease in net worth, and there is a decrease in leverage and the country risk premium in the calibrated model. Under a flexible exchange rate regime, the depreciation of the exchange rate, coupled with a decrease in the banks' net worth outweighs the decrease in foreign borrowing, and an increase in leverage is observed. The increase in leverage amplifies the drop in output.

3.4 Sensitivity Analysis

The fixed-flexible comparison so far was based on specific parameter values for the Taylor rule under flexible exchange rate regimes. In this section, I perform a grid search to find the minimum output volatility under flexible exchange rate regimes and compare this value with the volatility under fixed exchange rate regimes. Furthermore, I also exclude habit persistence, decrease price stickiness and decrease the foreign interest rate shock persistence, and report conditional standard deviations of the model's output in Table 2. I obtain the results assuming that the economy is hit simultaneously by an aggregate technology and a foreign interest rate shock.[22]

Conditional variances obtained from the benchmark model are consistent with the impulse responses. In particular, output is less volatile under flexible regimes. Moreover, the discrepancy between the two regimes is more apparent when I consider the optimal flexible regime. Nevertheless, the superiority of flexible regimes in terms of limiting output volatility depends on the degree of habit persistence and price stickiness[23]. This observation implies that a central bank policy is less effective when there is low price stickiness and high habit persistence, and that the advantages of independent monetary policy under flexible exchange rate regimes are less pronounced. I also find that increasing the coefficient of relative risk aversion, and decreasing the persistence of the foreign interest rate shock mitigates the advantages of flexible exchange rate regimes.

[22] The variance of the foreign interest rate shock is calibrated to $(0.032)^2$ which is obtained from a VAR model fit to 21 emerging market country averages using Blanchard-Quah restrictions. The variance of the technology shock is $(0.01)^2$.

[23] I assume that entrepreneurs can adjust prices every two quarters following the recent literature. See Eichenbaum, Fisher, Martin (2004).

When I include a country risk premium in the model, the results are reversed, and fixed exchange rate regimes yield lower output volatility. This finding is robust to using a smaller price stickiness coefficient and foreign interest rate shock persistence parameter, and the exclusion of habit persistence.

4. Welfare Analysis

The first order approximation methodology used thus far is not suitable for comparing welfare across different exchange rate regimes and different market structures. Therefore, the conventional practice for measuring welfare effects is to use a second order approximation to the objective function, and a linear approximation to the decision rules. Despite the ability to account for the effects of shocks on welfare through second order moments, this methodology neglects the effects of the shocks on the unconditional and conditional means of the endogenous variables. This section measures the welfare effects of the financial accelerator mechanism, and the country risk premium by approximating the model's objective function and the decision rules to the second order. Coefficients of the system of equations are obtained using the second order approximation algorithm of Schmitt-Grohe and Uribe (2004).

4.1 Unconditional Welfare

Welfare effects are measured by computing the percent of steady state consumption consumers are willing to give up to avoid the effects of the underlying shocks following Lucas (1987). Second order approximation to the utility function is of the form,[24]

$$EU_t = \overline{C}^{1-\Omega}(1-b)^{1-\Omega}E(\hat{c}_t) - k\frac{\overline{L}}{1-\overline{L}}E(\hat{l}_t) - \frac{1}{2}\Omega(1-b)^{1-\Omega}\overline{C}^{1-\Omega}Var(\hat{c}_t) - \frac{1}{2}\frac{k\overline{L}^2}{\left(1-\overline{L}\right)^2}\mathrm{var}\left(\hat{l}_t\right) \qquad (4.1)$$

where $\hat{c}_t$ and $\hat{l}_t$ are the percentage deviation of consumption and labor around their steady state levels respectively, and $E(\hat{c}_t), E(\hat{l}_t), Var(\hat{c}_t), Var(\hat{l}_t)$ represent the unconditional means and variances of consumption and labor.

The effects of the shocks on expected utility can be separated into two parts: the effects through the unconditional means and variances of consumption and labor. These two variables are represented by

[24] Money is omitted from the utility function following the standard application of the welfare literature.

u^{mean} and u^{var}. It is important to point out that, a linear approximation to the decision rules fails to take account of u^{mean}, and only captures u^{var}. u^{mean} can be obtained from the following equation:

$$U\left(\left(1+u^{mean}\right)\overline{C},\overline{L}\right)=\frac{\left(\left(1+u^{mean}\right)\left(1-b\right)\overline{C}\right)^{1-\Omega}}{1-\Omega}-k\ln\left(1-\overline{L}\right)=\overline{U}+\left(\overline{C}\left(1-b\right)\right)^{1-\Omega}E\left(\hat{c}_t\right)-\frac{k\overline{L}}{1-\overline{L}}E\left(\hat{l}_t\right) \qquad (4.2)$$

where, $\overline{U}=\frac{\left(\left(1-b\right)\overline{C}\right)^{1-\Omega}}{1-\Omega}-k\ln\left(1-\overline{L}\right)$, and

$$u^{mean}=\left(1+\left(1-\Omega\right)E\left(\hat{c}_t\right)-\frac{kL}{1-L}\left(1-\Omega\right)\left(\overline{C}\left(1-b\right)\right)^{1-\Omega}E\left(\hat{l}_t\right)\right)^{\frac{1}{1-\Omega}}-1 \qquad (4.3)$$

Similarly, u^{var} can be solved for as follows:

$$\frac{\left(\left(1+u^{var}\right)\left(1-b\right)\overline{C}\right)^{1-\Omega}}{1-\Omega}-k\ln\left(1-\overline{L}\right)=\overline{U}-\frac{1}{2}\Omega\left(1-b\right)^{1-\Omega}\overline{C}^{1-\Omega}Var\left(\hat{c}_t\right)-\frac{1}{2}\frac{k\overline{L}^2}{\left(1-\overline{L}\right)^2}\operatorname{var}\left(\hat{l}_t\right) \qquad (4.4)$$

$$u^{var}=\left(1-\frac{1}{2}\left(1-\Omega\right)\Omega\frac{1+b}{1-b}Var\left(\hat{c}_t\right)-\frac{1}{2}k\frac{\overline{L}^2}{\left(1-\overline{L}\right)^2}\left(1-\Omega\right)\left[\left(\left(1-b\right)\overline{C}\right)^{\Omega-1}Var\left(\hat{l}_t\right)\right]^{\frac{1}{1-\Omega}}-1\right) \qquad (4.5)$$

Consistent with the RBC literature, (e.g. Kollmann, 2002) the technology shock variance and the persistence of the technology shock is set equal to $(0.01)^2$ and 0.9 respectively

4.2 Conditional Welfare

The unconditional welfare calculation discussed above has been used extensively due to its straightforwardness. However, the methodology does not account for the welfare effects during a transitional period from one steady state to another after a change in policy variables. Therefore, measuring welfare with a one period utility that includes unconditional moments in a dynamic setting with discounting does not take account of the fact that earlier periods have higher weights. Therefore, if agents in the economy save more in earlier periods to attain a new level of steady state consumption, welfare losses computed using conditional moments, would be greater than those with unconditional moments[25]. Thus, to check the robustness of the results, a conditional welfare measure is constructed as follows:

[25] For example, Kim and Kim (2000) show that the unconditional welfare measure can produce the paradoxical result that autarky generates higher levels of welfare compared to complete markets.

$$V_o^{certain} = \sum_{t=0}^{\infty} \beta^t \left(\frac{\left((1-u)\overline{C}(1-b)\right)^{1-\Omega}}{1-\Omega} - k \ln\left(1-\overline{L}\right) \right) = \frac{1}{1-\beta} \left(\frac{\left((1-u)\overline{C}(1-b)\right)^{1-\Omega}}{1-\Omega} - k \ln\left(1-\overline{L}\right) \right) \qquad (4.6)$$

where $V_0^{certain}$ represents the value function or the sum of discounted utilities when there is no variability. Similarly, one can derive the second order approximation to the value function in order to measure the sum of discounted utilities when there is variability[26].

$$V_o^{'} = \sum_{t=0}^{\infty} \beta^t \left(\begin{array}{l} \overline{U} + \overline{C}^{1-\Omega}(1-b)^{-\Omega}\left(\tilde{c}_t - b\tilde{c}_{t-1}\right) + \\ \qquad k \frac{\overline{L}}{1-\overline{L}} \tilde{l}_t - \frac{1}{2}\Omega \overline{C}^{1-\Omega}(1-b)^{-\Omega-1}\left(\tilde{c}_t^2 - b^2 \tilde{c}_{t-1}^2\right) + \frac{1}{2} k \frac{\overline{L}^2}{\left(1-\overline{L}\right)^2} \tilde{l}_t^2 \end{array} \right) \qquad (4.7)$$

where $\tilde{c}_t$ and $\tilde{l}_t$ are the deviations of consumption and labor from their steady states. These variables are computed using simulated data from the model.

Similar to the exercise above, u^{mean} and u^{var} measure the level of steady state consumption needed to assume the risks coming through the first and second order terms respectively.

4.3 Results

I analyze four different models; the benchmark model, the model with a financial accelerator mechanism (FA), the model including a country risk premium (CRP), and the model with FA and CRP simultaneously. The benchmark model is a simple small open economy RBC model with price stickiness.

Output from the unconditional welfare computations are displayed in Table 3. There are three main observations. First, the country risk premium mechanism mitigates the effect of the shocks under a fixed regime, but amplifies it under a flexible regime. To see the intuition behind this result, note that under a flexible regime, the exchange rate appreciation following a positive technology shock leads to an improvement in the balance sheets of the domestic banks, and a decrease in their leverage which in turn decreases foreign interest rate premiums. Since the effect of a decrease in foreign interest rates on consumption and labor is similar to the effect of a positive technology shock, the original response is amplified. Under a fixed regime, there is a banks' balance sheets deteriorate following a positive technology shock due to the higher levels of foreign borrowing needed to support the growing demand for

[26] Source of uncertainty is the technology shock.

domestic investment. Therefore, balance sheet effects mitigate the initial response to the technology shock. Rows of Table 3 corresponding to CRP show an improvement in welfare relative to the benchmark model under a fixed regime, and a decline in welfare under a flexible regime.

Second, the financial accelerator mechanism's welfare effects are greater under a fixed exchange rate regime. The underlying shocks cause a 0.56 and 0.09 percent drop in welfare with a fixed and a flexible regime respectively. This result is consistent with the output response disparity observed in part 3. Nevertheless, the financial accelerator mechanism is not as significant as the country risk premium in terms of welfare.

Finally, the results obtained by using a first order approximation to the policy rules[27] would conflict the literature, and suggest that a fixed regime is better in terms of welfare under every specification. Table 4 illustrates the output from the conditional welfare computations. Although to a lesser extent, the mitigating and amplifying effects of CRP on welfare under fixed and flexible exchange rate regimes respectively are also observed with this different measure. Moreover, most of the welfare losses originate from the effects on the conditional means. I also find that the amplification property of the financial accelerator mechanism is stronger with the new measure.

The numerical values of the welfare losses are comparable to Bergin, Shin and Tchakarov (2007). The authors find that welfare losses from exchange rate volatility can increase up to 4.5 percent of annual income when habit persistence is included in a two country general equilibrium model. My results support their findings and show how welfare losses can be further amplified due to financial frictions.

5. Empirical Analysis

This part analyzes the implications of different exchange rate regimes for an economy that faces external finance shocks within the framework of balance sheet effects. In contrast to the standard practice in the literature I use the EMBI instead of a weighted average of advanced country lending rates as a proxy for external finance costs. This approach accounts for the fact that EMBI is a more realistic measure of the external finance costs of an emerging market country, and that these countries are unable

[27] The failure to pick up u^{mean}

to borrow at advanced country lending rates. Furthermore, using EMBI allows external finance costs to be affected by the domestic economy variables, in addition to their exogenously determined component. Therefore, using EMBI also provides a better test for the results of the model discussed in Section 3. More specifically, I compare the performance of fixed and flexible exchange rate regimes in terms of insulating an economy from external shocks using an alternative to Structural Vector Autoregressive (SVAR) models developed by Jorda (2004). I also use a weighted average of foreign interest rates instead of the EMBI following the literature, and compare the results.

Structural VAR methods have been put under scrutiny by recent research. According to this literature, there are two important shortcomings regarding these methods. First, misspecifications of VARs are large enough that they can lead to mistaken inferences. Second, VARs are designed to execute one period ahead forecasts, and they are subject to compounding misspecification errors with the forecast horizon. The latter shortcoming poses a problem for impulse responses which are functions of forecasts at distant horizons. In this respect, Chari, Kehoe and McGrattan (2005) show that VAR impulse responses obtained by using artificial data from a simple RBC model contradict the responses from the model itself. The authors argue that the misspecification stems from the inability of specifications involving few lags to capture the model data persistence due to capital's low rate of depreciation. Jorda (2004) proposes an alternative method for calculating impulse responses. This method is robust to the misspecification of the data generating process, and uses projections local to each forecast horizon. More specifically, the following equation is estimated for each forecast horizon to obtain impulse responses:

$$y_{t+s} = \alpha^{s} + \beta_1^{s+1} y_{t-1} + \beta_2^{s+1} y_{t-2} + \ldots\ldots.. + \beta_p^{s+1} y_{t-p} + u_{t+s}^{s} \qquad s = 0,1,2,\ldots\ldots h \qquad (5.1)$$

where h denotes the maximum forecast horizon, y is {Output, CPI, EMBI, R, E}, and output denotes industrial production. Optimal *p* is determined at each horizon using the Akaike Information Criterion. The impulse responses corresponding to equation (51) are calculated from,

$$IR(t,s,d_i) = \hat{\beta}_1 d_i \qquad s = 0,1,2,\ldots..,h \qquad (5.2)$$

where d_i represents the structural shock to the i^{th} element in y, and corresponds to the i^{th} column of the D matrix obtained by using a Cholesky decomposition of the reduced form's variance covariance matrix, Ω as

$$\Omega = PP' \quad and \quad D = P^{-1}$$

I use this methodology in the simulations. The data set consists of monthly observations from 1998 to 2004 for the 13 emerging market countries listed in Appendix D. A de facto classification is utilized to determine the countries that have followed a relatively tight and flexible exchange rate policy from 1998 to 2004[28]. The crisis periods for Russia, Brazil, Turkey and Argentina are excluded from the analysis together with the periods of high exchange rate volatility[29]. I measure the impulse responses using the data from the two groups of countries.

Responses to a one standard deviation EMBI shock are displayed in Figure 4. There are three main observations. First, contrary to a majority of the literature[30], impulse responses point to higher output volatility under flexible exchange rate regimes. Second, under flexible exchange rate regimes, central banks are prompted to respond more aggressively. Finally, the response of EMBI under flexible exchange rate regimes is more pronounced. These findings imply that tighter exchange rate regimes are better for withstanding external shocks in emerging market countries. However, it is essential to point out that these results should not be interpreted as a case for fixed exchange rate regimes, but rather as a possible explanation of the fear of floating observed in these countries.

Following the literature, I also use an equally weighted average of U.S., U.K. and Japan lending rates instead of the EMBI. The results are illustrated in Figure 5, and point to the lack of evidence in favor of either of the two regimes. Furthermore, the impulse responses to foreign interest rate shocks are much smaller in amplitude compared to the impulse responses generated by EMBI shocks[31]. These results

[28] The two groups of countries are listed in Appendix D. The standard deviation over the average is used to measure the relative exchange rate volatility during the period.
[29] The crisis periods are obtained from Kaminsky (2003).
[30] Hoffman (2003), Hochreiter, Korinek and Siklos (2003), Bergvall (2005), and LevyYeyati-Sturzenegger (2003) among others.
[31] These results are not sensitive to different weighting schemes. Weights favoring U.S., U.K. and Japan interest rates and weights based on the proximity of the emerging market economies to these countries produce similar results.

imply that the difference in the performance of exchange rate regimes is more sensitive to shocks related to the conditions in the domestic economy than to those in advanced countries.

6. Conclusion

Recent empirical and theoretical literature on emerging markets has favored flexible exchange rate regimes considering the vulnerability of fixed regimes to speculative attacks. Despite this fact, countries have been observed to control their exchange rate fluctuations. This paper has shown one reason for this “Fear of Floating” as it links the banking system’s balance sheets to the country risk premium. The paper finds that in the absence of a financial crisis, exchange rate regimes that limit the effect of external and technology shocks on balance sheets perform better in terms of limiting output volatility when the economy is unable to borrow in terms of its own currency. It is important to note, however that the results of the paper do not necessarily favor fixed exchange rate regimes, but rather should be seen as a case against perfectly flexible exchange rate regimes in a majority of emerging market countries. The analysis suggests that countries with shallow financial markets that have significant foreign exchange exposure should limit exchange rate fluctuations until their markets are developed enough to sustain a flexible regime. In this respect, it would be interesting to investigate how exchange rate regimes interact with the level of financial development to determine the vulnerability of these economies to external and domestic shocks.

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Table 1:

		% Change in the Exchange Rate (1)	Leverage (2)	GDP Growth (1)
1997 Asian Crisis	Malaysia	12.4	61.9	-4.5
	Philippines	14.6	-10.7	0.1
	Singapore	4.2	23.1	-1.2
	Thailand	25.8	136.3	-9.6
	Vietnam	5.8	-92.7	7.3
1994 Peso Crisis	Ecuador	16.7	37.7	-11.5
	Mexico	89.9	-30.7	-4.2
	Peru	2.3	-23.3	10.3
	Uruguay	26.0	-412.6	3.0
1998 Russian Default plus Brazil abandoning the band	Argentina	0.0	37.6	-4.0
	Chile	10.5	12.6	-1.6
	Colombia	23.2	42.9	-2.7
	Mexico	4.6	-155.1	2.4
	Panama	0.0	-101.4	3.5
	Peru	15.4	7.3	1.3
	Russia	153.6	26.5	-12.1
	Uruguay	8.3	-283.0	3.2
2001 Turkish Crisis	Turkey	96.0	41.1	-7.2
2002 Argentina Crisis	Argentina	206.0	122.1	-7.6

(1) % changes are over the year before and after the crisis
(2) Total banking sector net foreign liabilities divided by banking sector net worth (%).

Table 2: Conditional Standard Deviations of Output With Both Technology and External Shocks

		RBC	Without Habit Persistence $b=0$	Non-logarithmic Utility Function $\Omega=5$	Lower Price Stickiness $\theta=0.5$	Low Foreign Interest Rate Shock Persistence Persistence=0.25
Benchmark	Fixed	0.0554	0.0384	0.0513	0.0215	0.0403
	Flexible^{T}(1)	0.0494	0.0473	0.0506	0.0299	0.0393
	Flexible* (2)	0.0209	0.0203	0.0214	0.0226	0.0201
Financial Accelerator	Fixed	0.0722	0.0399	0.0646	0.0223	0.0409
	Flexible^{T}(1)	0.0505	0.0491	0.0511	0.0319	0.0403
	Flexible* (2)	0.0217	0.0204	0.0219	0.0237	0.0281
Country Risk Premium	Fixed	0.0403	0.0384	0.0413	0.0211	0.0342
	Flexible^{T}(1)	0.0549	0.0579	0.0611	0.0394	0.0537
	Flexible* (2)	0.0476	0.0438	0.0497	0.0342	0.0362
FA and CRP	Fixed	0.0409	0.0349	0.0414	0.0233	0.0354
	Flexible^{T}(1)	0.0572	0.0582	0.0579	0.0374	0.0518
	Flexible* (2)	0.0483	0.0414	0.0452	0.0344	0.0384

(1) FlexibleT row shows the standard deviations of output corresponding to the benchmark Taylor rule.
(2) Flexible* row shows the minimum standard deviation of output obtained from a grid search of Taylor rule parameters.

Table 3: Unconditional Welfare Effects of Technology Shocks [1]

	Fixed		
	u-overall	u-variance	u-mean
Benchmark Model	-4.87	-0.73	-4.14
Financial Accelerator (FA)	-5.43	-0.72	-4.71
Country Risk Premium (CRP)	-2.47	-1.11	-1.36
FA and CRP	-2.73	-1.82	-0.09
	Flexible		
	u-overall	u-variance	u-mean
Benchmark Model	-3.85	-2.17	-1.68
Financial Accelerator (FA)	-3.94	-2.30	-1.64
Country Risk Premium (CRP)	-4.56	-4.05	-0.05
FA and CRP	-5.48	-3.53	-1.95

(1) The numbers are percent deviations from steady consumption
that consumers are willing to give up to eliminate technology shocks.

Table 4: Conditional Welfare Effects of Technology Shocks [1]

	Fixed		
	u-overall	u-variance	u-mean
Benchmark Model	-3.83	-0.36	-3.47
Financial Accelerator (FA)	-5.47	-0.55	-4.93
Country Risk Premium (CRP)	-3.44	-0.41	-3.03
FA and CRP	-5.08	-0.54	-4.55
	Flexible		
	u-overall	u-variance	u-mean
Benchmark Model	-3.68	-0.66	-3.02
Financial Accelerator (FA)	-4.96	-0.65	-4.31
Country Risk Premium (CRP)	-4.14	-0.88	-3.26
FA and CRP	-5.55	-0.67	-4.88

(1) The numbers are percent deviations from steady consumption
that consumers are willing to give up to eliminate technology shocks.

FIGURE 1A:
Benchmark Model, Output Response to a 1% Technology Shock

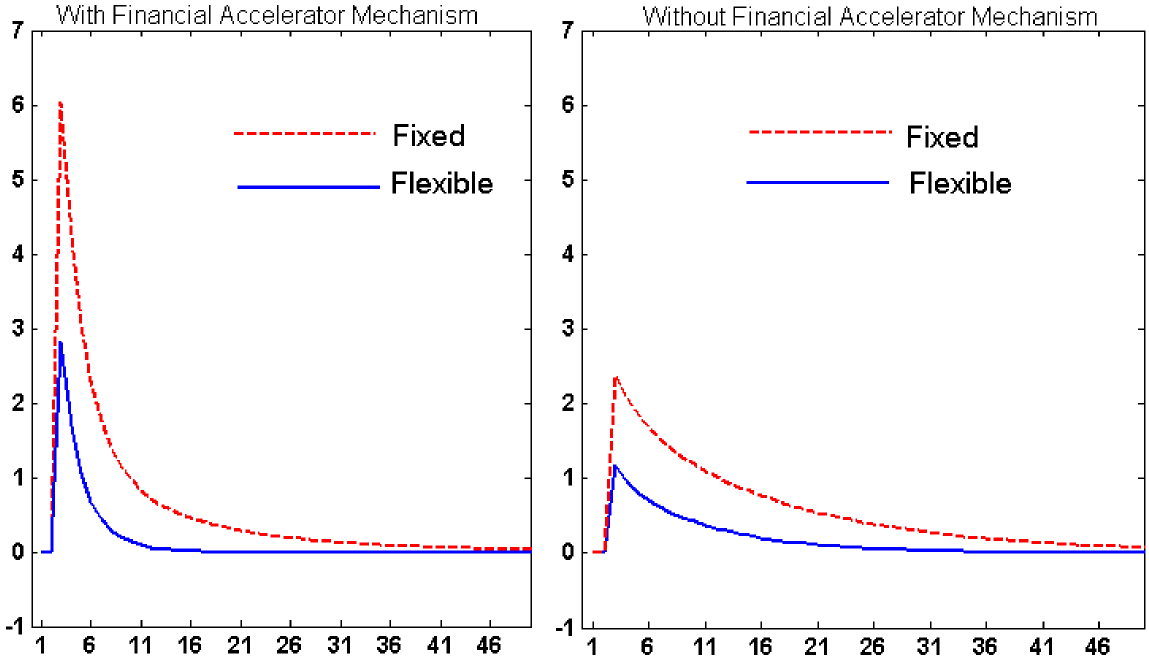


FIGURE 1B:
Benchmark Model, Output Response to a 1% Positive Foreign Interest Rate Shock

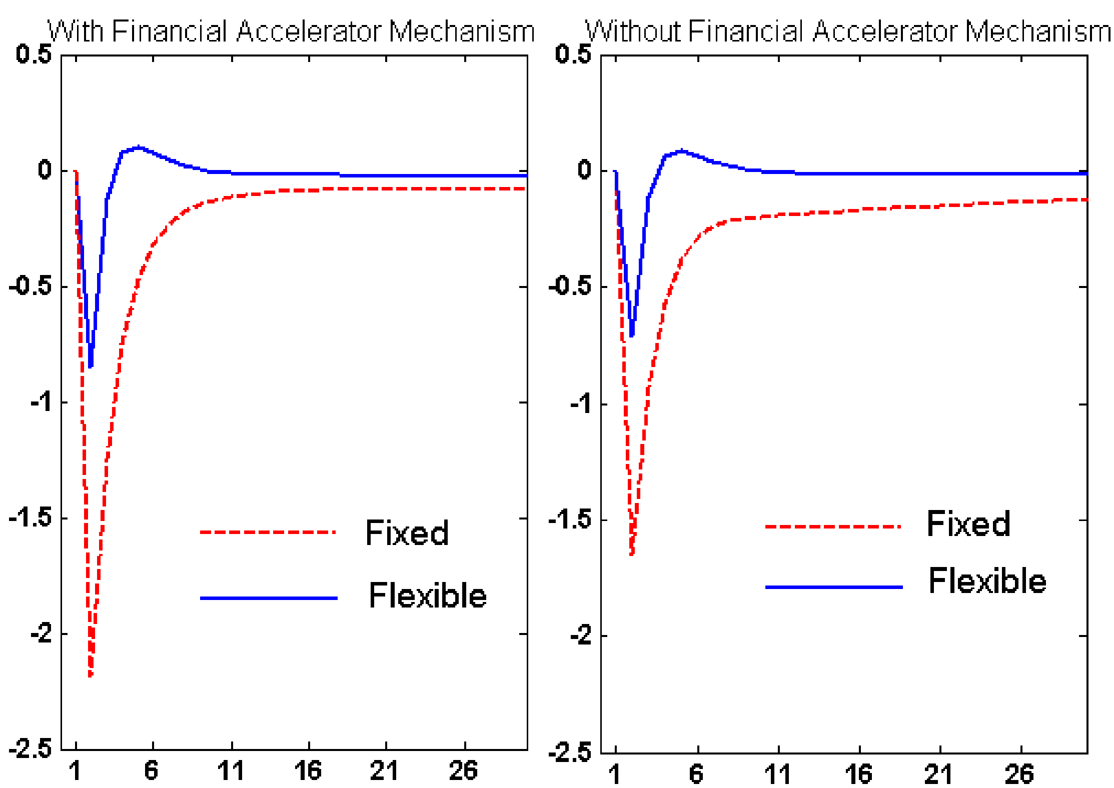


FIGURE 2:
The model including Country Risk Premium (Response to a 1% Tech. Shock)

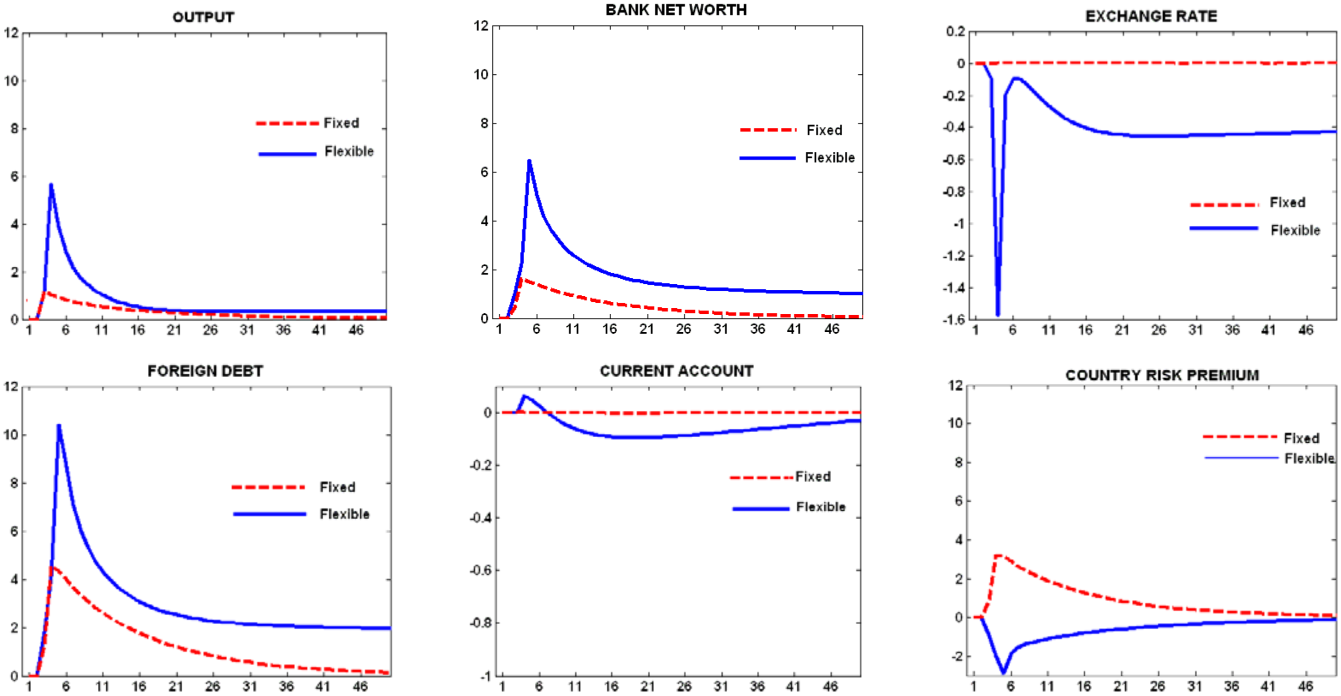


FIGURE 3:
The Model including Country Risk Premium (Response to a 1% Foreign Interest Rate Shock)

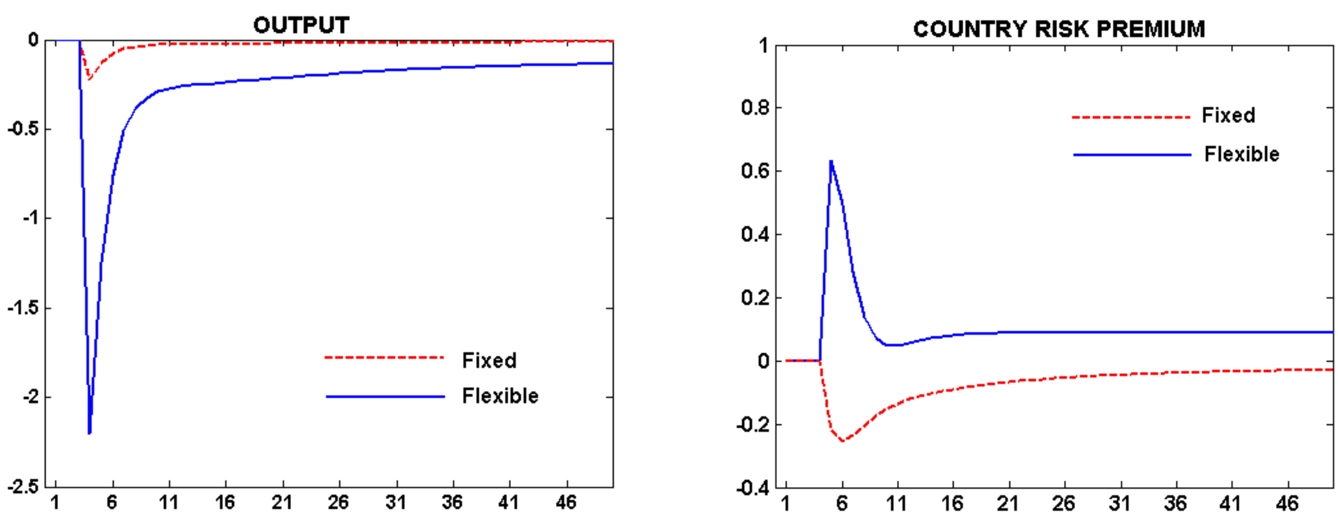


Figure 4: Impulse Responses from the Local Projections Model (1% Foreign Interest Rate Shock, Using EMBI, and Monthly Data)

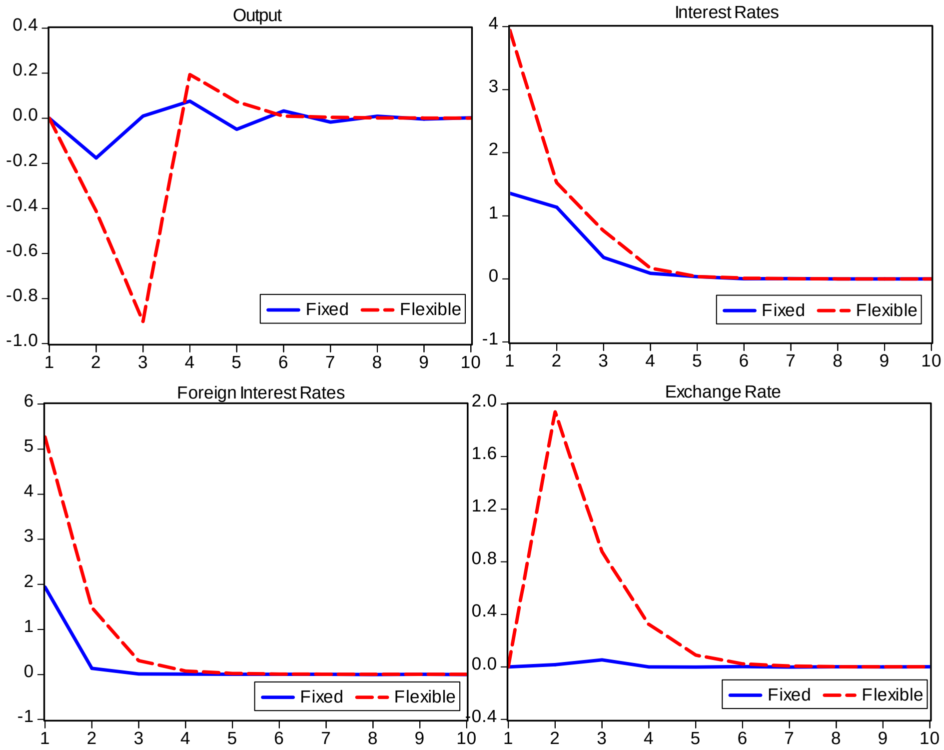
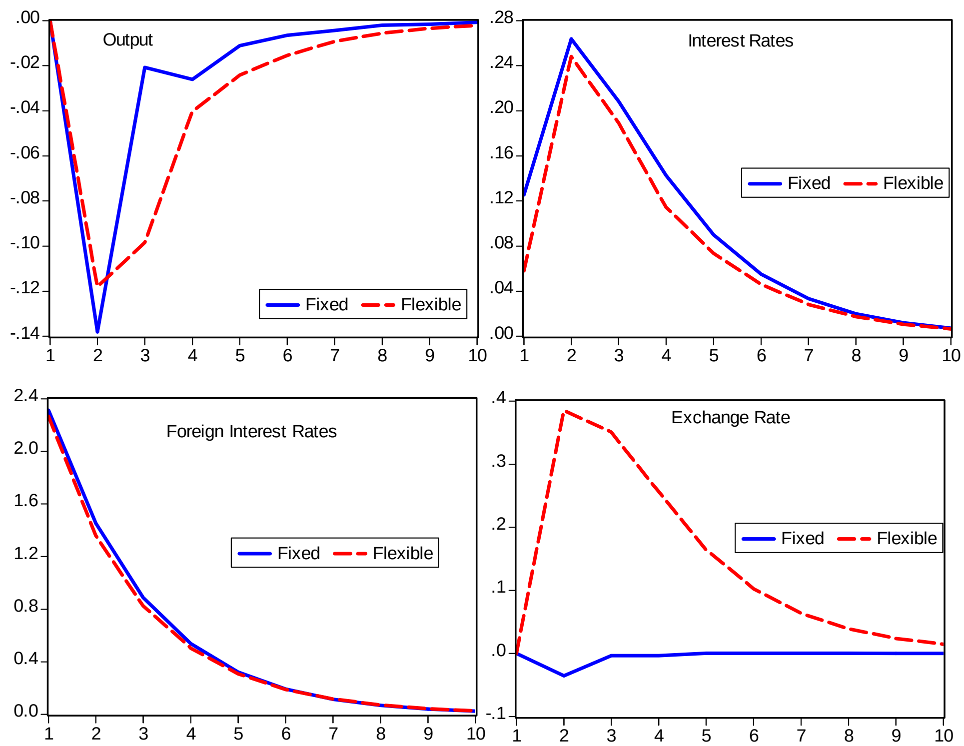


Figure 5: Impulse Responses from the Local Projections Model (1% For. Int. Rate Shock, Using Developed Country Avg. Int. Rates, Monthly Data)



Appendix A: Rest of the Model

Aggregate production function is given by,

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}$$

where the labor input L_t is a composite of household's and entrepreneurs labor supply such that,

$$L_t = \left(L_t^h\right)^{\varpi} \left(L_t^e\right)^{1-\varpi}$$

This modification is needed to provide some net worth to entrepreneurs that start producing for the first time. In our simulations ϖ is set equal to 0.05 and entrepreneurs' labor supply decision does not affect output significantly. The following sections describe the agents in the economy:

A.1 Households

Households consume a composite good, C_t which is a CES aggregation of domestic and foreign goods represented by C_t^H and C_t^F respectively where, C_t^H is a composite of the goods sold by the retailers.

$$C_t = \left[(\gamma)^{\frac{1}{p}} \left(C_t^H\right)^{\frac{p-1}{p}} + (1-\gamma)^{\frac{1}{p}} \left(C_t^F\right)^{\frac{p-1}{p}} \right]^{\frac{p}{p-1}} \tag{A.1}$$

The corresponding price index is given by,

$$P_t = \left[(\gamma)\left(P_t^H\right)^{1-p} + (1-\gamma)\left(P_t^F\right)^{1-p} \right]^{\frac{1}{p-1}} \tag{A.2}$$

Households exhibit habit formation and maximize,

$$E_t\left[\sum_{i=0}^{\infty} \beta^i \left[\frac{\left(C_{t+i} - bC_{t+i-1}\right)^{1-\Omega}}{1-\Omega} + x \ln\left(\frac{M_{t+i}}{P_{t+i}}\right) - k \ln\left(1 - L_{t+i}^h\right) \right]\right] \tag{A.3}$$

subject to,

$$C_t + \frac{M_t}{P_t} + \frac{R_t D_{t-1} + \left(R_t^* + h_t\right) e_t D_{t-1}^*}{P_t} + T_t = \frac{W_t^h}{P_t} L_t^h + \frac{M_{t-1}}{P_t} + \frac{D_t + e_t D_t^*}{P_t} + \Pi_t \tag{A.4}$$

Consumers buy goods, hold money, M_t , pay lump sum taxes, T_t . Their income comes from wages, profits received from the retailers, Π_t , the returns on deposits, and their money holdings. Furthermore, consumers can borrow in terms of foreign currency at the risk free interest rate R_t^* , or in domestic currency at an interest rate R_t . h_t represents the endogenously determined country risk premium. that is paid to borrow from abroad. Nominal foreign and domestic debt payments are denoted by $R_t D_{t-1}$ and $\left(R_t^* + h_t\right)e_t D_{t-1}$ respectively, and e_t represents the exchange rate. Given this setup, the first order conditions are derived from the consumer's optimization problem:

Consumption allocation;

$$\frac{C_t^H}{C_t^F} = \frac{\gamma}{1-\gamma}\left(\frac{P_t^H}{P_t^F}\right)^{-p} \tag{A.5}$$

intratemporal efficiency;

$$\lambda_t \frac{W_t^h}{P_t} = k \frac{1}{1-L_t^h} \tag{A.6}$$

marginal utility of consumption;

$$\lambda_t = \left(C_t - bC_{t-1}\right)^{-\Omega} - \beta b\left(C_{t+1} - bC_t\right)^{-\Omega} \tag{A.7}$$

intertemporal efficiency;

$$\lambda_t = \beta E_t\left(\lambda_{t+1} R_t \frac{P_t}{P_{t+1}}\right) \tag{A.8}$$

uncovered interest parity condition;

$$E_t\left(\lambda_{t+1}\frac{P_t}{P_{t+1}}\left[R_t - \left(R_t^* + h_t\right)\frac{e_{t+1}}{e_t}\right]\right) = 0 \tag{A.9}$$

Assuming that the law of one price holds,

$$P_t^H = e_t P_t^{H*} \tag{A.10}$$

$$P_t^F = e_t P_t^{F*} \tag{A.11}$$

where P_t^{H*} and P_t^{F*} are foreign price of home and foreign goods.[32] Foreign demand for home goods is:

$$C_t^{H*} = \left(\frac{P_t^{H*}}{P_t^*}\right)^{-\varepsilon} Y_t^* \tag{A.12}$$

where Y_t^* is foreign income, and the foreign aggregate price level P_t^* is taken as given.

A.2 Entrepreneurs

Wholesale firms are managed by entrepreneurs that have constant returns to scale production functions.

$$Y_{it} = A_t K_{it}^{\alpha} L_{it}^{1-\alpha} \tag{A.13}$$

where A_t is an i.i.d. aggregate productivity shock.

Capital expenditures are financed by banks and the entrepreneurs' net worth.[33]

$$Q_{t-1}K_{it} = N_{it} + B_{it} \tag{A.14}$$

where N_{it} is the net worth of the firm at the end of period t-1 and at the beginning of period t, B_{it} denotes the funds borrowed from the banks, and Q_{t-1} is the price of assets in period t-1. In the benchmark model I assume that households' domestic deposits equal the aggregate borrowing requirement of the entrepreneurs such that $B_t = \frac{D_t}{P_t}$

In addition to the economy wide technology shock, entrepreneurs face idiosyncratic returns to capital shocks. Real returns to capital are composed of the idiosyncratic iid shock, A_{it}, and the real aggregate return, R_t^k.[34]

$$R_{it}^k = A_{it}\left(\frac{\alpha \frac{P_t^w A_t K_t^{\alpha-1} L_t^{1-\alpha}}{P_t} + (1-\delta)\frac{Q_t}{P_t}}{\frac{Q_{t-1}}{P_{t-1}}}\right) = A_{it}R_t^k \tag{A.15}$$

[32] P_t^{F*} is assumed to equal one for every period.
[33] We refer to entrepreneurs and wholesale firms interchangeably since the entrepreneurs make the production decisions.
[34] This is the gross return averaged across firms.

P_t^w is the price of the wholesale good, and P_t is the aggregate price level. Firms will hire labor according to:

$$(1-\alpha)\omega \frac{Y_t}{L_t} = \eta_t \frac{W_t^h}{P_t}, \quad (1-\alpha)(1-\omega)\frac{Y_t}{L_t} = \eta_t \frac{W_t^e}{P_t} \tag{A.16}$$

where $\eta_t = \dfrac{P_t}{P_t^w}$ and $\dfrac{1}{\eta_t}$ represents the relative price of wholesale goods.

A.3 Capital Producers

The capital stock evolves according to the equation below, with increasing marginal costs to capital production.

$$K_{t+1} = \Phi\left(\frac{I_t}{K_t}\right)K_t + (1-\delta)K_t \qquad \text{A.17)}$$

Capital producers are perfectly competitive. They use wholesale goods as inputs to produce capital according to the production function: $\Phi(I_t / K_t)K_t$. The price of capital goods is derived from the producers' profit maximization problem. The final component of the accelerator mechanism is given by Equation (A.18).

$$E_{t-1}\left[\frac{Q_t}{P_t^w} - \left[\Phi'\left(\frac{I_t}{K_t}\right)\right]^{-1}\right] = 0, \quad \Phi'(\bullet) > 0 \tag{A.18}$$

If entrepreneurs experience a positive asset price shock, they borrow more and demand more capital. This leads to an increase in their expected net worth for the following period. In addition, as investment increases, there is an upward pressure on asset prices, which amplifies the initial response.

A.4 Retail Firms

Retail firms are monopolistically competitive. They buy wholesale goods and sell them after repackaging at no resource cost. The purpose of including these firms at this stage is to have a simple contract between the firm and the banking sector.[35] The other benefit of this framework is that it allows

[35] A financial contract with a monopolistically competitive firm would complicate aggregation due to the different levels of leverage for each monopolistic firm.

for sticky prices and therefore monetary policy that is not neutral in the short run. The demand for goods produced by retail firms is given by,

$$Y_t^H(z) = \left(\frac{P_t^H(z)}{P_t^H}\right)^{-\upsilon} Y_t^H \tag{A.19}$$

where,

$$Y_t^H = \left(\int_0^1 Y_t^H(z)^{\frac{\nu-1}{\nu}} dz\right)^{\frac{\upsilon}{\upsilon-1}} \tag{A.20}$$

Following the pricing scheme of Calvo (1983), I assume that only a portion of the retailers adjust their prices at a specific time.

$$P_t^H = \left(P_{t-1}^H\right)^{\theta} \left(P_{t-1}^{*H}\right)^{1-\theta} \tag{A.21}$$

Retailers maximize an intertemporal loss function and set their optimal price, P_t^{*H}, as follows,

$$P_t^{*H} = \mu_1 \prod_{i=0}^{\infty} P_{t+i}^{w^{(1-\beta\theta)(\beta\theta)^i}} \tag{A.22}$$

where $\mu_1 = 1/(1-1/\nu)$ is the desired gross mark up over wholesale prices. If equations (A.21) and (A.22) are combined, one can solve for the domestic inflation rate.

$$\frac{P_t^H}{P_{t-1}^H} = \left(\mu_1 \frac{P_t^w}{P_t^H}\right)^{\frac{(1-\theta)(1-\beta\theta)}{\theta}} E_t\left(\frac{P_{t+1}^H}{P_t^H}\right)^{\beta} \tag{A.23}$$

where the first term is the marginal cost to the retailers, and the second term is the expected inflation rate.

A.5 Closing the Model

To close the model, first we assume that the government finances its expenditures by printing money and collecting lump sum taxes:

$$G_t = \frac{M_t - M_{t-1}}{P_t} + T_t \tag{A.24}$$

Second, the resource constraint in this economy holds:

$$Y_t^H = C_t^H + C_t^{eH} + C_t^{H*} + I_t^H + \mu\left(\int_0^{\overline{A}_i^*} A_i f(A_i)\delta A_i\right) R_t^k Q_{t-1} K_t \tag{A.25}$$

where C_t^{eH} is entrepreneurial consumption, and $\mu\left(\int_0^{\overline{A}_i} A_i f(\overline{A}_i)\delta A_i\right)R_t^k Q_{t-1}K_t$ are the total monitoring costs.

Government budget constraint is given by,

Finally, we obtain the balance of payments condition in the economy by adding consumers' and entrepreneurs' budget constraints:

$$C_t + C_t^e + I_t + \frac{R_t D_{t-1} + \left(R_t^* + h_t\right)e_t\left(D_{t-1}^* + B_{t-1}\right)}{P_t} + \mu\left(\int_0^{\overline{A}_i} A_i f(\overline{A}_i)\delta A_i\right)R_t^k Q_{t-1}K_t$$
$$= Y_t + \frac{D_t + e_t\left(D_t^* + B_t\right)}{P_t} + \Pi_t \qquad \text{(A.26)}$$

Appendix B: The Positive Relationship Between the Aggregate Technology Shock, A_t and the Returns to the Bank, VB_t.

$$VB_t = \left[(1-\mu) \left(\int_0^{\bar{A}_{it}^*} A_{it} f(A_{it}) dA_{it} \right) \right] R_t^k Q_{t-1} K_t + \left[1 - F\left(\bar{A}_{it}^*\right)\right] \bar{A}_{it}^* R_t^k Q_{t-1} K_t \tag{B.1}$$

$$\bar{A}_{it}^* = \frac{\bar{A}_{it} E^a \left(R_t^k\right)}{\alpha \dfrac{A_t K_t^{\alpha-1} L_t^{1-\alpha}}{X_t} + \dfrac{(1-\delta) Q_t}{P_t}} \tag{B.2}$$

$$\begin{aligned} \frac{dVB_t}{dA_t} &= -\mu \bar{A}_{it}^* f\left(\bar{A}_{it}^*\right) R_t^k Q_{t-1} K_t \frac{d\bar{A}_{it}^*}{dA_t} + \left[(1-\mu) \left(\int_0^{\bar{A}_{it}^*} A_{it} f(A_{it}) dA_{it} \right) \right] Q_{t-1} K_t \frac{dR_t^k}{dA_t} \\ &+ \left[1 - F\left(\bar{A}_{it}^*\right)\right] R_t^k Q_{t-1} K_t \frac{d\bar{A}_{it}^*}{dA_t} + \left[1 - F\left(\bar{A}_{it}^*\right)\right] \bar{A}_{it}^* Q_{t-1} K_t \frac{dR_t^k}{dA_t} \end{aligned} \tag{B.3}$$

$$\frac{d\bar{A}_{it}^*}{dA_t} = -\frac{1}{\left(R_t^k\right)^2} \bar{A}_{it} E^a \left(R_t^k\right) \frac{dR_t^k}{dA_t} \quad \text{and} \quad \frac{d\bar{A}_{it}^*}{dA_t} = -\frac{1}{\left(R_t^k\right)^2} \bar{A}_{it}^* R_t^k \frac{dR_t^k}{dA_t} \tag{B.4}$$

If $\dfrac{d\bar{A}^*_{it}}{dA_t}$ from (A.4) is substituted for the same expression in $\dfrac{dVB_t}{dA_t}$, one can obtain:

$$\frac{dVB_t}{dA_t} = \mu \bar{A}_{it}^{*\,2} f\left(\bar{A}_{it}^*\right) Q_{t-1} K_t \frac{dR_t^k}{dA_t} + \left[(1-\mu) \left(\int_0^{\bar{A}_{it}^*} A_{it} f(A_{it}) dA_{it} \right) \right] Q_{t-1} K_t \frac{dR_t^k}{dA_t} \tag{B.5}$$

where both terms on the right hand side are positive since $\dfrac{dR_t^k}{dA_t} > 0$. Hence, $\dfrac{dVB_t}{dA_t} > 0$.

Appendix C: Leverage-Country Risk Premium relationship

The bank-foreign creditor contract is characterized by the following two equations:

$$\left[1-F\left(\overline{A}_t\right)\right]\left(R_t^*+h_t\right)F_t e_t+\left(1-\mu\right)\int_0^{\overline{A}_t} VB\left(A_t\right)dF\left(A_t\right)=R_t^* F_t e_t \tag{C.1}$$

$$VB_t\left(\overline{A}_t\right)=\left[\left(R_t^*+h_t\right)F_t e_t\right] \tag{C.2}$$

To find the leverage-country risk premium relationship, one has to find how the premium responds to changes in the cutoff value of the technology shock and how the cutoff value of the technology shock changes as foreign borrowing varies respectively. It is also important to note that the foreign borrowing requirement F_t is determined before the contract according to equation (2.14). (C.2) and (C.1) can be used to obtain the following expression:

$$\left[1-F\left(\overline{A}_t\right)\right]+\frac{\left(1-\mu\right)\int_0^{\overline{A}_t} VB\left(A_t\right)df\left(A_t\right)}{VB_t\left(\overline{A}_t\right)}=\frac{R_t^*}{R_t^*+h_t} \tag{C.3}$$

This equation implies a positive relationship between the risk premium h_t, and $\overline{A}_t$. As $\overline{A}_t$ increases, both terms on the left hand side decrease, and h_t increases. The second term on the left decreases, since as $\overline{A}_t$ increases, the numerator doesn't increase as much as the denominator, as it's an expectation of VB_t with $\overline{A}_t$ as the upper limit of the domain, and VB_t is a strictly increasing function as shown in Appendix B. Therefore,

$$h_t=\Omega\left(\overline{A}_t\right) \quad \text{where} \quad \Omega'\left(\bullet\right)>0 \tag{C.4}$$

This relation implies that as the risk of default increases, the country risk premium increases. Expression (C.3) can also be written in terms of $e_t F_t$, $\overline{A}_t$ and R_t^* as,

$$\left[1-F\left(\overline{A}_t\right)\right]VB_t\left(\overline{A}_t\right)+\left(1-\mu\right)\int_0^{\overline{A}_t} VB\left(A_t\right)df\left(A_t\right)=R_t^* F_t e_t \tag{C.5}$$

A positive relationship between F_t and $\overline{A}_t$ exists, if the following inequality obtained from (B.5) holds,

$$VB'\left(\overline{A}_t\right)\left(1-F\left(\overline{A}_t\right)\right)-\mu f\left(\overline{A}_t\right)VB\left(\overline{A}_t\right)>0 \tag{C.6}$$

This expression is significantly greater than zero for values of $\overline{A}_t$ within 3 standard deviations of its steady state value. Given that there is an increase in the right hand side of equation (C.5) due to higher foreign borrowing, the cutoff value of the technology shock has to increase. This is due to the fact that the increase in VB_t plus the proceeds in case the bank fails, dominates the opposite effects of the higher probability of default.

$$F_t=\varpi\left(\overline{A}_t\right) \quad \text{where} \quad \varpi'\left(\bullet\right)>0 \tag{C.7}$$

Equation (C.7) together with (C.4) illustrate the positive relationship as follows,

$$F_t = \Lambda(h_t) \quad where \quad \Lambda'(\bullet) > 0 \tag{C.8}$$

Therefore, as banks borrow more from abroad given a certain net worth, risk premium increases due to the higher probability of default. Moreover, there is a negative relationship between risk premium and net worth since the banks would borrow less as their net worth increases leading to a decrease in risk premium. Finally, since the contract is in terms of foreign currency, changes in the exchange rate will have an effect similar to the changes in foreign borrowing. As the domestic currency depreciates (appreciates), the country risk premium increases (decreases). Combining the implicit relationships mentioned above yields the leverage-premium relationship:

$$h_t = \Gamma\left(\frac{e_t F_t}{NW_t}\right) \quad where \quad \Gamma'(\bullet) > 0 \tag{C.9}$$

Appendix D: Monthly Panel Countries, Period: 1998-2004

		Standard Dev.(E-R) / Avg.(E/R)
Relatively Fixed E-R	Ukraine	1.44
	South Africa	1.48
	Ecuador	1.80
	Colombia	1.82
	Russia	2.50
	Brazil	2.81
	Philippines	2.87
Relatively Flexible E-R	Poland	2.90
	Mexico	3.28
	Argentina	3.96
	Turkey	8.47
	Bulgaria	9.04
	Malaysia	9.38