Real Business Cycles in Emerging Countries

Ozge Akinci

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Abstract

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This dissertation investigates the sources of real business cycle fluctuations in emerging countries, using a combination of real business cycle theory and econometric techniques.

The first chapter consists of two main sections. In the first section, I empirically evaluate the canonical dynamic stochastic general equilibrium model of a small open emerging economy using bayesian methods. I show that estimated dynamic models of business cycles in emerging countries deliver counterfactual predictions for the country risk premium. In particular, the country interest rate predicted by these models is acyclical or procyclical, whereas it is countercyclical in the data. The second section proposes and estimates a small open economy model of the emerging-market business cycle in which a time-varying country risk premium emerges endogenously through a variant of the financial accelerator mechanism as in Bernanke, Gertler, and Gilchrist (1999). In the proposed model, a firm's borrowing rate adjusts countercyclically as the productivity default threshold depends on the state of the macroeconomy. I

econometrically estimate the proposed model and find that it can account for the volatility and the countercyclicality of the country risk premium as well as for other key emerging market business cycle moments. Time varying uncertainty in firm specific productivity contributes to delivering a countercyclical default rate and explains more than 65 percent of the variances in the trade balance and in the country risk premium. Finally, I find that the predicted contribution of nonstationary productivity shocks in explaining output variations falls between the high estimate reported by Aguiar and Gopinath (2007) and the low estimates reported by Garcia-Cicco, Pancrazi, and Uribe (2010).

In the second chapter, I investigate the extent to which global financial conditions contribute to the macroeconomic fluctuations in emerging economies. Using a panel structural VAR model, I find that global risk shocks are important contributors to the dynamics of the country risk premium and real macroeconomic variables. In particular, I find that global risk shocks explain about 20 percent of movements both in the country risk premium and in the economic activity in emerging economies. The contribution of U.S. real interest rate shocks to macroeconomic fluctuations in emerging economies is negligible. I argue that the role of U.S. interest rate shocks in driving the business cycles in emerging economies, as emphasized in the previous literature, is taken up by global risk shocks. The country risk premium shock also has significant explanatory power of emerging economy real business cycle fluctuations. Global financial shocks altogether account for about 45 percent of the aggregate fluctuations in emerging economies. I find that domestic macroeconomic variables including domestic banking sector risk have sizable impact on the country risk premium fluctuations. I argue that the linkage between the economic activity and the country risk premium is the key mechanism through which global risk shocks are transmitted to emerging economies.

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To my family

Chapter 1

Financial Frictions and Macroeconomic Fluctuations in Emerging Economies

1.1 Introduction

Real business cycles in emerging markets are characterized by three distinct features: (1) excessive volatility of consumption relative to output (2) strong countercyclicality and persistence of the trade balance to output ratio and (3) high, volatile, and countercyclical country risk premia. Existing estimated models of business cycles in emerging markets place significant emphasis on explaining observed movements in output, consumption and the trade balance, but much less emphasis on capturing the cyclical behavior of country premia. This strand of the literature either assumes frictionless access to international financial markets or treats a country premium in a reduced-form, without explicitly incorporating a microfounded default mechanism. A difficulty faced by estimated versions of these models is that they deliver counterfactual predictions for the country interest-rate premium. In particular, the interest rate predicted by these models is either acyclical or procyclical while it is countercyclical in the data.

This paper proposes and estimates a small open economy model in which a time-varying country premium emerges endogenously through a variant of the financial accelerator model of Bernanke, Gertler, and Gilchrist (1999). In the model, due to a costly state verification problem, external funds will be more expensive than internal funds. Assuming that domestic households are the owners of the leveraged firms which might default on their debt, both country interest rate and the rate at which firms borrow are driven by the endogenous probability of default. In response to an unanticipated negative shock to productivity, a realization of the return on the inputs financed by external funds will be lower than its expected value. To guarantee an expected return to foreign lenders which is equal to a risk free return, the share of earnings promised to foreign lenders from investing in inputs financed by external funds has to rise. This necessitates an increase in the productivity default threshold. A higher default threshold, then, implies a higher default rate, and a higher risk premium.

The endogenous risk premium also contributes to generating higher consumption volatility relative to income volatility, and countercyclical trade balance-to-output ratio in the model economy. The first result arises because an unexpected decrease in productivity leads to a higher risk premium and hence less borrowing from abroad. The country's trade balance thus increases, leading to a negative correlation between trade balance and output. The second result occurs because the total consumption of households varies more in a model with endogenous spreads in response to productivity shocks. Firms tend to reduce the leverage when the economy is hit by adverse productivity shock. They do so by decreasing the real dividends distributed to the household, which tightens their budget constraints. As a result of this, households adjust consumption by more than in the absence of an endogenous risk premium.

I econometrically estimate the model on Argentine data using Bayesian methods.

I augmented the data series that is used in the standard estimations of frictionless or reduced form financial frictions models with country risk premium data. The estimated model accounts for a volatile and countercyclical interest rate and key emerging market business cycle moments.

In the estimation, the model is fed with a variety of shocks, such as stationary and nonstationary shocks to total factor productivity, consumption preferences shocks, government spending shocks and financial shocks. The financial shock introduced in this paper is inherent in the financial accelerator mechanism; therefore, it is more primitive than an exogenous shock to the country risk premium, which is a standard way of incorporating financial shock in this literature. In the model, firms acquire intermediate goods to be used in the production process through a combination of their own resources and borrowing from international lenders. Loans extended to an emerging economy are risky to foreign lenders because firms experience idiosyncratic productivity shocks which, if sufficiently severe, prevent them from repaying their loans. The magnitude of the idiosyncratic risk shock is determined by its standard deviation, and I assume that this standard deviation is the realization of a stochastic process as in Dorofeenko et al. (2008) and Christiano et al. (2009). The former extended the Carlstrom and Fuerst agency cost model of business cycles by including time-varying uncertainty in the technology shocks that affect capital production and then calibrated the model for the U.S. economy. The latter augmented the financial accelerator model as in Bernanke, Gertler, and Gilchrist (1999) with the time varying uncertainty shock and estimated the model for the U.S. economy and Euro area. Finally, Christiano et al. (2007) incorporated the time varying uncertainty shock into a small open economy, and then estimated the model on Swedish data. In all these papers, the financial frictions introduced into the model are related to domestic financial markets and the models are estimated for developed economies.[1]

Incorporating time varying uncertainty shock into an emerging market business cycle model is appealing for three reasons. First, it helps to account for the countercyclical risk premium and other key emerging market business cycle moments in the model. In response to an increase in the standard deviation of the idiosyncratic productivity shock, foreign lenders will charge a higher risk premium on their lending to an emerging economy because they have to bear the cost of more bankruptcies after a positive shock. Raising the risk premium is the only way they can shed this risk. With the higher cost of borrowing, firms reduce the amount of intermediate inputs used in the production because intermediate inputs are now more expensive to finance. Besides, households' demand for domestic goods diminishes because of the decrease in the dividend income they receive from firms. This leads firms to reduce their demand for labor, which further tightens the budget constraint of the households as the real wages declines. At the end, output decreases and a countercyclical interest rate emerges. Second, this shock is important in delivering a high and volatile country risk premium, which is shown to be a good business cycle leading indicator in emerging economies (see, for example, Neumeyer and Perri (2005)). Finally, time varying uncertainty shock in the model with financial frictions replaces some of the role of the nonstationary technology shock, which is shown to be the single most important shock for the emerging economy in the context of frictionless real business cycle models.

I investigated the sources of business cycle fluctuations in emerging economies using the estimated model. I find that shocks to a nonstationary component of productivity explains 50 percent of the unconditional variances of output and con-

[1] Similar to Dorofeenko et al. (2008) and Christiano et al. (2009), time varying uncertainty shock introduced in this paper is a mean preserving shift in the cross-sectional dispersion of returns from investing in intermediate inputs.

sumption. This estimate falls between the estimates in Aguiar and Gopinath (2007) (80 percent) and in Garcia-Cicco, Pancrazi, and Uribe (2010) (5 percent). Time varying uncertainty in the firm specific productivity explains more than 65 percent of the variance of trade balance-to-output ratio and country risk premium.

I show that incorporating the endogenous risk premium and the inclusion of the country risk premium data in the estimation modifies inferences about the sources of macroeconomic fluctuations in emerging markets. Without the financial frictions and the country risk premium data, the nonstationary technology shock is the main source of aggregate fluctuations. In response to a positive and persistent shock to productivity growth, current output increases on impact and is expected to continue to grow in the future. This increasing profile for future expected income levels induces households to consume beyond the increase in current output by increasing the debt they obtain from foreign lenders. This results in a countercyclical trade balance-to-output ratio and higher consumption volatility relative to income volatility. However, the estimated frictionless model implies excessive volatility of trade balance to output ratio.

With reduced form financial frictions and the neglecting of the information on the country risk premium, the data assigns a negligible role to the nonstationary technology shock. Its role is replaced by the stationary technology shock, the consumption preferences shock and the exogenous country risk premium shock. When the economy is hit by a higher consumption preference shock, everyone suddenly wants to consume more, which is partly financed by borrowing in the international markets. A higher demand for funds will in turn lead to a higher interest rates. The exogenous increase in the country risk premium will lead to a higher country interest rate by assumption in the reduced form financial frictions model. Once the model is forced to use information on country risk premium, some of the explanatory power of the consumption preference shock and the country risk premium shock is lost. The estimated standard deviation and the serial correlation of the stationary technology shock also decrease. The role of the nonstationary technology shock increases so that the model, especially the consumption euler equation, fits the data better. However, the estimated reduced form financial frictions model predicts acyclical or procyclical country interest rate. The endogenous risk premium model proposed in this paper (with country interest rate data used in the estimation) predicts that part of the role of the nonstationary shock in the frictionless model is taken up by the time varying uncertainty shock and the model successfully accounts for the interest rate cyclicality and other key moments of emerging market data.

The present paper is related to a large body of existing literature on emerging-market business cycles. Most models in this literature build on the canonical small open economy real business cycle model presented in Mendoza (1991) and Schmitt-Grohe and Uribe (2003). The first contributions in emerging-market business-cycle literature (see, for example, Neumeyer and Perri (2005) and Uribe and Yue (2006)) augmented the canonical model with two different types of financial friction: an induced process for the country risk premium and the working capital constraint. These papers treat country risk premium in a reduced form without explicitly incorporating a microfounded default mechanism. They also assume that working capital loans pay the total cost of labor in full, which implies that the share of working capital loans in the gross domestic product is very high while empirical evidence suggests it is a significantly smaller share.[2]

In a more recent paper, Aguiar and Gopinath (2007) argue that introducing shocks

[2] As also argued in Oviedo (2005) and Mendoza and Yue (2011), the implied share of working capital loans in the gross domestic product is approximately 67 percent while Mendoza and Yue (2011) report that it is 6 percent of the gross domestic product in Argentina and Schmitt-Grohe and Uribe (2007) estimate that it is 9.3 percent annually for the U.S.

to trend output in an otherwise standard small open economy real business cycle model can account for the key features of economic fluctuations in emerging market economies. I show in this paper that the model can account for excess volatility of consumption, but this comes at the cost of a high implied volatility of the trade balance to output ratio (about four times higher than the data). This result suggests that it is not reasonable to assume frictionless financial markets. The estimated model also predicts that the trade balance-to-output ratio and the country interest rates exhibit near random walk behavior. However, the empirical autocorrelation function of these variables takes a value slightly higher that 0.90 at order one and then declines quickly toward zero, resembling a variable with a stationary autoregressive behavior.

García-Cicco, Pancrazi, and Uribe (2010), motivated by the failure of frictionless real business cycle models augmented by trend shocks to productivity, estimated an encompassing model for an emerging economy with both trend shocks and financial frictions. The estimated model generates higher consumption volatility relative to income volatility and countercyclical trade balance-to-output ratio. However, the model cannot explain the interest rate driving its results. Financial market imperfections are introduced into the model in a reduced form by econometrically estimating the value of the parameter governing the debt elasticity of the country premium. I show in this paper that the model proposed by García-Cicco, Pancrazi, and Uribe (2010) predicts a procyclical interest rate, while it is strongly countercyclical in the data. Chang and Fernández (2010) also estimate a reduced form financial frictions model augmented with trend shocks to productivity. Similarly, they place significant emphasis on explaining observed movements in output, consumption and the trade balance-to-output ratio.

The recent work by Mendoza and Yue (2011) incorporated a slightly modified version of the default risk model of Eaton and Gersovitz (1981) into an otherwise standard real business cycle model. Their model is successful in replicating the countercyclical spreads and two key stylized facts of emerging market business cycles: countercyclical net exports and consumption variability that exceeds income volatility (but the model underestimates both relative to the data). However, their results crucially depend on the assumption that defaults on public and private foreign obligations occur simultaneously. They assume that government can divert the firms' repayment when it defaults on its own debt so that foreign lenders arbitrage interest rate on sovereign debt and the firms' working capital loans. Moreover, the only source of uncertainty in this model is shocks to the stationary component of total factor productivity. Aguiar and Gopinath (2006) in a quantitative model of sovereign default based on the classic setup of Eaton and Gersovitz (1981) show that the stationary productivity shock is not consistent with countercyclical spreads. They argue that permanent productivity shocks successfully generate the cyclicality of the risk premia seen in the data. However, this model cannot explain the cyclical output dynamics that are critical for their results, as they assume an exogenous output endowment.

Finally, my work is related to the literature studying the role of monetary and exchange rate policies within the context of a small open economy monetary business cycle model with financial frictions. Gertler et al. (2007), Elekdag et al. (2006), Curdia (2007) among others study the role of monetary and exchange rate policy in the presence of financial frictions *ala* Bernanke et al. (1999). The financial shock introduced in these models leads to a sudden stop of capital inflows to an emerging economy. In Gertler et al. (2007) and Elekdag et al. (2006), financial frictions are introduced into the physical capital markets and an exogenous increase in world interest rate causes the sudden stops. In Curdia (2007), similar to the setup employed in this paper, financial frictions apply to the intermediate inputs purchase decisions and the sudden stop is modeled as a change in the perceptions of foreign lenders that brings about an increase in the cost of borrowing.

The remainder of the paper is organized as follows: Section 2 outlines the real business cycle model of an emerging economy with an endogenous default premium through a variant of the financial accelerator model of Bernanke, Gertler, and Gilchrist (1999). Section 3 analyzes empirical regularities of business cycles in Argentina. Section 4 estimates the reduced form financial frictions model as in García-Cicco, Pancrazi, and Uribe (2010) and the frictionless real business cycle model as in Aguiar and Gopinath (2007) for Argentina. The purpose of this section is to evaluate the existing models in the literature in terms of their ability to produce countercyclical interest rates and other stylized facts. Section 5 describes the econometric estimation of the model with microfounded financial frictions using Bayesian methods and Argentine data. Section 6 concludes.

1.2 The Model with Microfounded International Financial Frictions

The model is a canonical small open economy real business cycle model augmented with financial frictions *ala* Bernanke et al. (1999). It consists of households, firms and the foreign sector. The households consume, invest in physical capital (subject to quadratic adjustment cost), and provide labor and capital for the production firms. The households are the shareholders of the firms that have access to the international markets. The domestic goods are produced via constant returns to scale technology that requires labor, capital and intermediate inputs. The firms rent labor and capital from households in a perfectly competitive market. However, it takes one period for the intermediate input to be ready for use in the production process. Therefore, I assume that firms borrow in the international markets from risk neutral foreign lenders to finance the purchase of the intermediate inputs. The mix of intermediate inputs is determined by a standard constant elasticity of substitution aggregator that combines domestically produced intermediate inputs with the imported intermediate inputs. Flowchart of the microfounded financial frictions model is shown in Figure 1.1. Appendix A presents a canonical small open economy real business cycle model and a small open economy real business cycle augmented with reduced form international financial frictions.

1.2.1 Households

The model economy is populated by a continuum of identical consumers. The household's preferences are defined by per capita consumption, C_t, and per capita labor effort, h_t, and are described by the utility function

$$E_0 \sum_{t=0}^{\infty} \beta^t \nu_t U(C_t, h_t), \tag{1.1}$$

where

$$U(C,h) = \frac{\left(C_t - \psi^{-1} X_{t-1} h_t^{\psi}\right)^{1-\sigma} - 1}{1-\sigma}, \tag{1.2}$$

E_t denotes the mathematical expectation operator conditional on information available at time t, $\beta \in (0,1)$ represents a subjective discount factor, the parameter σ is the coefficient of relative risk aversion, and ψ determines the wage elasticity of labor supply, which is given by $1/(\psi$-1). Utility is defined as in Greenwood et al. (1988), which implies non-separability between consumption and leisure. This assumption eliminates the wealth effect on labor supply by making the marginal rate of substitution between consumption and labor independent of consumption. The variable ν_t is an intertemporal preference shock with the law of motion:

$$log(\nu_{t+1}/\nu) = \rho_\nu log(\nu_t/\nu) + \varepsilon_{\nu,t+1}; \;\; \varepsilon_{\nu,t} \sim i.i.d. \;\; N(0, \sigma_\nu^2) \tag{1.3}$$

This intertemporal shock allows us to capture changes in aggregate demand in a simple way. Empirically, it helps the intertemporal euler equation of consumption to fit the data. The household is assumed to own physical capital, K_t, which accumulates according to the following law of motion

$$I_t \;\; = \;\; K_{t+1} - (1-\delta)K_t, \tag{1.4}$$

where I_t denotes investment and δ is the rate of depreciation of physical capital.

The household's period-by-period budget constraint is given by:

$$C_t + I_t + B_t^d \;\; = \;\; \frac{B_{t+1}^d}{R_t} + W_t h_t + R_{k,t}K_t - \frac{\varphi}{2}\left(\frac{K_{t+1}}{K_t} - \mu_X\right)^2 K_t + \Phi_t^f + \Phi_t^m \tag{1.5}$$

where μ_X is the steady state growth rate of permanent technology shock, X, and investment, I_t is given in equation (1.4). In each period $t \geq 0$, consumers have access to domestic one period bond, B_{t+1}^d, the net supply of which is zero in equilibrium. The variable R_t denotes the gross real interest rate of this one period domestic bond in period t. W_t is the household's real wage rate; $R_{k,t}$ is the real return on capital, Φ_t^f and Φ_t^m are transfers from the firms producing final goods and intermediate goods in the economy, respectively. The parameter φ introduces the quadratic capital adjustment cost. In addition, consumers are subject to a borrowing constraint that prevents them from engaging in Ponzi financing.

Consumers choose contingent plans $\left\{C_t, h_t, B_{t+1}^d, K_{t+1}\right\}$ to maximize 1.1 subject to capital accumulation equation, (1.4), their budget constraint, (1.5), and the no-Ponzi-game constraint, taking as given the processes $W_t, R_{k,t}, R_t, X_t$ and the initial conditions D_0, K_0. I let the multiplier on the budget constraint (1.5) be $\lambda_t X_{t-1}^{-\sigma}$. [3]

1.2.2 Firms

Final Goods Production Firms

Firms operate as price takers in a competitive market. They hire labor, h_t^f, and rent capital, K_t from households and purchase intermediate goods, M_t, that are required for production but take one period to be processed and used. Figure 1.2 summarizes the timing of the events. The sequence of events for the firm's problem is presented in detail in Appendix C.

The production technology takes the form:

$$Y_t^i \quad = \quad A_t \left[K_t^i\right]^{\alpha} \left[X_t h_t^{f,i}\right]^{\gamma} \left[\omega_t^i M_{t-1}^i\right]^{\eta} \tag{1.6}$$

where A_t is a stationary shock to total factor productivity following the AR(1) processes

$$log(A_{t+1}/A) \quad = \quad \rho_a log(A_t/A) + \varepsilon_{a,t+1}; \;\; \varepsilon_{a,t} \sim i.i.d. \;\; N(0, \sigma_a^2) \tag{1.7}$$

[3]First order conditions for household's optimization problem is presented in Appendix B.

The productivity shock X_t is nonstationary. Let

$$\mu_{X,t} = \frac{X_t}{X_{t-1}}$$

denote the gross growth rate of X_t. I assume that the logarithm of $\mu_{X,t}$ follows a first-order autoregressive process of the form

$$log(\mu_{X,t+1}/\mu_X) \;=\; \rho_\mu log(\mu_{X,t}/\mu_X) + \varepsilon_{\mu_X,t+1};\;\; \varepsilon_{\mu_X,t} \sim i.i.d.\;\; N(0, \sigma^2_{\mu_X}) \quad (1.8)$$

In addition, I assume that the purchased intermediate goods are shifted by a productivity shock, ω^i_t that is i.i.d. across firms and time. The shock is assumed to be lognormally distributed with cumulative density function $F(\omega)$ and parameters $\mu_{\omega,t}$ and $\sigma_{\omega,t}$ such that $E_{t-1}[\omega^i_t] = 1$ for all t. Therefore:

$$E_{t-1}\omega_t = e^{\mu_{\omega,t}+\frac{1}{2}\sigma^2_{\omega,t}} = 1 \;\Rightarrow \mu_{\omega,t} = -\frac{1}{2}\sigma^2_{\omega,t}$$

The evolution of the standard deviation is such that

$$log(\sigma_{\omega,t}/\sigma_\omega) \;=\; \rho_{\sigma_\omega} log(\sigma_{\omega,t-1}/\sigma_\omega) + \varepsilon_{\sigma_\omega,t};\;\; \varepsilon_{\sigma_\omega,t} \sim i.i.d.\;\; N(0, \sigma^2_{\sigma_\omega}) \quad (1.9)$$

The t subscript indicates that $\sigma_{\omega,t}$ is itself the realization of a random variable. I assume that technology is subject to constant returns to scale, $\alpha + \gamma + \eta = 1$. Firms produce a (tradable) good sold at a world-determined price (normalized to unity without loss of generality).[4]

[4] I assume that idiosyncratic shock is following a mean preserving spread distribution as in Dorofeenko et al. (2008). Moreover, idiosycratic productivity shock enters the production function with a power η. This assumption is desirable to make the model homogeneous in the term $R_{m,t+1}p_{m,t}M_t$ where $R_{m,,t+1}$ is the aggregate rate of return on intermediate goods (see the proof in Appendix D for the desirability of this assumption).

Labor and Capital Demand Schedules

At time t, the firm chooses labor and capital to maximize profits conditional on $(A_t, \mu_{x,t}, \nu_t, \omega_t^i)$, given the available intermediate goods purchased in the previous period, M_{t-1}^i. Accordingly, labor and capital demand satisfies

$$\gamma \frac{Y_t^i}{h_t^{f,i}} = W_t \quad (1.10)$$

$$\alpha \frac{Y_t^i}{K_t^i} = R_{k,t} \quad (1.11)$$

Intermediate Input Purchase Decision and Standard Debt Contract

Next, I consider the intermediate input purchase decision. At the end of the period t, firms which are solvent, or newly created to replace insolvent firms, purchase intermediate inputs which can be used in the subsequent period $t+1$ to produce output. The quantity of intermediate input purchased is denoted by M_t^i with the subscript denoting the period in which the intermediate input is purchased. The firm finances the purchase of the intermediate input partly with its own net worth available at the end of period t, N_t^i, and partly by borrowing from risk neutral foreign lenders, B_t^i. Then, the intermediate input financing constraint takes the form:

$$p_{m,t} M_t^i = N_t^i + B_t^i \quad (1.12)$$

where $p_{m,t}$ denotes the price of the intermediate good. The firms' demand for intermediate input depends on the expected marginal return and the expected marginal financing cost. The return to intermediate input is sensitive to both aggregate and idiosyncratic risk. The (gross) marginal return to intermediate input for firm i is the next period's ex-post output net of labor and capital costs, normalized by the period t market value of the intermediate input:

$$R^i_{m,t+1} = \frac{Y^i_{t+1} - W_{t+1}h^{f,i}_{t+1} - R_{k,t+1}K^i_{t+1}}{p_{m,t}M^i_t} \tag{1.13}$$
$$= \frac{Y^i_{t+1} - \gamma Y^i_{t+1} - \alpha Y^i_{t+1}}{p_{m,t}M^i_t} \tag{1.14}$$
$$= \frac{\eta Y^i_{t+1}}{p_{m,t}M^i_t} \tag{1.15}$$

Given the constant returns to scale assumption for the production function, the return on intermediate inputs can be expressed as

$$R^i_{m,t+1} = \omega^i_{t+1}\left(\frac{\eta\left(\frac{\gamma}{W_{t+1}}\right)^{\frac{\gamma}{\eta}}\left(\frac{\alpha}{R_{k,t+1}}\right)^{\frac{\alpha}{\eta}}}{p_{m,t}}\right) \equiv \omega^i_{t+1}R_{m,t+1} \tag{1.16}$$

where $R_{m,t+1}$ is the aggregate component of the return on the investment in intermediate inputs. (Proved in the Appendix D.)

Since $E_t[\omega^i_{t+1}] = 1$ for all $t \geq 0$ (the mean of ω^i_{t+1} across firms is unity), I can express the expected marginal return simply as

$$\begin{aligned} E_t\left\{R^i_{m,t+1}\right\} &= E_t\left\{\omega^i_{t+1}R_{m,t+1}\right\} \\ &= E_t\{\omega^i_{t+1}\}E_t\left\{R_{m,t+1}\right\} \\ &= E_t\left\{R_{m,t+1}\right\} \end{aligned}$$

The marginal cost of the intermediate input, on the other hand, depends on financial conditions. The idiosyncratic shock ω^i_{t+1} is private information for the firm, implying that a risk neutral foreign lender cannot freely observe the gross output. The risk free opportunity cost for the foreigner lenders is the international real interest rate, R_t^*. However, due to the uncertain productivity of the firms, implying risk for the creditors, a risk premium is charged to the firms on their debt. The foreign lenders are risk neutral. Following Bernanke et al. (1999), the problem is set as one of costly state verification. This implies that, in order to verify the realized idiosyncratic return, the lender has to pay a cost, consisting of a fraction of those returns, so that the total cost of verification is $\mu\omega_{t+1}^i R_{m,t+1} p_{m,t} M_t^i$ where μ is the real monitoring cost.[5]

The firm chooses intermediate input, M_t^i, and the associated level of borrowing, B_t^i, prior to the realization of the idiosyncratic and aggregate productivity shocks, $(A_{t+1}, \mu_{x,t+1}, \nu_{t+1}, \omega_{t+1}^i)$ but after the realization of the standard deviation shock, $\sigma_{\omega,t}$, which is affecting the distribution of idiosyncratic productivity shock, $F(\omega_{t+1}^i; \sigma_{\omega,t})$; hence, the external finance premium paid at time $t+1$. The firm with an idiosyncratic productivity shock, ω_{t+1}^i, above an endogenously determined default threshold value, $\bar{\omega}_{t+1}^i$, pays a gross interest rate, $R_{B,t}^i$, on their loans. The default threshold is set to a level of returns that is just enough to fulfill the debt contract obligations:

$$\bar{\omega}_{t+1}^i R_{m,t+1} p_{m,t} M_t^i = R_{B,t}^i B_t^i \tag{1.17}$$

Given the constant returns to scale assumption, the cutoff value $\bar{\omega}_{t+1}^i$ determines

[5] If there was no costly state verification problem, say ω_{t+1}^i is common knowledge, the total cost of funding would be equal to the amount of borrowing multiplied by the (gross) interest paid on the funds borrowed, $R_t B_t$. Neumeyer and Perri (2005) assume that a large mass of international investors is willing to lend to the emerging economy any amount at a rate R_t. Loans to the domestic economy are risky assets because they assume that there can be default on payments to foreigners. But their model does not provide microfoundations to explain the default decision; hence, the sources of high and time varying risk premium seen in the data. They rather assume that private domestic lenders always pay their obligation in full but in each period there is a probability that the local government will confiscate all the interest payments going from local borrowers to the foreign lenders.

the division of gross earnings from investing in intermediate inputs, $R_{m,t+1}p_{m,t}M_t^i$, between borrower and lender. If the idiosyncratic shock is greater than or equal to the default threshold, $\bar{\omega}_{t+1}^i$, i.e., the firm is solvent, the firm repays the loan and collects the remainder of the profits, equal to $(\omega_{t+1}^i - \bar{\omega}_{t+1}^i)R_{m,t+1}p_{m,t}M_t^i$. This means that if the firm does not default, a lender receives a fixed payment independent of ω_{t+1}^i. Otherwise, the firm defaults and the foreign lender receives nothing and pays the auditing cost, μ and collects everything there is to collect, $(1-\mu)\omega_{t+1}^i R_{m,t+1}p_{m,t}M_t^i$. I define $\Upsilon(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})$ as the expected gross share of the aggregate component of earnings retained by the firm and define $\Gamma(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})$ as the expected gross share of aggregate component of earnings going to the lender:

$$\Upsilon(\bar{\omega}_{t+1}^i;\sigma_{\omega,t}) \equiv \int_{\bar{\omega}_{t+1}^i}^{\infty} (\omega_{t+1}^i - \bar{\omega}_{t+1}^i) dF(\omega_{t+1}^i;\sigma_{\omega,t}) \tag{1.18}$$

$$\Gamma(\bar{\omega}_{t+1}^i;\sigma_{\omega,t}) \equiv \int_0^{\bar{\omega}_{t+1}^i} \omega_{t+1}^i dF(\omega_{t+1}^i;\sigma_{\omega,t}) + \int_{\bar{\omega}_{t+1}^i}^{\infty} \bar{\omega}_{t+1}^i dF(\omega_{t+1}^i;\sigma_{\omega,t}) \tag{1.19}$$

$$\equiv \int_0^{\bar{\omega}_{t+1}^i} \omega_{t+1}^i dF(\omega_{t+1}^i;\sigma_{\omega,t}) + \left[1 - \int_0^{\bar{\omega}_{t+1}^i} dF(\omega_{t+1}^i;\sigma_{\omega,t})\right] \bar{\omega}_{t+1}^i \tag{1.20}$$

$$\equiv \int_0^{\bar{\omega}_{t+1}^i} \omega_{t+1}^i dF(\omega_{t+1}^i;\sigma_{\omega,t}) + \left[1 - F(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})\right] \bar{\omega}_{t+1}^i \tag{1.21}$$

where $F_t(.)$ denotes the time varying cumulative density function of ω_{t+1}^i and $F(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})$

is the probability of default. Because $E_t[\omega^i_{t+1}] = 1$, I have that

$$\Upsilon(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) + \Gamma(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) \equiv 1$$

Rearranging the above given expression, I have

$$\Upsilon(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) \equiv 1 - \Gamma(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) \tag{1.22}$$

where $0 < \Gamma(\bar{\omega}^i_t; \sigma_{\omega,t-1}) < 1$.

The values of $\bar{\omega}^i_{t+1}$ and $R^i_{B,t}$ under the standard debt contract are determined by the requirement that risk neutral foreign lenders' expected income flow in $t+1$ is zero for each loan amount.[6]

Accordingly, the loan contract must satisfy the zero profit condition of the foreign lender:

$$E_t \left\{ \left[1 - F(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})\right] R^i_{B,t} B^i_t + (1-\mu) \int_0^{\bar{\omega}^i_{t+1}} \omega^i_{t+1} dF(\omega^i_{t+1}; \sigma_{\omega,t}) R_{m,t+1} p_{m,t} M_t \right\} = R^*_t B^i_t$$

where $\left[1 - F(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})\right]$ is one minus the probability of the default for the firm (i.e., the survival probability of the firm), R^*_t is the financial investors' return from investing in risk-free financial instruments.

Combining the balance sheet identity, equation (1.12), the equation defining the expected gross share of aggregate component of earnings going to the lender, (1.21), with the zero profit condition of the foreign lender given above yields the following expression:[7]

[6]Standard debt contract necessitates that the default threshold, $\bar{\omega}_{t+1}$ is state contingent but the contractual interest, $R_{B,t}$ is not.

[7]As discussed by BGG, $\Omega(.)$ is increasing in $\bar{\omega}_{t+1}$ given the log-normality assumption. Moreover, given the mean preserving increase in the uncertainty assumption, $\Omega(.)$ is decreasing in $\sigma_{\omega,t}$.

$$E_t\left\{\Omega(\bar{\omega}^i_{t+1};\sigma_{\omega,t})R_{m,t+1}p_{m,t}M_t\right\} = R^*_t B^i_t \tag{1.23}$$

where

$$\Omega(\bar{\omega}^i_{t+1};\sigma_{\omega,t}) \equiv \Gamma(\bar{\omega}^i_{t+1};\sigma_{\omega,t}) - \mu G(\bar{\omega}^i_{t+1};\sigma_{\omega,t}) \tag{1.24}$$

and

$$G(\bar{\omega}^i_{t+1},\sigma_{\omega,t}) \equiv \int_0^{\bar{\omega}^i_{t+1}} \omega^i_{t+1} dF(\omega^i_{t+1};\sigma_{\omega,t}) \tag{1.25}$$

Firms, after paying for labor and capital inputs, distribute the remaining output to households, as they are the owners of the firms. Real dividends distributed to households are given by the following expression:

$$\Phi^{f,i}_{t+1} = Y^i_{t+1} - W_{t+1}h^{f,i}_{t+1} - R_{k,t+1}K^i_{t+1} - R^i_{B,t}B^i_t - N^i_{t+1} \tag{1.26}$$

Using the constant returns to scale assumption, I can write dividends as the following:[8]

$$\Phi^{f,i}_{t+1} = \omega^i_{t+1}R_{m,t+1}p_{m,t}M^i_t - R^i_{B,t}B^i_t - N^i_{t+1} \tag{1.27}$$

Rearranging equation (1.27) by using the definition of the default threshold, (1.17),

[8]Under the constant returns to scale assumption, I have the following relationship between the output and production factors: $Y^i_{t+1} = W_{t+1}h^i_{t+1} + R_{k,t+1}K^i_{t+1} + \omega^i_{t+1}R_{m,t+1}p_{m,t}M^i_t$

I get the following expression for real dividends distributed to households:

$$\Phi_{t+1}^{f,i} = \left[\int_{\bar{\omega}_{t+1}^i}^{\infty} (\omega_{t+1}^i - \bar{\omega}_{t+1}^i) dF(\omega_{t+1}^i; \sigma_{\omega,t})\right] R_{m,t+1} p_{m,t} M_t^i - N_{t+1}^i \quad (1.28)$$

$$= \left[1 - \Gamma(\bar{\omega}_{t+1}^i; \sigma_{\omega,t})\right] R_{m,t+1} p_{m,t} M_t^i - N_{t+1}^i \quad (1.29)$$

Given the standard debt contract, the expected dividends to be distributed to households may be expressed as

$$E_t \Phi_{t+1}^{f,i} = E_t \left\{ \left[1 - \Gamma(\bar{\omega}_{t+1}^i; \sigma_{\omega,t})\right] R_{m,t+1} p_{m,t} M_t^i - N_{t+1}^i \right\} \quad (1.30)$$

The formal investment and contracting problem then reduces to choosing M_t^i and a schedule for $\bar{\omega}_{t+1}^i$ (as a function of realized values of $R_{m,t+1}$) to maximize equation (1.30) subject to the participation constraint of the foreign lender, equation (1.23).

After the firm has chosen M_t^i and $\bar{\omega}_{t+1}^i$, the firm's net worth, N_t^i is determined. I assume that a new firm is immediately created for the insolvent firm with a level of net worth, N_t^i, which is the only variable characterizing the firm at time t.

Formally, the problem of the firm at the end of time t is then given as follows:

$$\max_{\{M_t^i, \bar{\omega}_{t+1}^i, R_{B,t}^i, N_t^i\}} \Lambda_t \Phi_t^{f,i} + \beta E_t \Lambda_{t+1} \Phi_{t+1}^{f,i} \quad (1.31)$$

subject to the participation constraint of the foreign lenders, equation (1.23) and the default threshold definition, equation (1.17), with respect to M_t^i, $\bar{\omega}_{t+1}^i$, $R_{B,t}^i$ and N_t^i.[9]

I eliminate the second constraint by substituting the default threshold by $\bar{\omega}_t^i = \frac{R_{B,t-1}^i (p_{m,t-1} M_{t-1}^i - N_{t-1}^i)}{R_{m,t} p_{m,t-1} M_{t-1}^i}$. I denote the lagrange multiplier for the participation constraint of the lender, equation (1.23), as φ_t^i. The appropriate discount factor is given

[9] Expected dividend for the surviving firms is $\Phi_t^{f,i} = (\omega_t^i - \bar{\omega}_t^i) R_{m,t} p_{m,t-1} M_{t-1}^i - N_t^i$ and for the newly created firms it is given by $\Phi_t^{f,i} = -N_t^i$

by Λ_t where $\Lambda_t = \lambda_t X_{t-1}^{-\sigma}$ is the lagrange multiplier associated with the households' budget constraint, equation (A.2). The firm's problem is discussed in detail in the Appendix E.

Firms' optimal decision rules are given by the following three equations:

$$E_t\lambda_{t+1}\frac{R_{m,t+1}}{R_t^*}\left[1-\Gamma(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})\right] = E_t\lambda_{t+1}\rho(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})\frac{N_t}{p_{m,t}M_t^i} \quad (1.32)$$

$$\frac{R_t}{R_t^*}E_t\lambda_{t+1} = E_t\lambda_{t+1}\rho(\bar{\omega}_{t+1}^i,\sigma_{\omega,t}) \quad (1.33)$$

$$E_t\Omega(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})\frac{R_{m,t+1}}{R_t^*}p_{m,t}M_t^i = [p_{m,t}M_t^i - N_t^i] \quad (1.34)$$

where $\rho(\bar{\omega}_{t+1};\sigma_{\omega,t}) = \frac{(1-F(\bar{\omega}_{t+1};\sigma_{\omega,t}))}{(1-F(\bar{\omega}_{t+1};\sigma_{\omega,t})-\mu\bar{\omega}_{t+1}F_{\bar{\omega}}(\bar{\omega}_{t+1};\sigma_{\omega,t}))}$

(Proved in the Appendix E.)

Equation (1.32) implicity defines a key relationship in the firm sector, linking the price of intermediate inputs to the expected return on investment in those intermediate inputs, relative to the risk free rate, net worth and level of intermediate inputs that is demanded at that price. Therefore, this expression is also written as:

$$p_{m,t}M_t = \frac{E_t\rho(\bar{\omega}_{t+1},\sigma_{\omega,t+1})}{E_t\frac{R_{m,t+1}}{R_t^*}(1-\Gamma(\bar{\omega}_{t+1},\sigma_{\omega,t+1}))}N_t = \chi\left(\frac{R_{m,t+1}}{R_t^*},\bar{\omega}_{t+1},\sigma_{\omega,t+1}\right)N_t$$

which relates purchases of intermediate inputs to the level of net worth and the external finance premium, $R_{m,t+1}/R_t^*$.

The equation characterizing the evolution of net worth, equation (1.33), takes the form of a usual uncovered interest parity relationship linking domestic and foreign interest rates, added by a risk premium term, $\rho(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})$. The last equation, equation (1.34), is the participation constraint of the foreign lender.

Intermediate Goods Production Firms

I assume that intermediate goods are produced by a separate sector in a competitive market. Total intermediate good is assumed to be given by a CES aggregate of domestic and imported intermediate goods (M_t^H and M_t^F, respectively):

$$M_t = \left[\nu^{\frac{1}{\rho i}}(M_t^H)^{\frac{\rho i-1}{\rho i}} + (1-\nu)^{\frac{1}{\rho i}}(M_t^F)^{\frac{\rho i-1}{\rho i}}\right]^{\frac{\rho i}{\rho i-1}} \tag{1.35}$$

where ρi is the elasticity of substitution between domestic and imported intermediate goods. The relative price of domestic intermediate input, p_t^H is taken as given by the intermediate good producers. The world price of imported intermediate inputs, p_t^F, is exogenous and taken as given by the small open economy. The price index for intermediate goods and the breakdown into domestic and foreign components are, respectively, expressed as

$$p_{m,t} = \left(\nu(p_t^H)^{1-\rho i} + (1-\nu)(p_t^F)^{1-\rho i}\right)^{\frac{1}{1-\rho i}} \tag{1.36}$$

$$M_t^H = \nu M_t \left(\frac{p_t^H}{p_{m,t}}\right)^{-\rho i} \tag{1.37}$$

$$M_t^F = (1-\nu) M_t \left(\frac{p_t^F}{p_{m,t}}\right)^{-\rho i} \tag{1.38}$$

Domestic intermediate goods are produced by specialized competitive firms owned by households using labor, h_t^m with the following linear production technology: $M_t^H = X_{t-1}h_t^m$. The profit maximization problem gives us the following optimality condition: $p_t^H = W_t/X_{t-1}$.

1.2.3 Market Clearing Conditions

Labor Market: $h_t = h_t^f + h_t^m$

Goods Market Equilibrium:

$$Y_t + p_t^H M_t^H = C_t + I_t + \frac{\varphi}{2}\left(\frac{K_{t+1}}{K_t} - \mu_X\right)^2 K_t + p_{m,t}M_t + NX_t \qquad (1.39)$$

(Proved in the Appendix F)

Balance of Payments:

$$0 = NX_t - \Gamma(\bar{\omega}_{t+1};\sigma_{\omega,t})R_{m,t}p_{m,t-1}M_{t-1} + B_t$$

where NX_t is the net exports, $\Gamma(\bar{\omega}_t, \sigma_{\omega,t-1})R_{m,t-1}p_{m,t-1}M_{t-1}$ denotes the repayment of the debt and its service by the firms; B_t is the total amount of borrowing at time t by the firms.

The complete set of equilibrium conditions in stationary form are presented in Appendix G.

1.3 Business Cycles in Argentina: 1983Q1-2001Q3

I am going to estimate and evaluate the predictions of the model with the endogenous risk premium for Argentina. The reason for choosing Argentina as a case study is two-fold. First, Argentina is one of two countries (the other is Mexico) frequently used in the quantitative real business cycle literature. Since one of the main objectives of this paper is to evaluate the predictions of the model for the interest rates as well as other traditional moments, the use of Argentine data facilitates comparison of the model's results to the existent literature. Second, the interest rate series for Argentina starts in 1983 while for other emerging markets (for example, Mexico) it starts in 1994. I argue that one must use the interest rate data as one of the observables in the estimation to better identify the parameters of the model characterizing the international financial frictions. However, I exclude the post 2001 period from the analysis because Argentina was in default between 2002 and 2005 and was excluded from the international capital markets. Excluding this period is required for the purpose of this study because in my model the firm never loses its access to the international financial markets. Given that one of the objectives of this paper is to join to the discussion of the role of permanent technology shocks in emerging markets, estimating the model between 1983Q1 and 2001Q1 is also desirable because it facilitates the comparison of the model's results with the existent literature which uses quarterly data from 1980s until the beginning of 2000s (see, for example, Aguiar and Gopinath (2007)). Appendix H presents the details of the data used in this chapter and the data source.

Table 1.1 presents second moments and the corresponding GMM estimated standard error for g^Y, g^C, g^I and *tby* and country interest rate. Notably, per-capita consumption growth in Argentina is significantly more volatile than per-capita output growth. Gross investment growth is highly volatile. The trade balance– to-output ratio is about as volatile as output growth. The volatility of the (annualized) interest rates at which Argentina borrowed in the international markets in this period is quite high. The observed correlation between the trade balance-to-output ratio and output growth is negative and significantly different from zero. There is negative co-movement between the country interest rate (and the country risk premium) and output growth. The correlation of the country risk premium with the growth rate of the components of the domestic absorption; i.e, with consumption growth and investment growth is also negative and significantly different from zero. Therefore, this table illustrates that in Argentina, similar to other emerging economies, consumption is more volatile than output; the trade balance to output ratio is strongly countercyclical and the country risk premium is high, volatile, and negatively co-moves with the economic activity.

1.4 Estimation and Evaluation of the Reduced Form Financial Frictions Model

This section estimates and evaluates the performance of a canonical RBC model as in Aguiar and Gopinath (2007) and a reduced form financial frictions model as in Garcia-Cicco et al. (2010), in terms of their ability to match keys moments of Argentine data between 1983Q1-2001Q3. In particular, I investigate the ability of the reduced form financial frictions model to match the statistical properties of the interest rates. To this end, I augment the Garcia-Cicco et al. (2010) model with working capital loans and then estimate the model with and without the country interest rates used as an observable time series in the estimation.

The time unit in the model is meant to be one quarter. Table 1.2 presents the calibrated parameter values. I set the parameter $\bar{d}$ to induce a small steady-state trade balance-to-output ratio of about 0.41 percent, as observed on average in Argentina over the period 1983Q1–2001Q3. The value assigned to the depreciation rate δ implies an average investment ratio of about 17 percent, which is in line with the average value observed in Argentina between 1983Q1–2001Q3. The value assumed for the discount factor β implies a relatively high average real interest rate of 10 percent per annum, which is consistent with the interest rate observed in Argentina over the period 1983Q1–2001Q3. I set the parameter α, which determines the average capital income share, at 0.32, a value commonly used in the related literature. I set $\theta = 2.33$, to ensure that in the steady state households allocate about one-third of their time to market work. The parameter γ, defining the curvature of the period utility function, takes the value 2, which is standard in related business-cycle studies. Finally, ω is calibrated at 1.6, which implies a labor-supply elasticity of 1.7. Gross long-run growth rate of the economy is set to $\mu_X = 1.005$.

I estimate the remaining parameters of the model using Bayesian methods and Argentine data on output growth, consumption growth, investment growth, and the trade balance–to-output ratio over the period 1983Q1–2001Q3. Specifically, I estimate five structural parameters, namely, the four parameters defining the stochastic process of the productivity shocks, σ_A, ρ_A, σ_{μ_X}, and ρ_{μ_X} and the parameter governing the degree of capital adjustment costs, ϕ. I also estimate four nonstructural parameters representing the standard deviations of i.i.d. measurement errors on the observables. Table 1.3 presents key statistics of the prior and posterior distributions when the model is estimated with exactly same four time series used in Garcia-Cicco et al. (2010). Table 1.4 presents key statistics when the model is estimated with 5 observables including the country interest rate data into the observable set.

Table 1.5 displays second moments predicted by the model with reduced form financial frictions. The table shows that both RBC model augmented with trend shock and reduced form financial frictions model perform similarly in explaining observed movements in output and consumption. Reduced form financial frictions model significantly improves along matching the statistical properties of trade-balance-to output ratio. However, both models perform poorly in matching the interest rate process seen in the data. In particular, the interest rate predicted by these models is either acyclical or procyclical while it is countercyclical in the data.

Finally, Table 1.6 presents the variance decomposition predicted by the model with frictionless RBC and financial frictions. The most remarkable result that emerges from this exercise is that there is significant disagreement in the literature regarding the contribution of nonstationary productivity shocks to business cycles. In a frictionless model, nonstationary technology shock is the main source of aggregate fluctuations. In response to a positive and persistent shock to productivity growth, current output increases on impact and is expected to continue to grow in the future. This increasing profile for future expected income levels induces households to consume beyond the increase in current output by increasing the debt they obtain from foreign lenders. This result in countercyclical trade balance-to-output ratio and higher consumption volatility relative to income volatility. However, estimated frictionless model implies excessive volatility of trade balance- to-output ratio.

With reduced form financial frictions and the neglecting of the information on the country risk premium, the data assigns a negligible role to the nonstationary technology shock. Its role is replaced by the stationary technology shock, the consumption preferences shock and the exogenous country risk premium shock. When the economy is hit by a higher consumption preference shock, everyone suddenly wants to consume more, which is partly financed by borrowing in the international markets. A higher demand for funds will in turn lead to a higher interest rates. The exogenous increase in the country risk premium will lead to a higher country interest rate by assumption in the reduced form financial frictions model. Once the model is forced to use information on country risk premium, much of the explanatory power of the consumption preference shock and the country risk premium shock is lost. The estimated standard deviation and the serial correlation of the stationary technology shock also decrease. The role of the nonstationary technology shock increases so that the consumption euler equation fits the data better. However, the estimated reduced form financial frictions model predicts acyclical or procyclical country interest rate.

In the next section, I will show that the endogenous risk premium model proposed in this paper (with country interest rate data used in the estimation) predicts that part of the role of the nonstationary shock in the frictionless model is taken up by the time varying uncertainty shock and the model successfully accounts for the interest rate cyclicality seen in the data.

The reduced form financial frictions model in this paper is estimated using quarterly Argentine data. However, Garcia-Cicco et al. (2010) argue that a drawback of existing studies is the use of short samples to identify permanent shifts in productivity. In order to overcome this difficulty, they used more than one century of Argentine data to estimate the structural parameters of a small-open economy real business cycle model. I showed in the Appendix I that the inclusion of country interest rate data into their set of observables in the empirical analysis modifies inferences. To be more specific, the nonstationary technology becomes more important.

1.5 Estimation and Evaluation of the Model with Microfounded Financial Frictions

The time unit in the model is meant to be one quarter. I assign values to the structural parameters using a combination of calibration and econometric estimation techniques. Table 1.7 presents the calibrated parameter values. The risk aversion parameter is set to 2 and the quarterly world risk-free interest rate R^* is set to 1 percent, which are standard values in quantitative business cycle studies. The curvature of labor disutility in the utility function is set to $\psi = 1.6$, which implies a Frisch wage elasticity of labor supply of $1/(\psi - 1) = 1.7$. This is the value frequently used in calibrated versions of small open economy models (e.g. Mendoza (1991) and

Schmitt-Grohe and Uribe (2003)).

The share of intermediate goods in gross output M is set to 0.43, which corresponds to the average ratio of intermediate goods to gross production calculated using annual data for Argentina for the period 1993-2005 from the United Nations database. Given M, I set $\alpha = 0.17$ so that the capital income share in value added of the final goods sector matches the standard 30 percent. These factor shares imply a labor share in gross output of final goods $\gamma = 0.40$, which yields a labor share in value added of 0.7 in line with the standard 70 percent labor share. I assume linear production technology using only labor in the production of domestic intermediate goods. The values ν and ρi as well as factor income shares are taken from Mendoza and Yue (2011).

For the risk premium, I used EMBI+ spread for Argentina calculated by J.P. Morgan after 1994 and I used country spread data constructed by Neumeyer and Perri (2005) before 1994. The average spread on public sector debt is about 10 percent annually and the private sector pays an average spread of 7 percent annually in Argentina. The case of Argentina is exceptional in the sense that the effective financing cost of firms is lower on average than the sovereign interest rates (see Figure 1.3).[10]The assumptions on the foreign interest rate, the steady state growth rate and risk premium imply that the value of the discount factor is about 0.975. In order to calibrate the financial frictions of the economy, the steady state leverage ratio of the Argentine firms, d, is set to 47 percent. Using firm level data set with annual balance sheet information for Argentine firms, I report a median debt-to-assets ratio of 47 percent for firms in Argentina (see Figure 1.4). The values for μ and $\sigma_{\omega,ss}$, important parameters characterizing the financial frictions in the economy, are obtained in the

[10]Mendoza and Yue (2011) compare these numbers for 15 emerging markets and report that except Argentina, China and Russia, the effective financing cost of firms is higher on average than the sovereign interest rates.

process of calibrating the leverage ratio, the country spread and a firm-level debt. The implied values are 0.075 for μ and 0.45 for $\sigma_{\omega,ss}$.

I estimate the remaining parameters of the model using Bayesian methods and Argentinean data on output growth, consumption growth, investment growth, the trade balance–to-output ratio, the country risk premium and the world interest rate data over the period 1983Q1–2001Q3. Specifically, I estimate twelve parameters defining the stochastic process of the shocks, and the parameter governing the degree of capital adjustment costs, ϕ. I also estimate five nonstructural parameters representing the standard deviations of i.i.d. measurement errors on the observables. Measurement errors are permitted to absorb no more than 25 percent of the standard deviation of the corresponding observable time series. I assume that there is no measurement error associated with the world interest rate series.

1.5.1 Evaluating Model Fit

As it is difficult to quantify prior beliefs for the shock processes, I selected the priors for the autocorrelation and standard deviation of the exogenous shocks with the following criteria in mind. First, all standard deviations of the innovations to the shock processes are assumed to follow an inverse-gamma distribution with five degrees of freedom. For autocorrelation parameters, I adopt beta distributions which have a mean equal to 0.5 and a standard deviation of 0.2. These priors allow for a quite dispersed range of values. Table 1.8 presents key statistics of the prior and posterior distributions, along with the 5 percent and 95 percent intervals. I highlight the following features: First, when the posterior distributions are compared with the prior distributions, it is evident that all parameters of the model, except for those related to the stochastic process for the government spending shock, are well identified. In particular, the posterior distributions of the parameters σ_{μ_X} and ρ_{μ_X} defining the nonstationary productivity shock are quite tight, with 95 percent probability intervals of (0.028, 0.047) and (0.14, 0.32), respectively. Second, the median of σ_{μ_X} takes the value 0.035 while the median of the standard deviation of nonstationary technology shocks, σ_a is 0.011. As will be evident when I present the variance decomposition results, this suggests that the role of trend shocks is more pronounced under the present specification. Third, the estimated volatility of the time varying uncertainty shocks, σ_{σ_ω}, is quite high in Argentina and the shock is very persistent.

Table 1.9 displays second moments predicted by the model with endogenous financial frictions. To facilitate comparison, the table reproduces some of the empirical counterparts from Table 1.1. The table shows that the model with endogenous default risk successfully generate countercyclical interest rates and key business cycle moments. The model also predicts that the country risk premium negatively co-moves with the growth rate of the components of domestic absorption. The correlation between the growth rate of consumption and the country risk premium is -0.21 in the data and the model implied model is -0.22. The model also does remarkable job in matching the negative correlation between the investment growth and the country risk premium. The model captures the fact that in Argentina over the period 1983Q1-2001Q3, as in most other developing countries, consumption growth is more volatile than output growth and trade balance -to output ratio is countercyclical.

Table 1.10 presents the variance decomposition predicted by the model with financial frictions. I want to highlight four important results regarding the sources of macroeconomic fluctuations in emerging markets. First, time varying uncertainty in the firm specific productivity explains more than 65 percent of the variances of the trade balance and of the country risk premium. However, its contribution to output and consumption volatility is limited while its contribution to investment volatility is sizable. It explains about 9 percent of the output fluctuations and more than 40 percent of the fluctuations in investment.

Second, the predicted contribution of nonstationary productivity shocks to explaining output variations falls between the high estimate (80 percent) reported by Aguiar and Gopinath (2007) and the low estimate (5 percent) reported by Garcia-Cicco et al. (2010). Unlike Garcia-Cicco et al. (2010), shocks to nonstationary productivity are well identified in this model. Therefore, I argue that introducing microfounded financial frictions and disciplining the estimation with the data on country risk premium significantly helps the model to identify between trend and stationary technology shocks. Third, preference shocks identified in Garcia-Cicco et al. (2010) as the significant source of fluctuations for consumption have very small impact on consumption as well as other macroeconomic variables. The endogenous nature of the country risk premium accompanied with shocks to trend productivity are sufficient for the model to match the consumption process seen in the data. Disturbances in productivity, whether permanent or temporary, contribute to the explanation of the country risk premium in this economy. Finally, I find that domestic spending shocks and world interest rate shocks are estimated to have a negligible role in explaining business cycles in Argentina.

1.5.2 Uncertainty Shocks

Before presenting the responses of the model variables to a shock in uncertainty it will be useful to discuss briefly how an exogenous increase in the cross-sectional dispersion affect financial variables in partial equilibrium. Figure 1.5 shows the effect 20 percent increase in standard deviation of the cross-sectional dispersion of firm specific productivity. The uncertainty shock in this paper is is a mean-preserving shift in the cross-sectional dispersion of firm's returns. Being idiosyncratic, it is diversable from the perspective of foreign lenders. After a positive shock to time varying uncertainty, foreign lenders, other things equal, bears the cost of more bankruptcies, as a fatter left tail of firm's returns falls below the solvency threshold, but does not participate in the higher returns of those borrowers on the (fatter) right tail. Therefore, if the threshold level of firm specific productivity was unchanged, there would be more firms with productivity below the threshold level. Since the distribution of idiosyncratic shock is known at the time the debt contract is made, foreign lenders now understand that there will be fewer firms who will be able pay their debts. Since the lenders should be compensated for the increase in the associated expected monitoring costs, this in turn induces a higher equilibrium level of premium. The threshold level of productivity is endogenous though, and the general equilibrium effect of an exogenous increase is quantitative in nature.

Figure 1.6 plots the impulse response of selected macroeconomic variables in the model to a one standard deviation shock to uncertainty. The transmission mechanism of the shock, as shown by those figures, can be broadly described as follows. Increase in the standard deviation of the idiosyncratic productivity of the firm will lead them to expect higher premium in the future. It is due to the fact that the premium that will be applied at time t+1 is backwardly indexed to the value of the standard deviation of the shock realized today, at t. Upon the higher cost of borrowing firms will reduce the amount of debt they are obtaining. In addition to that firms will also reduce the amount of intermediate inputs used in the production because they are now more expensive to finance. In order to reduce their leverage firms have to reduce the dividend distributed to the households. This leads them to reduce consumption expenditure. Investment also falls through a nonarbitrage condition between the returns to physical capital and to investing in the stocks of the firm. Decrease in households' demand for domestic goods leads firms to reduce their demand for labor, which in turn lead to lower real wages. Lower wages contributes to a decrease in households' demand for domestic goods. As a result output contracts in the economy. In sum, in response to unexpected shock to uncertainty, both higher cost effect (financing intermediate inputs are more costly now) and lower demand effect (through lower dividends and lower wages) contribute to the decline in the output in the economy. Since the risk premium is endogenous in this model, the lower output feeds onto higher risk premium and countercyclical country risk premium emerges in the model economy.

1.6 Conclusion

This paper proposes and estimates a dynamic equilibrium model of an emerging economy with endogenous default risk premia. Default risk premia arise from financial frictions in firms' access to international markets. I show that its quantitative predictions are in line with observed empirical regularities in emerging markets: the model predicts high, volatile and countercyclical country risk premia; excessive volatility of consumption relative to output and strong countercyclicality of the trade balance to output ratio. This result is a significant improvement over the current empirical models of emerging market business cycles, as the interest rate predicted by these models is either acyclical or procyclical.

I investigate the sources of business cycle fluctuations in emerging economies using the estimated model. I find that shocks to nonstationary component of the productivity explain a 50 percent of the unconditional variances of output and consumption, which fall between the number presented in Aguiar and Gopinath (2007) (80 percent) and in Garcia-Cicco et al. (2010) (5 percent). Time varying uncertainty in the firm specific productivity explains more than 65 per cent of the variance of trade balance-to-output ratio and country risk premium. Finally, the model predicts that approximately 30 percent of fluctuations in the borrowing spread is explained by domestic macroeconomic shocks.

Table 1.1: Argentina 1983Q1-2001Q3: Summary Statistics

Statistics	g^Y	g^C	g^I	tby	$Premium$	R
Standard Deviation	2.72	3.13	6.03	2.6	4.43	5.38
	(0.42)	(0.47)	(0.78)	(0.26)	(0.72)	(0.7)
Correlation with g^Y	1.00	0.94	0.86	-0.18	-0.25	-0.25
	-	(0.008)	(0.03)	(0.07)	(0.08)	(0.08)
Correlation with tby	-0.18	-0.15	-0.24	1.00	0.90	0.90
	(0.07)	(0.07)	(0.08)	-	(0.02)	(0.02)
Correlation with $Premium$	-0.25	-0.21	-0.32	0.86	1.00	0.97
	(0.08)	(0.07)	(0.09)	(0.04)	-	(0.02)
Correlation with R	-0.25	-0.20	-0.35	0.90	0.97	1.00
	(0.08)	(0.08)	(0.09)	(0.02)	(0.02)	-
Serial Correlation	0.10	0.18	0.39	0.95	0.90	0.93
	(0.12)	(0.12)	(0.09)	(0.008)	(0.02)	(0.01)

Notes: g^Y, g^C, g^I and tby denote the growth rates of output per capita, consumption per capita, and investment per capita, respectively, and tby denotes the trade balance-to-output ratio. Premium is the country premium faced by Argentina in the international financial markets. R is the real interest rate for Argentina. I constructed the real interest rate for Argentina as the sum of the country risk premium, Premium, and the risk-free U.S. real interest rate (see Schmitt-Grohe and Uribe (2011) for details). Except for tby, all variables are measured in logs. Interest rates (annualized) are measured as the log of the gross interest rate. GMM standard errors are shown in parenthesis.

Table 1.2: Calibration for Reduced Form Financial Frictions Model

Parameter	γ	δ	α	ψ	ω	θ	β	d
Value	2	0.05	0.32	0.001	1.6	2.33	0.975	0.1

Table 1.3: Prior and Posterior Distributions - Reduced Form Financial Frictions Model (w/ 4 Observables)

	Prior Distribution			Posterior Distribution								
				RBC Model			Reduced Form Financial Frictions Model					
							w/o working capital			w/ working capital		
Parameter	Prior	Mean	Stdev	Median	5%	95%	Median	5%	95%	Median	5%	95%
σ_{μ_X}	IG	0.010	0.015	0.0207	0.0167	0.0250	0.004	0.002	0.008	0.0041	0.0015	0.0081
ρ_{μ_X}	B	0.5	0.2	0.675	0.63	0.71	0.56	0.21	0.85	0.58	0.23	0.86
σ_A	IG	0.010	0.015	0.0066	0.005	0.009	0.0151	0.0126	0.0178	0.0145	0.012	0.017
ρ_A	B	0.5	0.2	0.87	0.82	0.94	0.96	0.93	0.984	0.961	0.93	0.99
ϕ	G	5	5	9.61	7.2	12.2	8.93	6.19	11.8	8.96	6.75	11.59
σ_ν	IG	0.10	0.15	-	-	-	0.075	0.0472	0.1209	0.0881	0.06	0.14
ρ_ν	B	0.5	0.2	-	-	-	0.86	0.66	0.98	0.90	0.79	0.97
σ_s	IG	0.010	0.015	-	-	-	0.0064	0.0015	0.0185	0.007	0.002	0.0234
ρ_s	B	0.5	0.2	-	-	-	0.49	0.12	0.87	0.50	0.13	0.85
σ_{μ_R}	IG	0.010	0.015	-	-	-	0.0041	0.0026	0.006	0.0045	0.003	0.006
ρ_{μ_R}	B	0.5	0.2	-	-	-	0.97	0.95	0.99	0.974	0.95	0.99
ψ	IG	0.7	0.7	-	-	-	0.129	0.073	0.207	0.148	0.08	0.23
η	B	0.5	0.1	-	-	-	-	-	-	0.5316	0.35	0.71
Measurement Errors												
$100\sigma_y^{me}$	IG	0.27	0.27	0.17	0.06	0.39	0.31	0.08	0.50	0.28	0.08	0.48
$100\sigma_c^{me}$	IG	0.31	0.31	0.88	0.73	1.05	0.25	0.07	0.52	0.23	0.07	0.47
$100\sigma_i^{me}$	IG	0.60	0.60	2.91	2.67	3.02	1.17	0.21	1.89	0.49	0.13	1.18
$100\sigma_{tby}^{me}$	IG	0.26	0.26	0.12	0.05	0.21	0.18	0.07	0.29	0.22	0.10	1033
Log-marginal likelihood					806.3			798.3			803.0	

Notes: Estimation is based on Argentine data from 1983Q1 to 2001Q3. Posterior statistics are based on a two million MCMC chain from which the first million draws were discarded. For the priors, B, G and IG indicate, respectively, the Beta, Gamma and Inverse Gamma distributions. The Log-Marginal Likelihood was computed using Geweke's modified harmonic mean method.

Table 1.4: Prior and Posterior Distributions - Reduced Form Financial Frictions Model (w/ 5 Observables)

	Prior Distribution			Posterior Distribution					
				Reduced Form Financial Frictions Model					
				w/o working capital			w/ working capital		
Parameter	Prior	Mean	Stdev	Median	5%	95%	Median	5%	95%
σ_{μ_X}	IG	0.010	0.015	0.0152	0.0081	0.0219	0.0163	0.0096	0.0222
ρ_{μ_X}	B	0.5	0.2	0.78	0.67	0.92	0.76	0.65	0.89
σ_A	IG	0.010	0.015	0.0128	0.0084	0.0171	0.0110	0.0072	0.0151
ρ_A	B	0.5	0.2	0.89	0.82	0.95	0.88	0.79	0.94
ϕ	G	5	5	10.94	8.72	14.11	10.89	8.4	13.4
σ_ν	IG	0.10	0.15	0.06	0.03	0.11	0.06	0.032	0.0974
ρ_ν	B	0.5	0.2	0.73	0.37	0.98	0.70	0.36	0.96
σ_s	IG	0.010	0.015	0.0064	0.0016	0.0187	0.0064	0.0015	0.0187
ρ_s	B	0.5	0.2	0.51	0.13	0.87	0.50	0.13	0.88
σ_{μ_R}	IG	0.010	0.015	0.0035	0.0028	0.0044	0.0034	0.0027	0.0043
ρ_{μ_R}	B	0.5	0.2	0.98	0.94	0.99	0.98	0.95	0.99
ψ	IG	0.7	0.7	0.147	0.097	0.20	0.154	0.10	0.21
η	B	0.5	0.1	-	-	-	0.49	0.31	0.68
Measurement Errors									
$100\sigma_y^{me}$	IG	0.27	0.27	0.21	0.06	0.45	0.24	0.07	0.53
$100\sigma_c^{me}$	IG	0.31	0.31	0.43	0.10	0.70	0.48	0.11	0.76
$100\sigma_i^{me}$	IG	0.60	0.60	2.42	1.77	3.02	2.52	2.00	3.02
$100\sigma_{tby}^{me}$	IG	0.26	0.26	0.18	0.07	0.30	0.18	0.07	0.31
$100\sigma_R^{me}$	IG	0.13	0.13	0.37	0.28	0.48	0.37	0.27	0.48
Log-marginal likelihood					1065.4			1066.2	

Notes: Estimation is based on Argentine data from 1983Q1 to 2001Q3. Posterior statistics are based on a two million MCMC chain from which the first million draws were discarded. For the priors, B, G and IG indicate, respectively, the Beta, Gamma and Inverse Gamma distributions. The Log-Marginal Likelihood was computed using Geweke's modified harmonic mean method.

Table 1.5: Comparing RBC Model, Reduced Form Financial Frictions Model and Data: Second Moments

Statistics	g^Y	g^C	g^I	tby	R
Standard Deviation					
- RBC model	2.79	3.07	5.37	**10.2**	0.72
- Reduced Form Frictions model	2.90	3.17	5.12	1.55	4.04
- Data	2.72	3.13	6.03	2.6	4.43
	(0.42)	(0.47)	(0.78)	(0.26)	(0.72)
Correlation with g^Y					
- RBC model	1.00	0.99	0.94	-0.07	**0.04**
- Reduced Form Frictions model	1.00	0.94	0.83	-0.13	**0.10**
- Data	1.00	0.94	0.86	-0.18	**-0.25**
	-	(0.008)	(0.03)	(0.07)	(0.08)
Correlation with R					
- RBC model	**0.04**	**0.03**	**0.006**	**0.95**	1.00
- Reduced Form Frictions model	**0.10**	**0.05**	**-0.02**	**0.57**	1.00
- Data	**-0.25**	**-0.20**	**-0.35**	**0.90**	1.00
	(0.08)	(0.08)	(0.09)	(0.02)	-
Serial Correlation					
- RBC model	0.13	0.07	0.01	0.99	0.99
- Reduced Form Frictions model	0.12	0.05	-0.01	0.82	0.94
- Data	0.10	0.19	0.39	0.95	0.92
	(0.12)	(0.12)	(0.09)	(0.008)	(0.02)

Notes: Empirical moments are computed using Argentine data from 1983Q1 to 2001Q3. Standard errors of sample-moment estimates are shown in parenthesis. Model moments are computed at the median of the posterior distribution.

Table 1.6: Variance Decomposition implied by RBC Model and Reduced Form Financial Frictions Model

Shock	g^Y	g^C	g^I	tby	R
Stationary Technology, σ_a					
- RBC model	17.7	9.1	2.6	4.4	4.2
- Reduced Form Frictions model with 4 obs.	94.8	78.8	42.3	3.9	18.2
- Reduced Form Frictions model with 5 obs.	48.5	34.1	21.3	7.6	10.9
Nonstationary Technology, σ_{μ_X}					
- RBC model	82.3	90.9	97.4	95.6	95.8
- Reduced Form Frictions model with 4 obs.	**3.9**	**2.6**	**1.7**	**0.5**	**0.6**
- Reduced Form Frictions model with 5 obs.	**51.1**	**53.8**	**53.0**	**29.5**	**50.5**
Preference, σ_ν					
- RBC model	-	-	-	-	-
- Reduced Form Frictions model with 4 obs.	0.47	11.7	9.7	13.4	22.1
- Reduced Form Frictions model with 5 obs.	0.05	9.0	2.5	11.9	4.1
Risk Premium, σ_{μ_R}					
- RBC model	-	-	-	-	-
- Reduced Form Frictions model with 4 obs.	**0.74**	**6.85**	**46.2**	**82.0**	**59.1**
- Reduced Form Frictions model with 5 obs.	**0.27**	**3.03**	**23.2**	**50.8**	**34.4**

Notes: The estimated contribution of all five measurement errors (not shown) is negligible for all five variables.

Table 1.7: Calibration for Microfounded Financial Frictions Model

Parameter	Description	Value	Target Statistics
σ	Inverse of IES	2	Standard RBC value
ψ	Elasticity of L_s, $1/(\psi-1)$	1.6	Labor supply elasticity of 1.7
δ	Depreciation rate of capital	0.1	Average investment ratio of about 17 percent
α	Capital income share in gross output	0.17	Standard Capital Share, 30 percent
γ	Labor income share in gross output	0.40	Standard Labor Share, 70 percent
η	Intermed. input income share in gross output	0.43	Mendoza and Yue (2011)
μ_x	Long-run productivity growth	1.005	GPU (2010)
R^*	Gross risk free foreign interest rate	1%	Standard RBC Value
β	Discount Factor	0.975	Steady state annual spread, 10%
ρi	Home good bias in intermed. goods	0.65	Mendoza and Yue (2011)
ν	Weight of domestic inputs	0.73	Mendoza and Yue (2011)
μ	Monitoring cost	0.075	μ and σ_ω implied by $d^{ss} = 47\%$,
$\sigma_{\omega,ss}$	Std. dev. of the log-normal dist. of ω	0.45	$prem = 10\%$ and C.spread=7%
$p_{z,ss}$	World price of intermed. inputs	1.028	Mendoza(2010) for Mexico

Table 1.8: Prior and Posterior Distribution - Microfounded Financial Frictions Model

	Microfounded Financial Frictions Model					
	Prior Distribution			Posterior Distribution		
Parameter	Prior	Mean	Std	Median	5%	95%
σ_a	IG	0.010	0.015	0.011	0.006	0.015
ρ_a	B	0.5	0.2	0.61	0.41	0.78
σ_{μ_X}	IG	0.010	0.015	0.035	0.028	0.047
ρ_{μ_X}	B	0.5	0.2	0.25	0.14	0.32
σ_v	IG	0.10	0.15	0.051	0.014	0.06
ρ_v	B	0.5	0.2	0.55	0.20	0.96
σ_s	IG	0.010	0.015	0.006	0.002	0.019
ρ_s	B	0.5	0.2	0.52	0.15	0.88
ϕ	G	5	5	4.14	2.54	6.11
σ_{σ_ω}	IG	0.30	0.42	0.1694	0.13	0.21
ρ_{σ_ω}	B	0.5	0.2	0.98	0.97	0.99
$\sigma_{R^\star}$	IG	0.010	0.015	0.0013	0.0010	0.0014
$\rho_{R^\star}$	B	0.5	0.2	0.93	0.88	0.98
		Measurement Errors				
Parameter	Prior	Min	Max	Median	5%	95%
$100\sigma_y^{me}$	U	0.01	0.68	0.104	0.10	0.11
$100\sigma_c^{me}$	U	0.01	0.78	0.106	0.10	0.12
$100\sigma_i^{me}$	U	0.01	1.51	0.347	0.26	0.42
$100\sigma_{tby}^{me}$	U	0.01	0.65	0.117	0.10	0.16
$100\sigma_{prem}^{me}$	U	0.01	0.28	0.102	0.10	0.11
Log-marginal likelihood					1281.2	
Log- likelihood					1373.3	

Notes: Estimation is based on Argentine data from 1983Q1 to 2001Q3. Posterior statistics are based on a two million MCMC chain from which the first million draws were discarded. For the priors, B, G, IG and U indicate, respectively, the Beta, Gamma, Inverse Gamma and Uniform distributions. The estimated standard deviations for measurement errors are smaller than 25 percent of the standard deviation of the corresponding empirical time series. The Log-Marginal Likelihood was computed using Geweke's modified harmonic mean method.

Table 1.9: Second Moments: Microfounded Financial Frictions Model vs Data

Statistics	g^Y	g^C	g^I	tby	$Premium$
Standard Deviation					
- Model	2.80	3.05	5.44	1.80	6.1
- Data	2.72	3.13	6.03	2.6	4.43
	(0.42)	(0.47)	(0.78)	(0.26)	(0.72)
Correlation with g^Y					
- Model	1.00	0.90	0.60	-0.22	**-0.12**
- Data	1.00	0.94	0.86	-0.18	**-0.25**
	-	(0.008)	(0.03)	(0.07)	(0.08)
Correlation with $Premium$					
- Model	**-0.12**	**-0.22**	**-0.36**	**0.72**	1.00
- Data	**-0.25**	**-0.21**	**-0.32**	**0.86**	1.00
	(0.08)	(0.07)	(0.09)	(0.04)	-
Serial Correlation					
- Model	0.18	0.15	-0.08	0.40	0.70
- Data	0.10	0.18	0.39	0.95	0.90
	(0.12)	(0.12)	(0.09)	(0.008)	(0.02)

Notes: Empirical moments are computed using Argentine data from 1983Q1 to 2001Q3. Standard errors of sample-moment estimates are shown in parenthesis. Model moments are computed at the median of the posterior distribution.

Table 1.10: Variance Decomposition Predicted by the Model with Microfounded Financial Frictions

Shock	g^Y	g^C	g^I	tby	$Prem.$	R^{star}
Stationary Technology, σ_a	**40.14**	28.37	23.42	11.66	8.49	0.00
Nonstationary Tech., σ_{μ_X}	**50.33**	61.25	32.15	18.28	12.83	0.00
Uncertainty, σ_{σ_ω}	8.98	4.28	40.72	**67.08**	**72.95**	0.00
Preference, σ_ν	0.20	5.94	2.95	1.21	2.13	0.00
Government Spend., σ_s	0.006	0.0124	0.10	0.05	0.07	0.00
US Interest Rate, $\sigma_{R^\star}$	0.34	0.14	0.65	1.70	3.51	100.00

Notes: The estimated contribution of all five measurement errors (not shown) is negligible for all five variables.

Figure 1.1: Flowchart of the Model

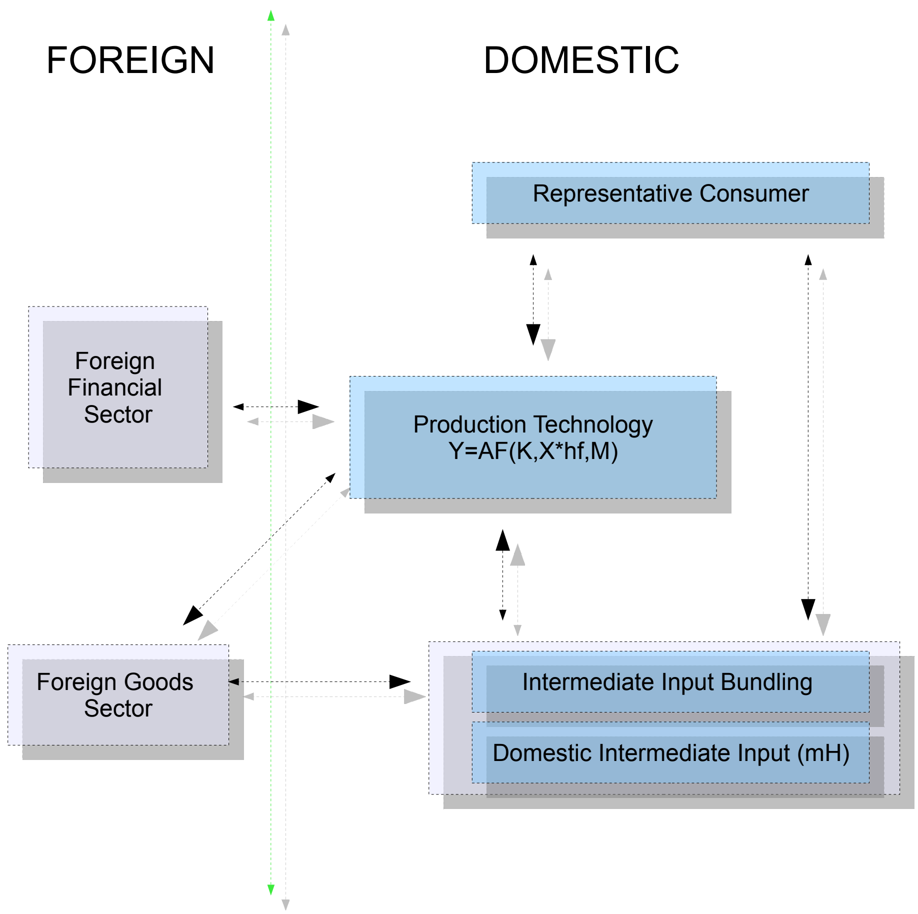


Figure 1.2: Timing of the Events

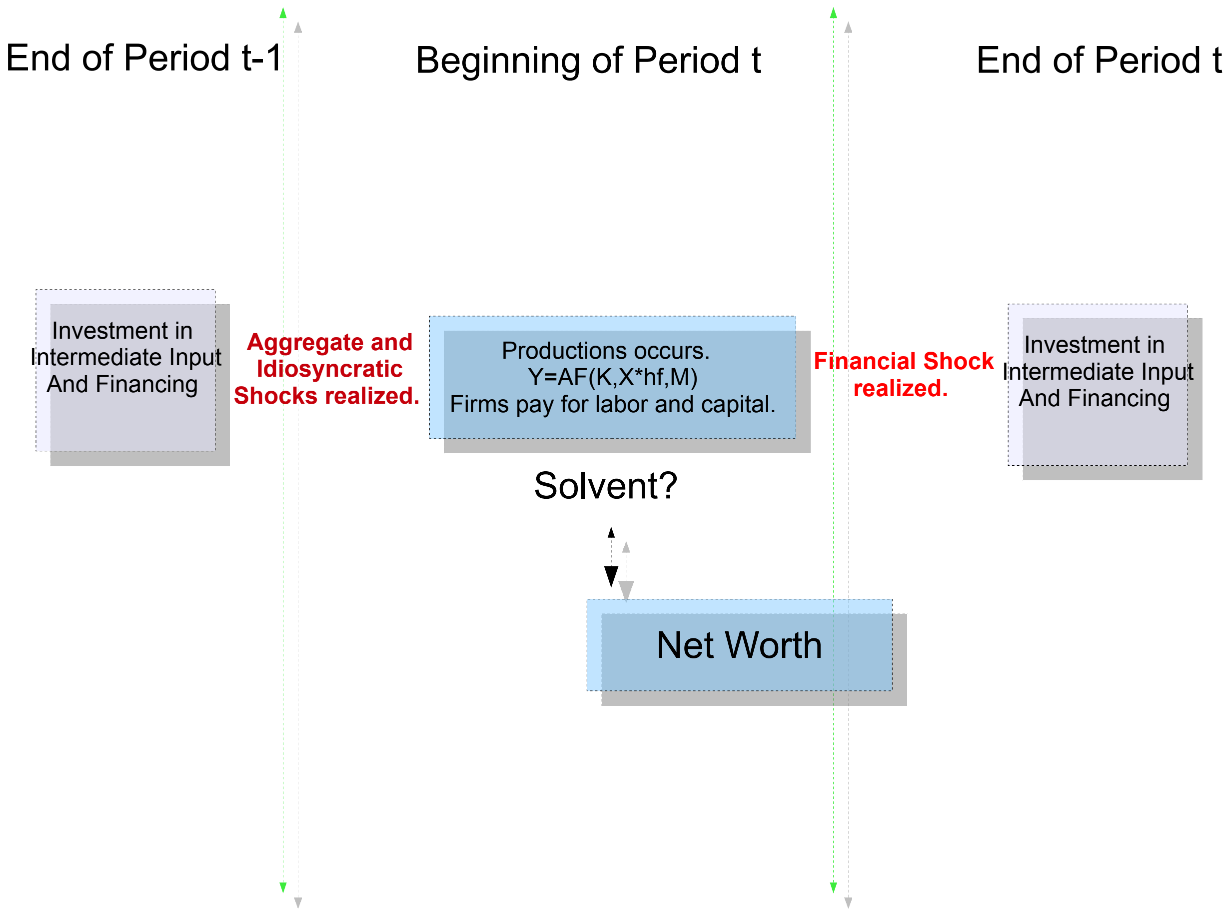


Figure 1.3: Firm Borrowing Spreads in Argentina: Annualized 1994Q1-2010Q4

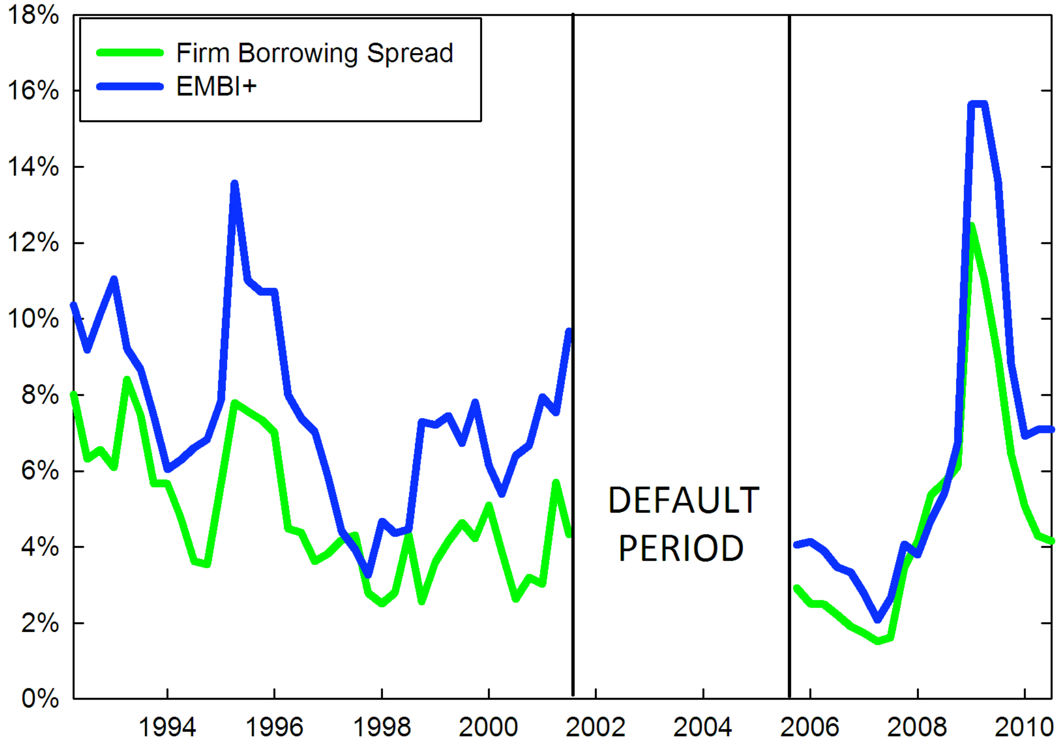


Figure 1.4: Leverage Ratio of Argentine Firms in Different Sectors 1993-2009

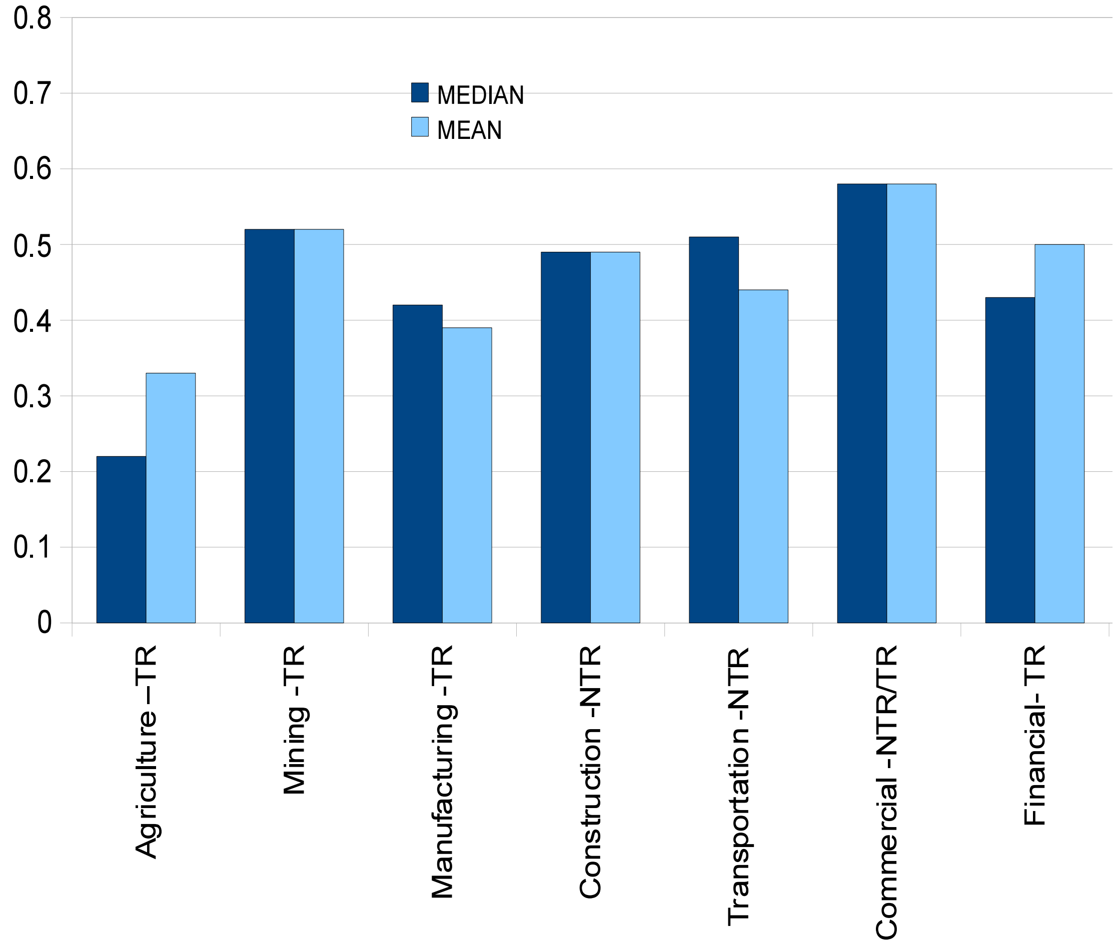


Figure 1.5: Uncertainty Shock

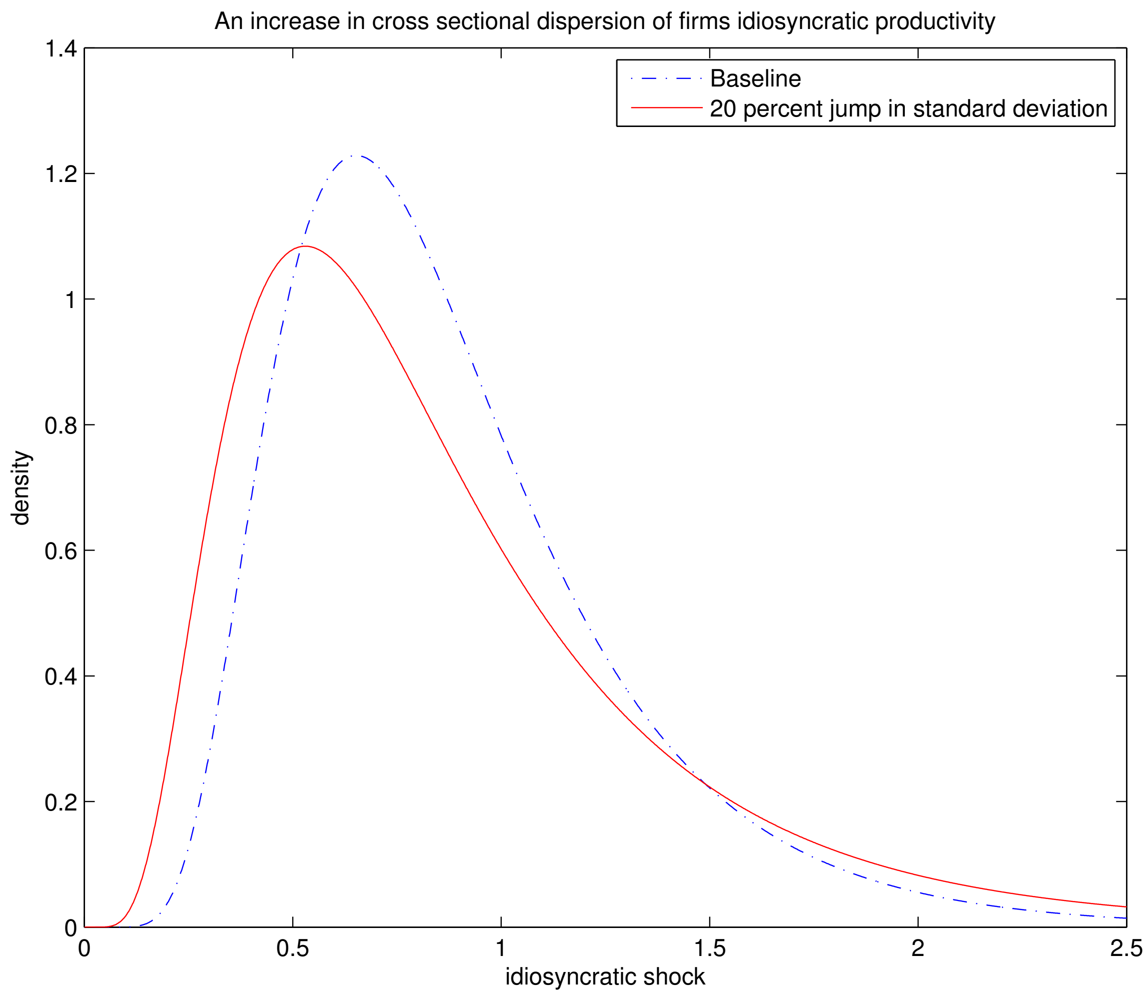
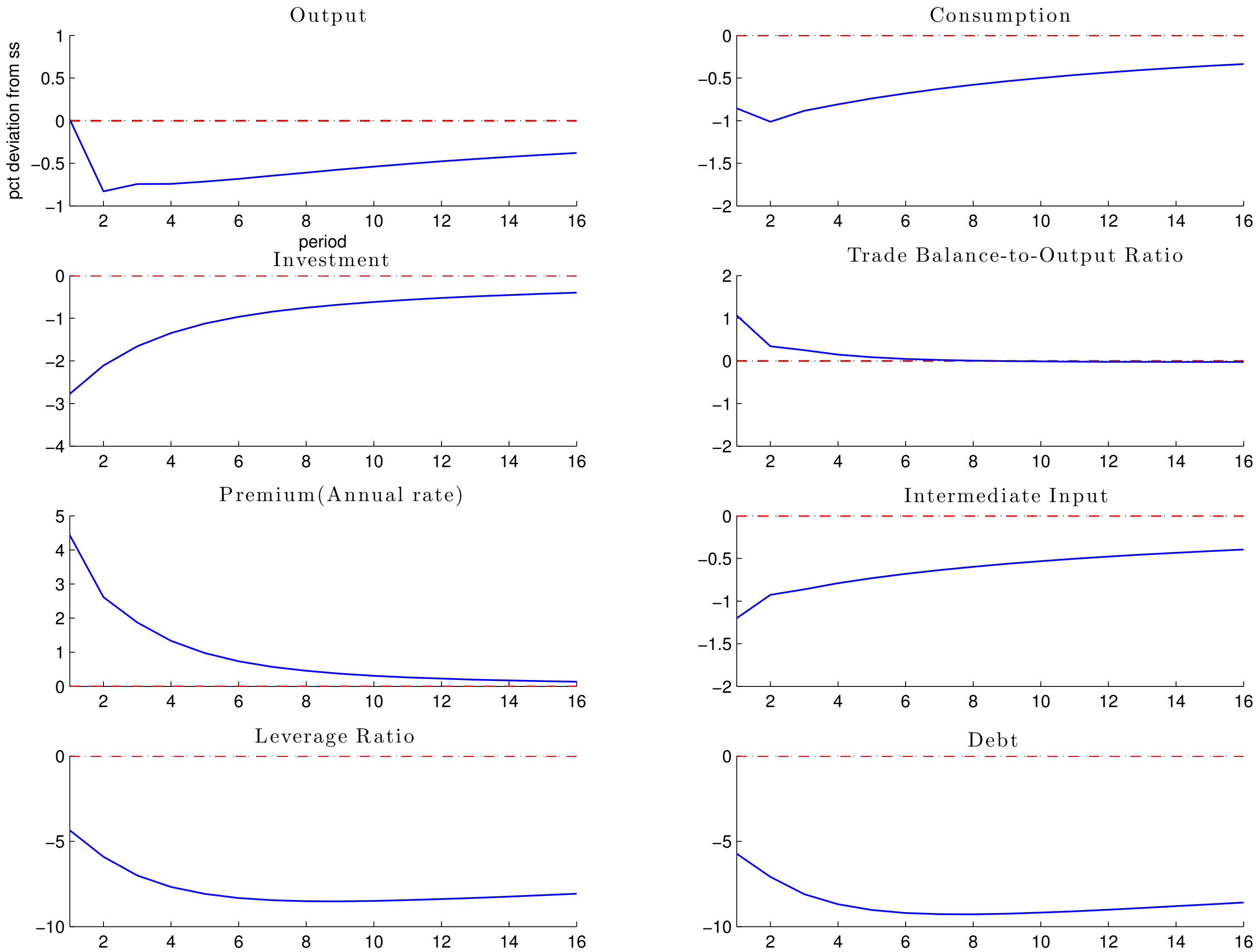


Figure 1.6: Impulse Responses to a one standard deviation shock to Uncertainty



Chapter 2

Global Financial Conditions and Macroeconomic Fluctuations in Emerging Countries: A Panel VAR Approach

2.1 Introduction

Understanding the driving forces behind the fluctuations in the country interest rate premium and its impact on the macroeconomic fluctuations in emerging economies has been at the center of academic and policy research. The traditional literature has identified the U.S. risk-free interest rate as the main global financial factor affecting country spreads and hence the aggregate fluctuations in emerging markets. The underlying assumption of such studies is that international lenders are risk neutral and the changes in the U.S. real interest rate will affect the country interest rate in international markets through the usual arbitrage relation plus the higher risk premium required for probability of default. However, international lenders are indeed risk averse and the actual interest rate that sovereign faces in the international markets includes not only a base premium that compensates the lenders for the probability of default (as in the risk neutral case) but also an additional premium that compensates them for taking the risk of default. In particular, as lenders become wealthier or less risk averse, the emerging economy becomes less credit constrained. Quantifying the relative contributions of U.S. real interest rate shocks and global risk shocks to aggregate fluctuations in emerging countries is perplexed by the fact that country interest rates do not respond one to one to movements in the global financial conditions. Country spreads serve as a transmission mechanism of global financial conditions, capable of amplifying or dampening the effect of external shocks on the domestic economy as they also respond to domestic fundamentals.[1]

The objective of this paper is to investigate the extent to which international factors contribute to the variability of country spreads and macroeconomic fundamentals in emerging economies. This work attempts to investigate the endogeneity of country spreads, and to relate them to the degree of risk in the international financial markets, as well as to domestic macroeconomic variables in a Panel VAR framework. I consider six emerging market economies in the baseline analysis: four emerging markets in Latin America (Argentina, Brazil, Mexico, Peru), and two from other regions (South Africa and Turkey).[2]

The results of the analysis can be discussed under four sections. First, I present some facts about the relation between the external financing conditions, country spreads, and the cyclical component of output. There is high level of commonality in country spreads. In particular, the first principal component of country spreads explains 87 percent of the variation in country spreads during the 1998-2011 sample period. Figure 2.1 shows that the first principal component of country spreads has

[1]In this paper, I use the term global risk to refer to worldwide measures of investors' "appetite" for risk.

[2]In the robustness analysis, four more countries (Chile, Colombia, Malaysia, and Philippines) are included in to the estimation. Details of the data used in this study are presented in Appendix J.

a correlation of 52 percent with the implied U.S. stock market volatility index; 30 percent with the U.S. BAA Corporate spread, 43 percent with the U.S. High yield corporate spread. However, its correlation with the U.S. real interest rate is 18 percent. Therefore, country risk appears to be more related to global risk factors than they are to the U.S. real interest rate. The negative co-movement between the country spreads and the real economic activity is also depicted in Figure 2.2.[3]

Second, I estimate a Panel Structural VAR model with country specific factors, a measure of global risk, US real interest rates and country spreads. In general, all variables have significant explanatory power for country spreads. I find that the country spread is driven more by global risk factors than the US real interest rate. The contribution of country-specific fundamentals to the fluctuations in the country spread is slightly lower than the contribution of global risk. On average, 20% percent of fluctuations in country spreads is explained by global risk shocks; 5% of fluctuations by the US real rate; and 15% of the fluctuations is explained by domestic factors.

Third, I investigate the extent to which the global risk, the U.S. interest rate and the country interest rate premium contribute to macroeconomic fluctuations in emerging economies. I find that global risk shocks explain about 20 percent of movements in aggregate activity in emerging economies. The contribution of the U.S. Interest Rate shock to emerging market business cycle fluctuations is negligible. Therefore, the role of U.S. interest rate shocks in driving the business cycle fluctuations in emerging economies, as emphasized in the previous literature (see for example Uribe and Yue (2006)), is replaced by global risk shocks. Country spread shocks explain about 15 percent of the business cycles in emerging economies. The feedback from domestic fundamentals to the country borrowing rate, even after a measure of global risk is included in the analysis, plays an important role in transmitting external shocks to the

[3] Some of these facts are also documented in previous studies which are referenced below.

domestic economy. Moreover, the global risk shock affects domestic macroeconomic variables mostly through their effects on country spreads. When the country spread is assumed not to respond directly to variations in the global risk, the variance of output, investment, and the trade balance-to-output ratio explained by global risk shocks is about two thirds smaller.

Fourth, I extent the Panel VAR model by incorporating a measure of domestic banking sector risk into the analysis. The purpose is to investigate whether the domestic banking sector risk has any impact on country spreads, after external factors and the state of the macroeconomy are taken into consideration. As depicted in Figure 2.3, there is a positive co-movement between the country interest rate premium and the domestic banking sector spread. There is a negative comovement between the bank lending spread and the output in emerging economies, as shown in Figure 2.4. I find that bank lending spreads explain about 10% of the fluctuations in country spreads while 50% of the fluctuations in the country spreads is explained by its own shock. The country interest premium also have significant impact on the private sector borrowing cost in emerging economies. Higher sovereign risk leads to higher bank lending spreads and lower economic activity. The feedback between the country risk and the domestic banking sector risk results in higher domestic macroeconomic volatility in emerging economies.[4]

In summary, I show that the global risk, which is measured by the U.S. corporate credit spread and the U.S. Stock market volatility index, plays an important role in deriving macroeconomic fluctuations in emerging economies. The global risk shock affects domestic macroeconomic variables mostly through their effects on the country

[4] The results for the extended model are not directly comparable to the baseline model. It is because in the extended model the sample size is shorter for two countries in the panel even if the number of countries is same. In the baseline model I report that around 60 percent of fluctuations in country spread is due to country spread shock itself.

interest rate premium. Moreover, global risk shocks replaces the role of the risk free U.S. interest rate identified in the traditional literature as an important external driving force of macroeconomic fluctuations in emerging economies.

This paper is related to growing body of empirical and theoretical research in emerging economy real business cycle fluctuations. In a number of papers, Calvo (Calvo et al. (1993), Calvo (2002)) has observed that emerging market risk premia are correlated with international factors, in particular worldwide measures of investors' "appetite" for risk, such as, for instance, the spread between the yield on U.S. corporate bonds and that on U.S. Treasuries. In fact, Calvo suggests further that once one accounts for the international financial shocks, domestic factors in emerging markets have a limited role in explaining country spreads. The work by Garcia-Herrero et al. (2006) contributed to the literature by analyzing how investors' attitude toward risks affects Latin American sovereign spreads, by treating the default risk in emerging economies as purely an exogenous process. In other words, they do not take the state of the macroeconomy in emerging economies into consideration. In an influential paper, Uribe and Yue (2006) investigated the relationship between the country interest premium, the U.S. interest rate and business conditions in emerging markets. Their structural VAR analysis, using data for a panel of emerging market economies between 1994:Q1 and 2001:Q4, pointed out the importance of the U.S. interest rates shock in deriving the macroeconomic fluctuations in emerging markets. However, they identified external shocks by only risk free U.S. interest rates. Agenor et al. (2008) also studied the effects of external shocks on bank lending spreads and output fluctuations in Argentina during the early 1990s. They did not incorporate any global financial variables into the estimation. An external shock is modeled as a shock in the country interest rate.[5]

[5]The theoretical models of an emerging economy with explicit intermediation sector (see among

The empirical literature of the impact of external shocks to emerging economies is not only restricted to real business cycle models. Empirical monetary models have focused mainly on the impact of external shocks; such as oil price shocks and exchange rates shocks (see for example Mishkin and Schmidt-Hebbel (2007)) on inflation and have studied the effectiveness of inflation targeting regime in coping with external shocks. Studies on the impact of terms of trade shocks mainly focused on the implications for the choice of exchange rates (see for example Broda (2004); Edwards and Levy Yeyati (2005)).

The present paper is also related to a large body of existing theoretical literature on emerging-market business cycles. Most models in this literature build on the canonical small open economy real business cycle model presented in Mendoza (1991) and Schmitt-Grohe and Uribe (2003). Neumeyer and Perri (2005) augmented the canonical model with financial friction. However, they treat country risk premium in a reduced form without explicitly incorporating a microfounded default mechanism. In a more recent paper, Aguiar and Gopinath (2007) argue that introducing shocks to trend output in an otherwise standard small open economy real business cycle model (with frictionless international financial markets) can account for the key features of economic fluctuations in emerging market economies. García-Cicco, Pancrazi, and Uribe (2010) developed and estimated an encompassing model for an emerging economy with both trend shocks and financial frictions. Financial market imperfections introduced in this paper are also in a reduced form fashion. Therefore, in the earlier theoretical models, the dependence of the country premium on variables such as output were not microfounded. There has been progress in the recent theoretical work to address the concerns about the microfoundations of the country spread behavior

others, Edwards and Vegh (1997) and Oviedo (2005)) predict that sovereign risk and/or global shocks systematically affects private-sector borrowing conditions in emerging economies.

(see Mendoza and Yue (2011) and the first chapter of the dissertation). However, all these models assume that international lenders are risk neutral. An exception is the work by Lizarazo (2011) who develops a quantitative model of debt and default for small open economies that interact with risk averse international investors. This model does not take endogenous nature of the spreads into consideration.

After recent financial crises, there has been a renewed interest in understanding the role of global factors in explaining the variation in the country spreads. According to Blanchard et al. (2010), an increase in the global risk was an important channel through which the crisis was propagated to emerging economies. The empirical evidence in Longstaff et al. (2011)) also suggests that global factors explain a large fraction of the variation in the international interest rate. These studies concentrate mainly on the role of global factors in deriving country spreads; nothing is said about the implications of higher global risk on business cycle fluctuations in emerging economies.

The remainder of the paper is organized in five sections. In Section 2, I present the empirical model and discuss the identification of the country spread shocks, the U.S. risk free interest rate shocks, and the global risk shocks. In section 3, I analyze the business cycles implied by these three sources of aggregate uncertainty with the help of impulse responses and variance decompositions. Section 4 discusses the role of bank lending spreads in the transmission of external shocks and the country spread shocks in emerging economies. Section 5 discusses the robustness of the results. The last section concludes the paper.

2.2 The Empirical Model

The goal of this section is to identify shocks and to determine the lag length. The empirical model follows closely the model specification in Uribe and Yue (2006):

$$Ay_{i,t} = \sum_{k=1}^{p} B_k y_{i,t-k} + \eta_i + \epsilon_{i,t} \tag{2.1}$$

where η_i is a fixed effect and

$$\begin{aligned} y_{i,t} &= \left[\hat{gdp}_{i,t}, \hat{inv}_{i,t}, tby_{i,t}, \hat{R}_t^{US}, \hat{GR}_t, \hat{R}_{i,t}\right] \\ \epsilon_{i,t} &= \left[\epsilon_{i,t}^{gdp}, \epsilon_{i,t}^{inv}, \epsilon_{i,t}^{tby}, \epsilon_t^{R,US}, \epsilon_t^{GR}, \epsilon_{i,t}^{R}\right] \end{aligned}$$

$gdp_{i,t}$ denotes the real gross domestic output, $inv_{i,t}$ denotes the real gross domestic investment, $tby_{i,t}$ denotes the trade balance to output ratio, R_t^{US} denotes the gross real U.S. interest rate, GR_t is an indicator for global risk (proxied by three variables: the U.S. BAA Corporate Spread, $\hat{S}_t^{BAA,US}$; the U.S. Stock Market Volatility Index, $\hat{Vol}_t^{US}$; and the U.S.High Yield Corporate Spread, $\hat{S}_t^{HYI,US}$), and $R_{i,t}$ denotes the country specific interest rate. A hat on $gdp_{i,t}$ and $inv_{i,t}$ denotes log deviations from a log-linear trend. A hat on R_t^{US}, $S_t^{BAA,US}$, Vol_t^{US}, $S_t^{HYI,US}$, and $R_{i,t}$ denotes the log. The trade balance-to output ratio, $tby_{i,t}$ is expressed in percentage points. I measure R_t^{US} as the 3-month gross U.S. Treasury Bill rate deflated using a measure of expected U.S. inflation (see Schmitt-Grohe and Uribe (2011) for details of the calculation of the expected U.S. Inflation). In the calculation of the expected inflation I use two lags of CPI inflation. The results are robust to using higher order lags of inflation. I measure $S_t^{BAA,US}$ as the difference between the U.S. BAA corporate borrowing rate calculated by Moody's and long term (20 years, constant maturity) U.S. Treasury bond rate. $R_{i,t}$ is measured as the sum of the J. P. Morgan's EMBI+ sovereign spread and the US real interest rate. Output, investment, and the trade balance are seasonally adjusted. Finally, the subscript i denotes that corresponding variable is country specific. For example, $\hat{gdp}_{i,t}$ has TN observations where T represents time series dimension and N diplays the number of countries included in the sample. The variables, $\hat{R}_t^{US}$ and $G\hat{R}A_t$, are common across coutries included in the sample.[6]

2.2.1 Identification

The domestic macroeconomic variables are included in the model to capture the impact of local variables on sovereign spreads. Moreover, once I estimate the VAR system (2.1), I will be able to quantify the importance of the country risk premium on business cycle fluctuations in emerging economies. I place country spreads last in the ordering of the VAR model, in order to capture primarily the exogenous component of the country spread shock when calculating variance decompositions and impulse response functions. This ordering also allows me to account for the fact that movements in country spreads may respond subsequently to changes in domestic variables after the initial exogenous shock.

Sovereigns included in the study typically have extensive economic relationships with other countries. Thus, the ability of one of these sovereigns to repay its debt may depend not only on local variables, but also on the state of the global economy. To capture broad changes in the state of the global economy, I include some measures from the U.S. financial markets. There are several reasons for choosing financial variables related the US economy as the global macroeconomic forces external to

[6]More details on the data are provided in the Appendix J.

small open economies in the sample. First, the U.S. is not one of the sovereigns included in our sample. Second, there is an extensive evidence that shocks to the U.S. financial markets are transmitted globally. Finally, as the largest economy in the world, the U.S. has direct effect on the economies and financial markets of many other sovereigns; but, emerging economies are too small to have an impact on the financial system in the U.S.

In particular, I identify the empirical model by imposing the restriction that the matrix A be lower triangular with unit diagonal elements. An additional restriction I impose in estimating the VAR system is that $\hat{R}_t^{US}$ and a measure of Global Risk ($\hat{GR_t}$) follows a two-variable VAR process (i.e., I impose the restriction $B_{k,4,j} = B_{k,5,j} = 0$, for all $j \neq 4$ and $j \neq 5$ and $k = 1, 2, .., p$. I also impose the restriction on A matrix, $A_{4,j} = 0$, for all $j \neq 4$ and $A_{5,j} = 0$ for all $j \neq 4$ and $j \neq 5$). I adopt this restriction because it is reasonable to assume that disturbances in a particular (small) emerging country will not affect either the corporate borrowing rate (and the stock market volatility) or the real interest rate of a large country like the U.S. I however, let the real interest rates and a measure of Global Risk affecting each other. The restriction on A matrix imply that U.S. corporate spreads (or the U.S. Stock Market volatility) respond contemporaneously to the U.S. risk-free interest rate while U.S. risk free rate responds to the lagged values of U.S. Corporate spreads (or the U.S. Stock market volatility).

I note that the country-interest-rate shock can equivalently be interpreted as a country spread shock in the VAR system (2.1). As I mentioned before, $R_{i,t}$ is measured as the sum of the J. P. Morgan's EMBI+ sovereign spread and the US real interest rate. Because $R_{i,t}$ appears as a regressor in the bottom equation of the VAR system, the estimated residual $\epsilon_{i,t}^R$ would be identical to a country spread shock. Therefore, throughout the paper I refer to $\epsilon_{i,t}^R$ as a country spread shock.

The identification strategy employed in this paper presupposes that innovations in global financial conditions and innovations in country interest rates affect domestic real variables with a one-period lag; while real domestic shocks affect financial markets contemporaneously. The identification strategy is a natural in order to capture primarily the exogenous component of the country spread shock. It is also reasonable to assume that financial markets are able to react quickly to news about the state of the business cycle in emerging economies.[7]

2.2.2 Estimation Method

I estimate the structural VAR given in Equation (2.1) by pooling quarterly data from Argentina, Brazil, Mexico, Peru, South Africa and Turkey. The sample begins in the first quarter of 1994 and ends in the third quarter of 2011. The choice of countries is guided by my desire to limit attention to emerging countries, and by the availability of reliable quarterly data on macroeconomic aggregates and the country borrowing rate in the international markets. The rationale for pooling data is to gain efficiency. I estimate the Output, Investment, Trade Balance-to-Output Ratio and the Country Interest rate equations of the VAR system in Equation (2.1) by OLS including country dummies and constant term. I define the first country in the sample to be the reference category so that the estimated constant is its intercept, and then treated the estimated coefficients of the dummies for the other countries as the shifts in the intercept for the particular country included in the sample. The exogenous block (U.S. real interest rate and Global Risk Equations) of the VAR system in Equation (2.1) is estimated by OLS including only constant for the longer time span from 1987:3 to 2011:4.

[7] In section 2.5.2, I explore an identification scheme that allows for real domestic variables to react contemporaneously to innovations in financial variables.

A potential concern with the panel VAR is the inconsistency of the least squares parameter estimates due to the combination of fixed effects and lagged dependent variables (e.g., Nickell (1981)). However, because the time series dimension of my data is large, the inconsistency problem is likely not to be a major concern. I calculate the bias following the methodology in Hahn and Kuersteiner (2002). The estimated impulse response function with the bias corrected least square dummy variable method is close to those obtained with simple least square estimation method.[8]

My estimation procedure imposes that the matrices A and B are the same across the six countries from which I pool information. This simplifying assumption seems appropriate in light of the fact that estimations using individual country data yield similar results for the dynamic effects of external shocks on country spreads and the macroeconomic aggregates.[9]

2.2.3 Lag Length Selection

Table 2.1 presents results for lag length selection test. Guided by the LR, FPE and AIC, the panel SVAR specification allows for two lags. Lag exclusion test result also show that Joint(p-value) for Lag 3 is 0.1241, implying that 3rd lag can be excluded from the equation while Joint (p-value) for Lag 2 is 0.0078, implying that lag 2 is significant and should be included.

2.3 Estimation Results

In this section I discuss the consequences of incorporating a measure of global risk into the VAR system in Equation (2.1) in accounting for the fluctuations in

[8]Section 2.5.1 compares the estimated impulse response functions predicted by different estimation methods.

[9]Individual country estimates are available upon request

country spreads and real domestic variables such as output, investment, and the trade balance. I also investigate how and by how much do country spreads move in response to innovations in emerging-country fundamentals, after including a measure of global risk in the estimation. Calvo (2002) suggest that once one accounts for international financial shocks, domestic factors in emerging markets have a limited role in explaining variables such as sovereign borrowing spreads. With an estimate of the VAR system (2.1) at hand, I can decompose the relative importance of domestic macroeconomic variables and international factors in accounting for movements in country spreads. I will also address additional questions, such as, the importance of the US real interest rate for the movements of country spreads and domestic variables in emerging economies and how important country spread shocks are in explaining movements in aggregate activity in emerging economies.

2.3.1 Impulse Responses

The impulse responses following one standard deviation increase in a measure of Global Risk is shown in Figure 2.5. Dark-grey shaded area depicts 95% confidence bands while light-grey shaded area show 68% confidence interval. In the baseline model, the U.S. BAA Corporate Spread; i.e., the spread between the yield on U.S. BAA rated corporate bonds and that on U.S. Treasuries of the same maturity, is used as a proxy for the global risk. Country spreads respond strongly to innovations in the global risk. In response to an unanticipated one standard deviation shock to U.S. BAA corporate spreads (0.3 percent), the country spread increases by 0.4 percentage point on impact and stays high for two quarters after the shock. The response of the country spread to global risk shock is higher than the response of the global risk to the global risk itself. Output, investment, and the trade balance-to-output ratio are unchanged in the period of impact because of our maintained assumption that external financial shocks take one quarter to affect production and absorption. In the two periods following the global risk shock, output and investment fall, and subsequently recover gradually until they reach their preshock level. The trade balance improves in the two periods following the shock. One might argue that the persistence of the country spread response to global risk shock is resulting to some extend from the fact that output decrease feeds back on to the higher country spreads following the global risk shock. Setting the estimated coefficient for the response of country spread to domestic macroeconomic variables to zero confirms the intuition: the country spread shock (not shown in the figure) dies out much quicker. The US real interest rate is unchanged on impact and increases by 0.6 percentage point in the two periods following the shock. But the impact of global risk shock on US interest rate dies out very quickly.[10]

Figure 2.6 displays the response of the variables included in the VAR system to one standard deviation increase in the U.S. real interest rate. The US real interest rate is used in the earlier literature to identify the impact of external shocks on country spreads and domestic variables. Under our maintained assumption that global risk responds to US real interest rate shock contemporaneously, global risk decreases on impact and continues to decline two periods after the shock. This result is not in line with what one would expect. Theoretical models would predict that an increase in the risk free real interest rate leads to an increase in the U.S. credit spreads. This counterfactual result is mainly driven by the financial crises period and the period after that during which US nominal interest rates hit the zero lower pound. As it is depicted in Figure 2.7, once I restrict the sample period to pre-crises period (sample

[10]The estimated impulse response functions for other measures of the global risk are presented in section 2.3.3.

ends in 2007Q4), global risk initially falls following an increase in the US real interest rates and after a couple of quarters it increases.[11]

The response of country spreads to innovations in the US interest rate is qualitatively same both in the restricted sample and in the baseline model: Country spreads increase in response to US real interest rates shocks but with a short delay. Output and investment improves after a positive shock to US real interest rates, but, as I argued before, it is mainly because output and investment respond strongly to changes in global risk. If the sample is restricted to pre-crises period, output and investment decreases following a shock but again with a short delay. Overall, I argue that the responses of macroeconomic variables are in line with what one would expect but quantitatively the impact of the shock is not big. Moreover, all the impulse responses due to an innovation in U.S. real interest rate are measured with significant error. Both 68% and 95% errors bands are very wide and the responses of variables in the VAR system (2.1) are not statistically significant. These results combined with impulse responses to the global risk show that the role of US real interest rate is replaced by the global risk as the main global macroeconomic force external to the country.

Figure 2.8 displays the response of the variables included in the VAR system (2.1) to one standard deviation increase in the country spread shock. In response to an unanticipated country-spread shock, the country spread itself increases and then quickly falls toward its steady-state level. The half life of the country spread response is about one and half year. Output, investment, and the trade balanceto-output ratio respond as one would expect. They are unchanged in the period of impact. In the two periods following the country-spread shock, output and investment fall, and subsequently recover gradually until they reach their preshock level. The trade

[11] The robustness of my results to different sample periods is discussed in detail in section 2.5.3.

balance improves in the two periods following the shock. The trough in the output response with a country spread shock is about the same in magnitude under a global risk shock.

2.3.2 Variance Decomposition

Figure 2.9 displays the variance decomposition of the variables contained in the VAR system at different horizons. Solid lines in the first row depict the fraction of the variance of the k-quarter ahead forecasting error explained by the US real interest rate shock at different horizons. The fraction of the variance of the k-quarter ahead forecasting error explained by the global risk shock is shown in the second row and by the country spread shocks is shown in the last row. For the purpose of the present discussion, I associate business-cycle fluctuations with the variance of the forecasting error at a horizon of about five years (20 quarters).

According to my estimate of the VAR system given in equation (2.1), innovations in the global risk explain 18 percent of movements in aggregate activity and the US real interest rate account for about 6 percent in emerging countries at business cycle frequency. But the impact of US real interest rates on macroeconomic variables is driven mainly by the response of the global risk to US real interest rates on impact. If one eliminated only the impact effect of the US real interest rate on the global risk, the variance of output explained by the US real interest rate decreases significant (from 6 percent to 2 percent). Therefore, I argue that the impact of US real interest rates on business cycle fluctuations is negligible.[12]

[12] An alternative identification assumption for global shocks is also possible. If I assume that the US real interest rate is ordered after the global risk indicators; i.e, the US interest rate responds to global risk shock contemporaneously but US interest rates affect global risk with one period lag, I find that the contribution of the U.S. interest rate to aggregate fluctuations is very small, around 2 percent. However, this ordering assumption is harder to justify on theoretical grounds.

Country-spread shocks account for about 18 percent of aggregate fluctuations in these countries. Therefore, around 40 percent of business cycles in emerging economies is explained by disturbances in external financial variables. These disturbances play smaller role in explaining movements in trade balance-to-output ratio. In effect, global risk shock and country-spread shocks are responsible for about 15 percent of movements in the trade balance-to-output ratio in the countries included in our panel. The majority of variance of the international transaction is explained by the shock to trade balance-to-output ratio itself and shocks to the real investment. This result suggest the investment specific shocks could be the important source of the fluctuations in the trade balance-to-output ratio. Variations in country spreads are largely explained by innovations in the global risk, country specific variables and and innovations in country-spreads themselves. The contribution of domestic macroeconomic variables to fluctuation in sovereign spreads (15%) is slightly lower than the contribution of global risk (18%). These two sources of uncertainty jointly account for about 35% of the fluctuations in sovereign spreads.

The second largest shock contributing to the fluctuation in country spreads (after the country spread shock itself) is global risk shock. The natural question to ask in this context is to what extent the responsiveness of country spreads to global shocks contributes to aggregate fluctuations in emerging countries. I address this question by means of a counterfactual exercise. In particular, I assume (without re-estimating the VAR system (2.1)) that the country spread does not directly depend on the global financial conditions (both U.S. real interest rates and U.S. credit spreads). The variance decomposition of the country specific variables contained in the VAR system (2.1) under counterfactual exercise is shown in Figure 2.10. When I shut off the response of the country spread to global financial conditions, the variance of domestic macroeconomic variables explained by global financial shocks is about two thirds smaller than in the baseline scenario. This result is robust to different measures of the global risk used in the estimation of the VAR system (2.1), which is discussed in the next section. Therefore, I conclude that external shocks affect domestic variables mostly through their effects on country spreads.[13]

2.3.3 Estimation Results with Alternative Measures of Global Risk

I estimate the baseline model with U.S. investment-grade corporate bond spreads (U.S. BAA Corporate spreads) as a measure of global risk. In this section, I discuss the estimation results of the VAR system (2.1) for different measures of the global risk (U.S. high-yield corporate bond spreads and the U.S. Stock Market Volatility index) and compare them with the baseline estimation.

The impulse responses following one standard deviation increase in different measures of global risk variables are shown in Figure 2.11. Solid lines with diamond show point estimates of impulse responses when the U.S. High Yield Spread is used as a proxy for the global risk; dashed lines depict point estimate when the U.S. Stock Market Volatility Index is used as a proxy for the global risk; and solid lines show point estimates of impulse responses when the U.S. BAA Corporate spread (as in the baseline model) is used as a proxy for the global risk. 68% and 95% confidence bands associated with estimates with the U.S. High Yield spread are depicted with dark-grey and light-grey shaded areas respectively. Qualitatively, the response of the country spread and domestic variables to different measures of global risk are very similar: an increase in the global risk leads to a significant and persistent increase in

[13] I am aware that this counterfactual exercise is subject to Lucas' (1976) critique. This more satisfactory approach involves the use of a theoretical model economy where private decisions change in response to alterations in the country spread process.

the country spread on impact. Under the maintained assumption that global financial markets affect emerging economy macroeconomic variables with one period lag, output, investment and the trade balance-to-output ratio do not change on impact but output and investment decrease and the trade balance-to-output ratio improves one period after the shock.

The quantitative effect of different measures of the global risk shock on country specific variables slightly varies across different proxies used as global risk. The largest response is due to changes in the U.S. High Yield index. This result is partly coming from the fact that the U.S. High Yield Corporate Bond spread has more persistent process compared to other two measures of the global risk. There is deep recession in emerging economies after a shock to global risk. After one standard deviation increase in the U.S. High Yield Corporate Bond spread (1 percentage point, annually), country spread increases by 0.6 percentage point (annually) on impact and it stays as high one period after the shock. Output decreases three periods period after the shock and recovers back to its steady state level gradually. The response of investment is about three times as large as that of output. At the same time, the trade balance improves for two periods then converges gradually to its steady-state level. The U.S. real interest rate is also affected with one period lag to changes in the global risk (under our identification assumption). One period after the shock, the U.S. real interest rate increase by 0.4 percent.

One standard deviation shock to the U.S. Stock Market Volatility Index (1 percentage point, annually) leads to 0.4 percentage point (annually) increase on country spreads. The shock to the U.S. Stock Market volatility dies out pretty quickly. The half life of the U.S. Stock Market Volatility response after the U.S. Stock Market Volatility shock is only two quarters while the the half life of the U.S. High Yield Spread after a shock to U.S. High Yield spread is about a year. The decrease in output and investment are lower with stock market volatility shock compared to high yield spread shock. The response of investment is about three times as large as that of output. The trade balance improves for two periods by about 0.1 percent and then converges gradually to its steady-state level.

Figure 2.12 displays the variance decomposition of the variables contained in the VAR system at different horizons. Solid lines with circles depict the fraction of the variance of the k-quarter ahead forecasting error explained jointly by the US real interest rate, the global risk and country spread shocks. Solid lines shows the fraction of the variance of the k-quarter ahead forecasting error explained jointly by the US real interest rate and the global risk. Broken lines depict the fraction of the variance of the forecasting error explained the US interest rate shock. The first row shows the forecast error variance decomposition at different horizons when the US BAA Corporate spread is used as a proxy for the global risk. The second row shows the forecast error variance decomposition at different horizons when the US stock market volatility index is used as a proxy for the global risk. The third row shows the forecast error variance decomposition at different horizons when the U.S. High Yield spread is used as a proxy for the global risk.

According to our estimate of the VAR system given in equation (2.1), innovations in the U.S. high yield spreads explain slightly more than 20 percent of movements in aggregate activity while the U.S. stock market volatility and the U.S. BAA Corporate spreads explain slightly less than 20 percent of aggregate fluctuations in emerging economies. The robust finding across different measures of the global risk is that the US real interest rate account for negligible portion of the variance of domestic variables in emerging countries at business cycle frequency. Country-spread shocks account for about 20 percent of aggregate fluctuations when the U.S. BAA Corporate spread and the U.S. Stock Market volatility are used while it account for 15 percent when U.S. high yield corporate spreads is used. Therefore, around 40 percent of business cycles in emerging economies is explained by disturbances in external financial variables. These disturbances play smaller role in explaining movements in trade balance-to-output ratio.

2.4 Sovereign Risk, Banking Sector Risk and Business Cycle Fluctuations

In this section, I investigate the impact of the global financial conditions and sovereign risk on domestic bank lending spreads and macroeconomic fluctuations in emerging economies. Sovereign distress has often gone hand in hand with banking crises in emerging market economies. As it was briefly discussed before, there is strong positive comovement between bank lending spreads (as a proxy for banking sector risk) and country spreads in emerging economies (see Figure 2.3).

2.4.1 Extended Model

I extend the model given in Equation (2.1) to incorporate a measure of banking sector risk as the following.

$$Ay_{i,t} = \sum_{k=1}^{p} B_k y_{i,t-k} + \eta_i + \epsilon_{i,t} \tag{2.2}$$

where η_i is a fixed effect and

$$\begin{aligned} y_{i,t} &= \left[\hat{gdp}_{i,t}, \hat{inv}_{i,t}, tby_{i,t}, \hat{R}_t^{US}, \hat{GR}_t, \hat{DS}_{i,t}, \hat{R}_{i,t}\right] \\ \epsilon_{i,t} &= \left[\epsilon_{i,t}^{gdp}, \epsilon_{i,t}^{inv}, \epsilon_{i,t}^{tby}, \epsilon_t^{RUS}, \epsilon_t^{GR}, \epsilon_{i,t}^{DS}, \epsilon_{i,t}^{R}\right] \end{aligned}$$

$DS_{i,t}$ denotes the domestic bank intermediation spread.

Movements in the domestic bank intermediation spread depend on changes in the risk premium that banks charge to their borrowers; this premium, in turn, reflects changes in the (perceived) risk of default. To the extent that default risk tends to vary with the state of the business cycle–during recessions, default rates tend to increase, and vice versa–the ordering of bank lending spread after local variables in the VAR model (2.2) allows me to capture the endogeneity of bank lending spreads. I acknowledge that there might be other reasons for the observed co-movement between the domestic bank lending spread and the country spread. In the context of the present paper; however, I interpret the comovement as caused by banking sector developments is immediately picked by international investor to charge higher premium; however, changes in sovereign risk (after all domestic variables and global financial conditions are taken into account), affect domestic bank lending spreads with one period lag. I maintain the assumption that it takes one period for the developments in the financial markets to be effective in real economic activity.

I estimate the structural VAR pooling quarterly data from the same group of countries as in the baseline model: Argentina, Brazil, Mexico, Peru, South Africa and Turkey. However, the sample period for some of the countries is shorter than the baseline model based on the availability of the bank lending spread data. The sample also begins in the first quarter of 1994 and ends in the third quarter of 2011. The only difference is that the sample for Brazil starts from 1999Q3 instead of 1995Q1; and for Turkey from 2003Q1 instead of 1999Q3. I estimate the Bank Lending Spread, Output, Investment, Trade Balance-to-Output Ratio and Country Interest rate equations of the VAR system in Equation (2.2) by OLS including country dummies and constant term. The exogenous block (U.S. real interest rate and Global Risk Aversion Equations) of the VAR system in Equation(2.2) is estimated by OLS including only constant for the longer time span from 1987:3 to 2011:4.

2.4.2 Estimation Results for the Extended Model

This section focuses on the role domestic interest rates in the transmission process of external shocks to output. Figure 2.13 displays the response of the variables included in the VAR system (2.2) to one standard deviation increase in the domestic bank lending spread shock. In response to an unanticipated one standard deviation shock to domestic lending spread (1.3 percentage points), the country spread increases by about 0.5 percentage point and then quickly falls toward its steady-state level. Output, investment, and the trade balance to-output ratio respond as one would expect. The output and investment fall significantly one period after the shock and recover pretty quickly to their steady state level. The trade balance improves significantly in the year following the shock. The impact of a bank lending spread shock on domestic macroeconomic aggregates is vert short-lived. The effect of the shock dies out very quickly and its impact is statistically insignificant about a year after the shock. Based on the variance decomposition analysis (not shown in the figure), 10 percent of the fluctuations in country spreads is explained by bank lending spreads, which is also robust to alternative orderings (not shown in figure).[14]

Figure 2.14 displays the response of the variables included in the VAR system to one standard deviation increase in the country spread shock. In response to an unanticipated country-spread shock, the country spread itself increases on impact, stays high one period after the shock and then falls toward its steady-state level.

[14]The results in this are not directly comparable to the baseline model because in the extended model sample size is different even if the number of countries is same. In the baseline model I report that around 60 percent of fluctuations in country spread is due to country spread shock itself. In the model with bank lending spreads, 50 percent of fluctuations in country spread is explained by the country spread shock itself.

Output and investment fall, and the trade balance improves significantly in the three periods following the shock. The impact of heightened country risk on the domestic bank lending spreads is statistically significant. 0.8 percentage point increase in the country risk premium leads to 0.4 percentage point increase in the bank-lending spread in emerging economies. The effect of the shock on bank lending spreads dies out quickly. The half life of bank lending spread is about a year.

The impulse responses following one standard deviation increase in a measure of Global Risk is shown in Figure 2.15. The interesting result is that the effect of the global risk on domestic bank lending spreads is negligible. Most of the impact of the global risk still transmitted to the domestic economy through its impact on country spreads.

2.5 Robustness Analysis

2.5.1 Robustness of Results to Different Estimation Methods

The purpose of this section is to apply different econometric estimation methods and compare the estimated impulse response function. Judson and Owen (1999) and Juessen and Linnemann (2010) compare the performance of widely applied techniques to estimate panel VARs from macroeconomic (large T) data with the help of Monte Carlo simulations. In this section I briefly discuss estimation methods implemented in this paper (Least square dummy variable method (LSDV), Bias corrected Least square dummy variable method (LSDVBC) following Hahn and Kuersteiner (2002) and GMM method following Arellano and Bond (1991)) and then compare the estimated impulse response functions across different methods.

The panel VAR model given in equation (2.1) has additive individual time invariant intercepts (fixed effects) along with a parameter common to every country used in the sample. LSDV method eliminates the fixed effects. A potential concern with LSDV estimation of the panel VAR models is the inconsistency of the least squares parameter estimates due to the combination of fixed effects and lagged dependent variables, but, the associated bias decreases in T; see e.g. Nickell (1981). I use the bias-corrected fixed effects estimator developed by Hahn and Kuersteiner (2002). Their method is suitable for panel VAR models with large times series dimension which is the case in this study. The estimator I implement is given by equations (3) and (4) in Hahn and Kuersteiner (2002). GMM estimator takes first differences of the dynamic system to eliminate the fixed effects. This introduces a correlation between lagged dependent variables and differenced errors. Arellano and Bond (1991) have developed GMM estimators that use all linear moment restrictions specified by the model, as more lagged instruments become available for the differenced equation. Since the number of moment restrictions increases at the order T^2; I do not use all available moment restrictions but use a maximum of five lagged levels as instruments.

Figure 2.16 shows the estimated impulse responses to one standard deviation shock to country spreads. The dashed lines are the impulse response functions that are implied by the LSDV estimates and the solid lines with stars show impulse response functions from the bias-corrected fixed effects estimator, LSDVBC. Only the former impulse responses are accompanied by 95% and 68% bootstrapped confidence bands (shown by the dark-gery and light-grey shaded areas respectively). All responses are estimated to be in line with one would expect. The bias-corrected estimates show more persistence than the LSDV estimates. This observation reflects the negative bias of the LSDV estimator in samples of this size. Output and Investment responses are still substantial and they stay as low as a period after shock after about a year, i.e. at a time when the exogenous persistence of country spending itself has reduced the decrease in output and investment to about half its impact value. Other than with respect to persistence, the impulse responses from the LSDV and LSDVBC estimates turn out to be fairly similar (with the LSDVBC responses lying within the confidence bands of the LSDV based ones).

Figure 2.17 shows impulse response functions to one standard deviation shock to country spreads. The estimated impulse responses with GMM method are shown with circled lines. The results are in general in line with the monte carlo evidence presented in Juessen and Linnemann (2010) . The substantial negative bias in this type of estimator translates into impulse response functions dying out very quickly. This problem is most remarkable for Investment equation. Investment decreases one period after the shock. The decrease in the investment is substantially lower than the decline predicted by the LSDV estimator and the effect of the shock on domestic macroeconomic variables dies out very quickly.

Overall, I argue that estimated impulse response functions following country spread shocks obtained using widely applied simple fixed effects LSDV estimator are still reasonably close to the bias-corrected ones, though they tend to understate the persistence of shock effect. Since the time series dimension of my data is very large (significantly larger than cross section dimension), LSDV method produces estimates with small bias; and when converted into impulse responses and variance decompositions, the results obtained with LSDVBC method are fairly close to the results predicted by simple LSDV.

2.5.2 An Alternative Identification Scheme

In this section I present an an alternative strategy for identifying country-spread shocks. Namely, I assume that innovations to the US interest rate, to the global risk and to country spreads can affect real domestic variables contemporaneously and that innovations to domestic variables affect country spreads with a lag. Formally, the empirical system takes the form where the matrix A is assumed to be lower triangular. I continue to assume that the US interest rate and a measure of global risk follows a VAR(2) process.

$$Ay_{i,t} = \sum_{k=1}^{p} B_k y_{i,t-k} + \eta_i + \epsilon_{i,t} \tag{2.3}$$

where η_i is a fixed effect and

$$\begin{aligned} y_{i,t} &= \left[\hat{R}_t^{US}, \hat{GR}_t, \hat{R}_{i,t}, \hat{gdp}_{i,t}, \hat{inv}_{i,t}, tby_{i,t}\right] \\ \epsilon_{i,t} &= \left[\epsilon_t^{RUS}, \epsilon_t^{GR}, \epsilon_{i,t}^{R}, \epsilon_{i,t}^{gdp}, \epsilon_{i,t}^{inv}, \epsilon_{i,t}^{tby}\right] \end{aligned}$$

The impulse responses following one standard deviation shock to the country spread and to the global risk is shown in Figure 2.18. The shape of the impulse responses is very similar to the one obtained under baseline model. Figure 2.19 displays the variance decomposition of the variables contained in the VAR system at different horizons. Surprisingly, the difference in the contribution to external financial conditions to domestic variables in this identification scheme is very small compared to the baseline model. International financial factors jointly accounts for about 45 percent of the fluctuations in domestic activity. The contribution of the U.S. interest rate shock is still negligible.

2.5.3 Sub-sample Analysis - Pre-crises period

One natural question in this context is whether the results presented in this study are driven by the crises in 2008. There is a tendency for comovements in financial markets indicators to increase during crisis periods. In light of this, I re-run the baseline VAR system 2.1 for the time period between 1994Q1-2007Q3.

Figure 2.20 displays the variance decomposition of the variables contained in the VAR (2.1) system at different horizons between 1994Q1-2007Q4 period. Solid lines show the fraction of the variance of the forecasting error explained jointly by US-interest-rate shocks and country-spread shocks. Broken lines depict the fraction of the variance of the forecasting error explained by US-interest rate shocks. The results show that global risk is still important in deriving sovereign spreads and macroeconomic fluctuations in emerging economies. The percent of forecast error variance explained by global risk for output and investment decreases only slightly. The role of US real interest rate on business cycle fluctuations of the countries included in the sample is still small. The role of country spreads in accounting for the fluctuations in output and investment is unchanged.

2.5.4 Different country coverage

To study the robustness of the results presented in the baseline model, I augment the sample by adding 4 more emerging economies. Namely, Chile, Colombia, Malaysia, and Philippines. I also deepen the sample in the temporal dimension by enlarging the Argentine sample to the period 1983:1 to 2001:3. The variance decomposition results of estimating the VAR system (2.1) using the expanded sample are shown in Figure 2.21. External shocks still account for an important fraction of the variance explained in emerging economies. Around 30% of the fluctuations in economic activity is explained jointly by external financial conditions and sovereign spreads.

2.6 Conclusion

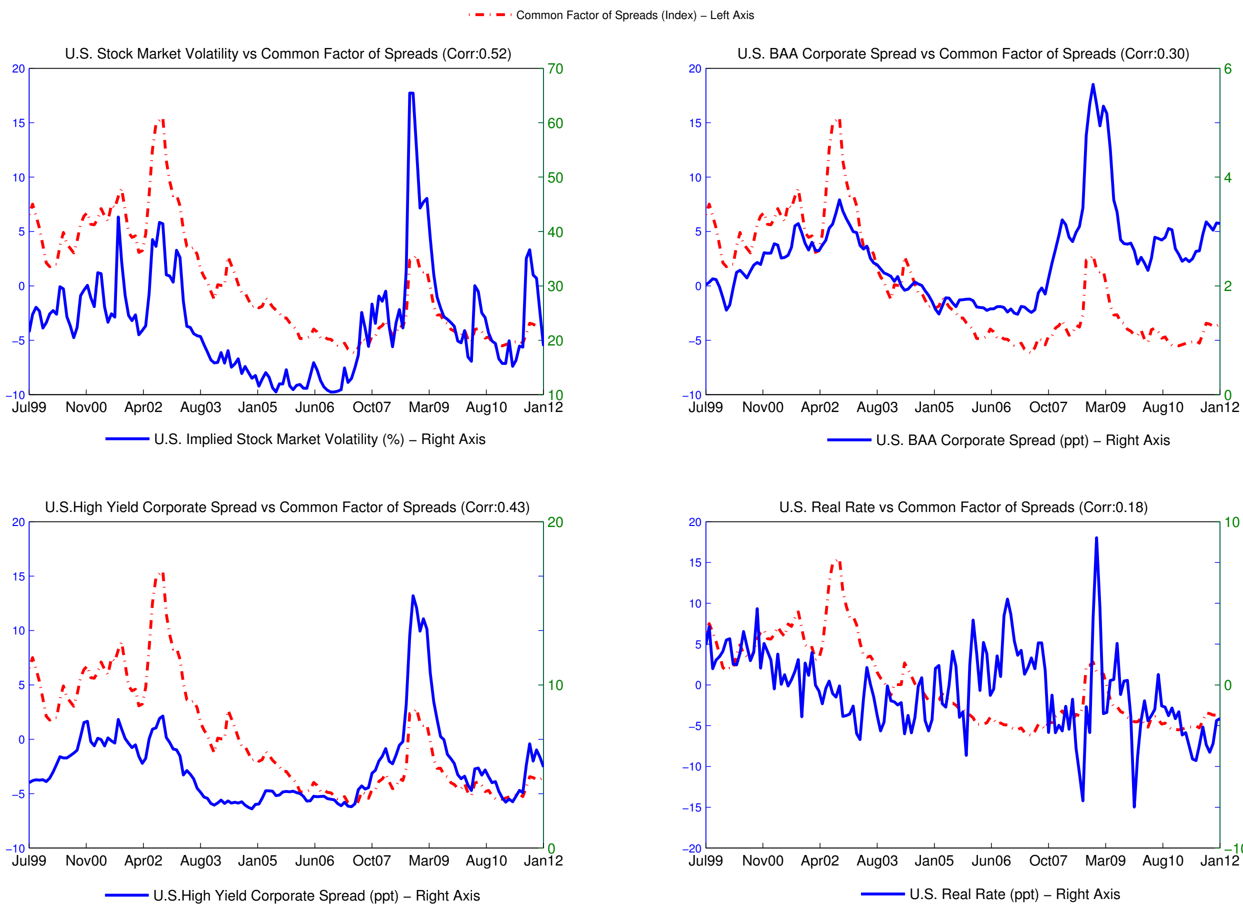
After recent financial crises, there has been a renewed interest in understanding the role of global factors in explaining the variation in the country spreads and in the business cycle fluctuations in emerging economies. This paper has explored the role of global shocks in accounting for the volatility of macroeconomic aggregates in emerging economies. Impulse responses and variance decomposition exercise show that global risk shocks explain about 20 percent of movements in aggregate activity in emerging economies while the contribution of U.S. Interest Rate shocks to emerging market business cycle fluctuations is negligible. Therefore, the role of U.S. interest rate shocks in driving the business cycle fluctuations in emerging economies, as emphasized in the previous literature, is taken up by the global risk shocks. Sovereign spread shocks, after the role of external factors and state of the macroeconomy is taken into account, explain about 15 percent of business cycles in emerging economies. But, more importantly, country spreads play a significant role in propagating shocks. For instance, I find that global risk shocks explain about 20 percent of movements in output. This is a large number. But most of the contribution of global risk to business cycles in emerging markets is due to the fact that country spreads respond systematically to variations in this variable. Specifically, if country spreads were independent of the global risk, then the variance of emerging countries' output explained by global risk would fall by about two thirds.

Table 2.1: Lag Length Selection Criteria (6 country Panel with country specific dummy and constant)

Lags	LR	FPE	AIC	SC	HQ
0	NA	1.95e-13	-17.92	-17.44	-17.73
1	2018.44	6.76e-16	-23.57	**-22.93***	**-23.32***
2	**40.16***	**6.57e-16***	**-23.60***	-22.79	-23.28
3	19.27	6.78e-16	-23.57	-22.59	-23.18
4	23.48	6.91e-16	-23.55	-22.40	-23.10

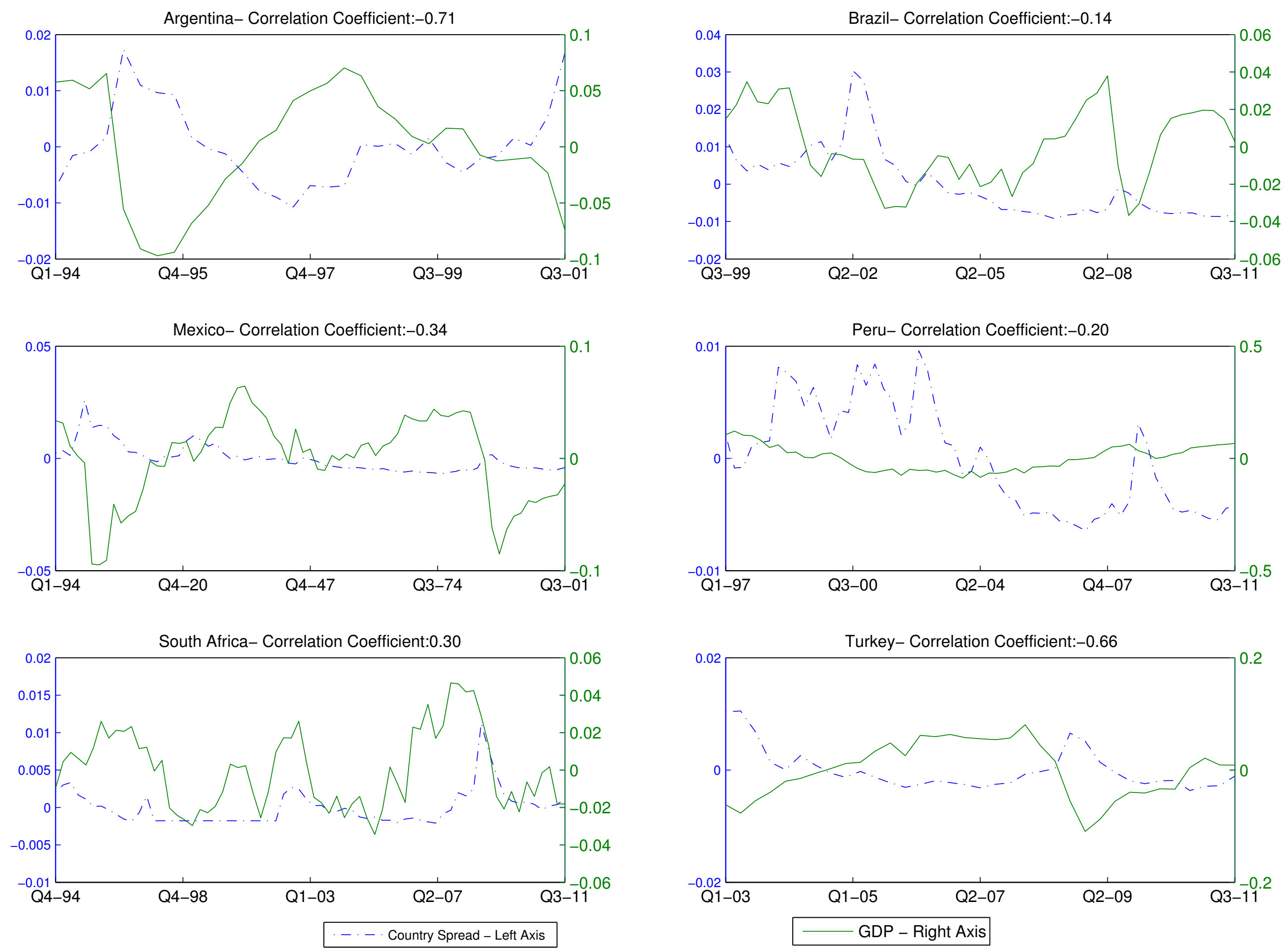
Notes: * indicates lag order selected by the criterion (at 5% level). LR: sequential modified LR test statistics; FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion.

Figure 2.1: The Global Risk, The U.S. Real Rate and the Country Spread



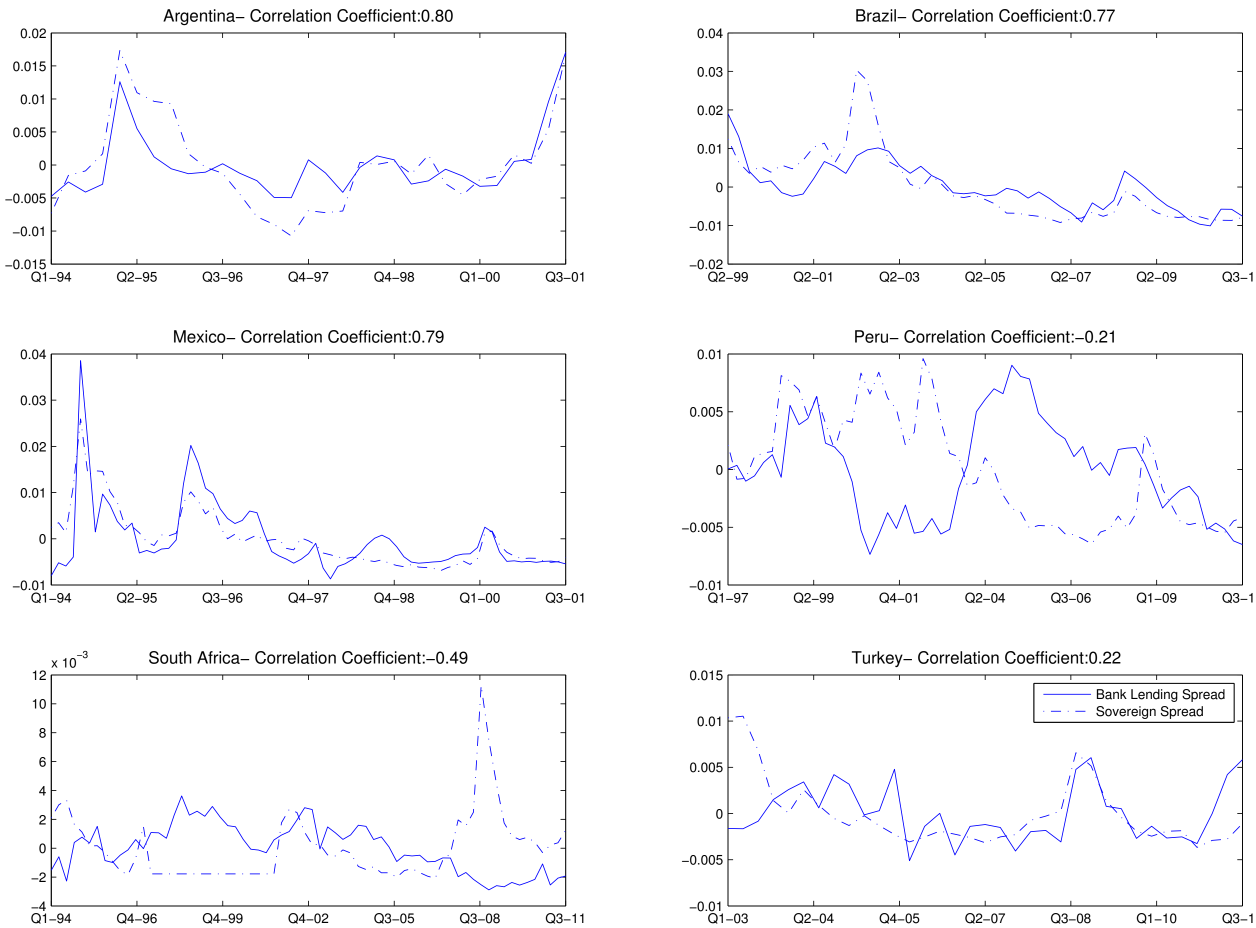
Notes: The common factor of spreads is the first principal component based on sovereign spreads of Brazil, Chile, Colombia, Malaysia, Mexico, Peru, Philippines, South Africa and Turkey. Argentina is excluded from the group of countries because of sovereign default in 2001. U.S. Stock Market Volatility is the monthly (averages of daily values) U.S. Implied Stock Market Volatility (VXO index: Chicago Board of Options Exchange VXO index of percentage implied volatility, on a hypothetical at the money S&P500 option 30 days to expiration). U.S. High Yield Corporate Spread is the spread between the yield of the Merrill Lynch High Yield Master II Index (YTM) and U.S. 20 Year Government Bond Yields. U.S. BAA Corporate Spread is calculated as the difference between U.S. BAA Corporate Rate and U.S. 20 Year Government Bond Yields. U.S. Real Interest Rate is measured as the 3-month gross U.S. Treasury Bill rate deflated using a measure of expected U.S. inflation (see Schmitt-Grohe and Uribe (2011) for details of the calculation of expected U.S. Inflation). I use 13 lags of inflation when calculating expected U.S. inflation. Data Source: Sovereign spreads (EMBI+), Global Financial Data and Bloomberg; U.S. 3M TBILL Rate and U.S. CPI, U.S. BAA Corporate Rate and 20Y Government Bond Yield, St. Louis Fed. FRED Database; U.S. Stock Market Volatility, Bloom (2009). Merrill Lynch High Yield Master II Index (YTM), Bloomberg. The common factor is measured on the left axis. Restricting the sample to those countries included in the baseline analysis in (Brazil, Mexico, Peru, South Africa and Turkey) yields very similar correlation coefficients with U.S. financial market variables.

Figure 2.2: Country Spread vs GDP



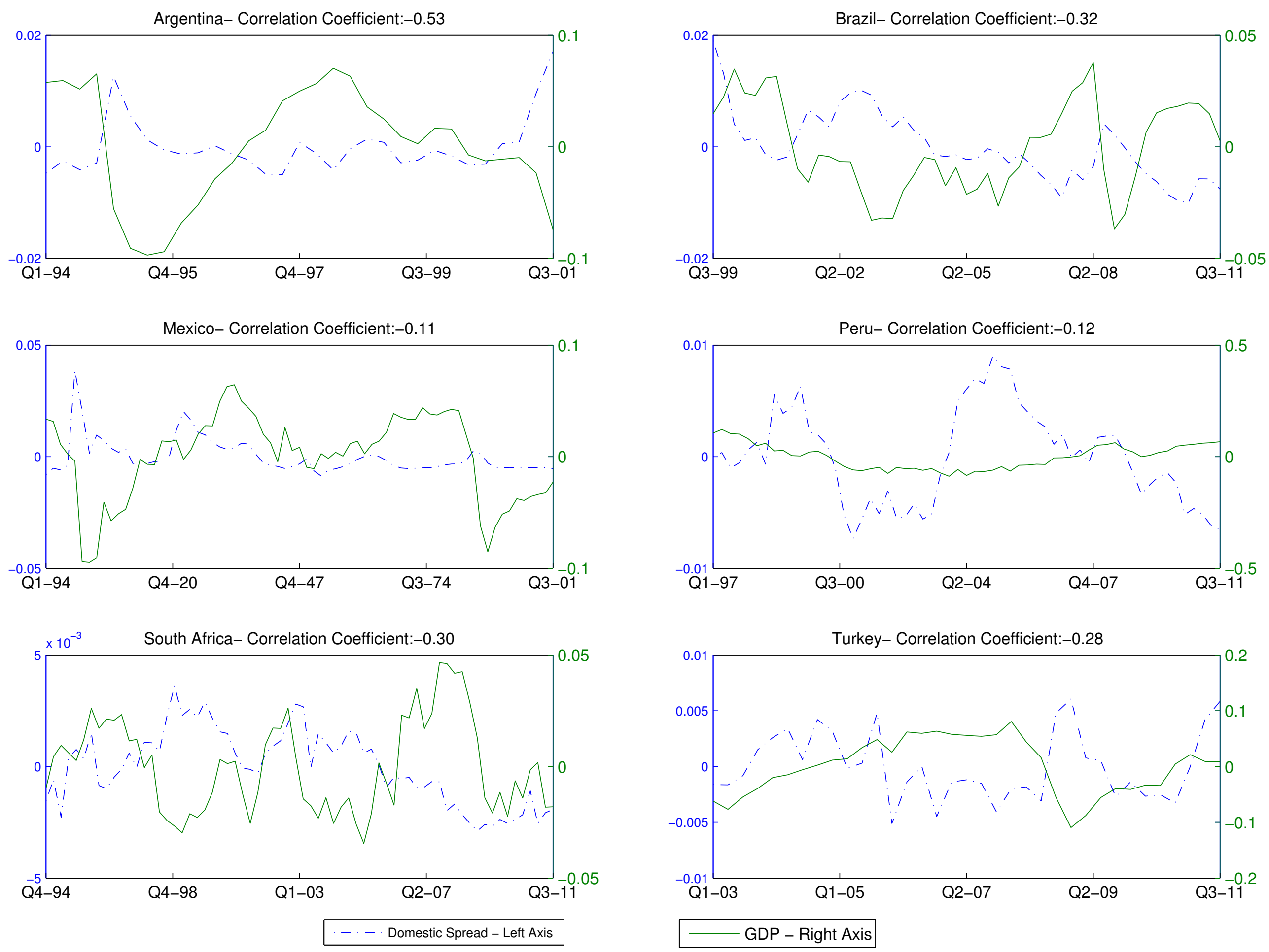
Notes: Output is seasonally adjusted and detrended using a log-linear trend. EMBI+ is an index of country interest rates which are real yields on dollar-denominated bonds of emerging countries issued in international financial markets. Data source: Output, IFS; EMBI+,Global Financial Data.

Figure 2.3: Domestic Borrowing Lending Spreads vs Sovereign Risk



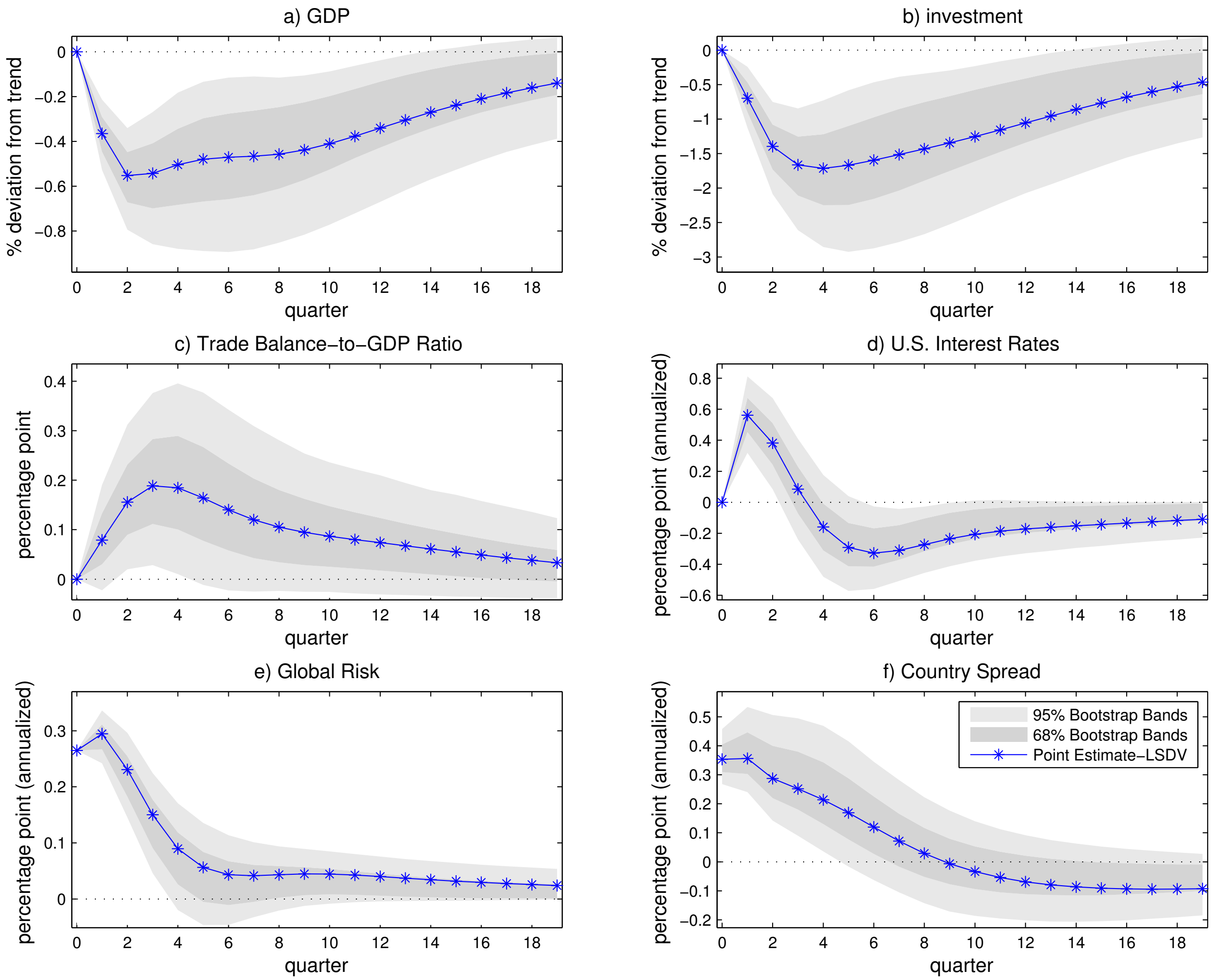
Notes: EMBI+ is an index of country interest rates which are real yields on dollar-denominated bonds of emerging countries in international financial markets. Borrowing lending spread is the difference between domestic lending rate by banks to corporate sector and the deposit rate. Data source: Domestic bank lending spreads, IFS; EMBI+,Global Financial Data.

Figure 2.4: Domestic Borrowing Lending Spreads vs GDP



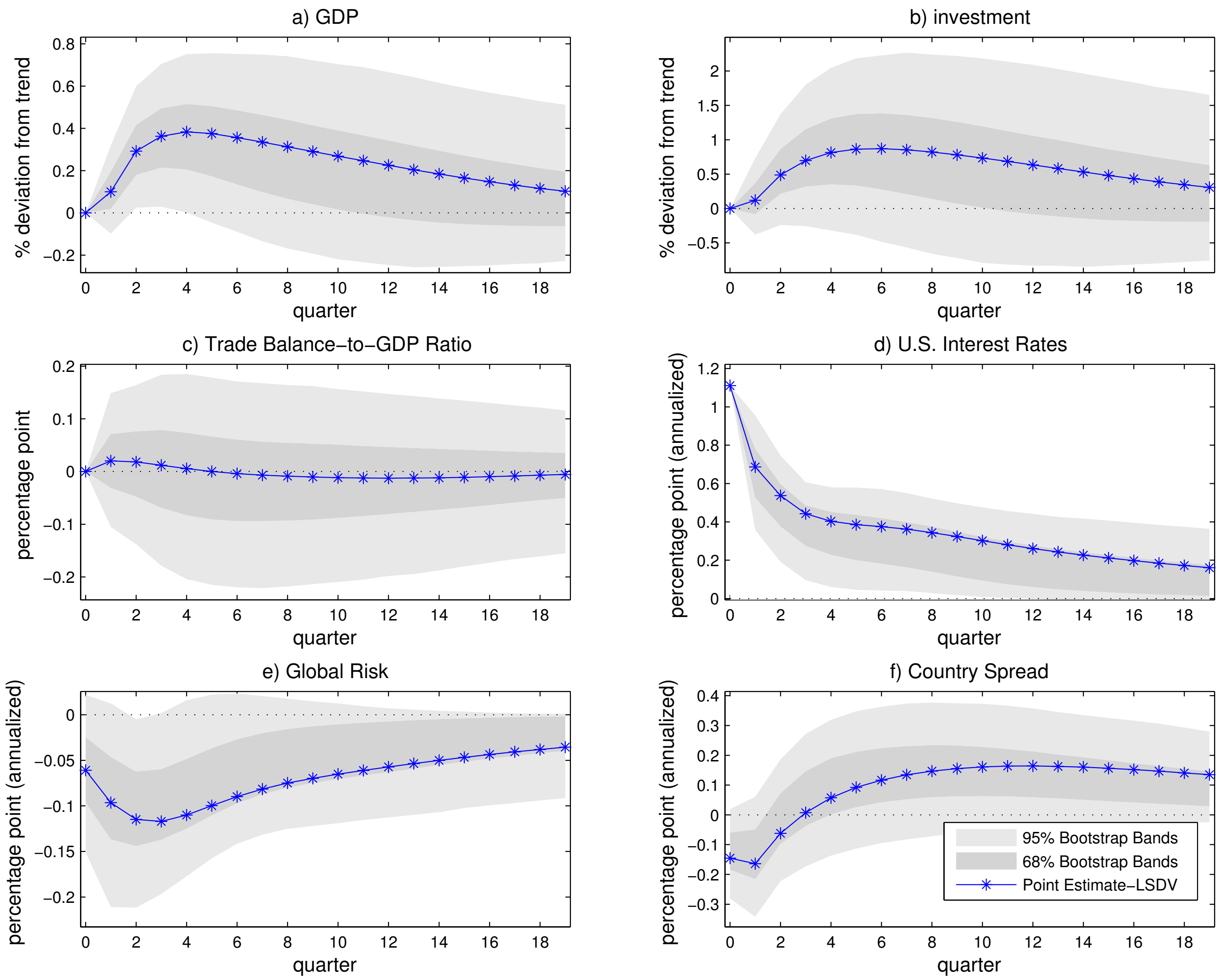
Notes: Borrowing lending spread is the difference between domestic lending rate by banks to corporate sector and the deposit rate. Output is seasonally adjusted and detrended using a log-linear trend. Data source: Output and domestic bank lending spreads, IFS.

Figure 2.5: Impulse Response to a one standard deviation shock to the Global Risk: The U.S. BAA Corporate spread



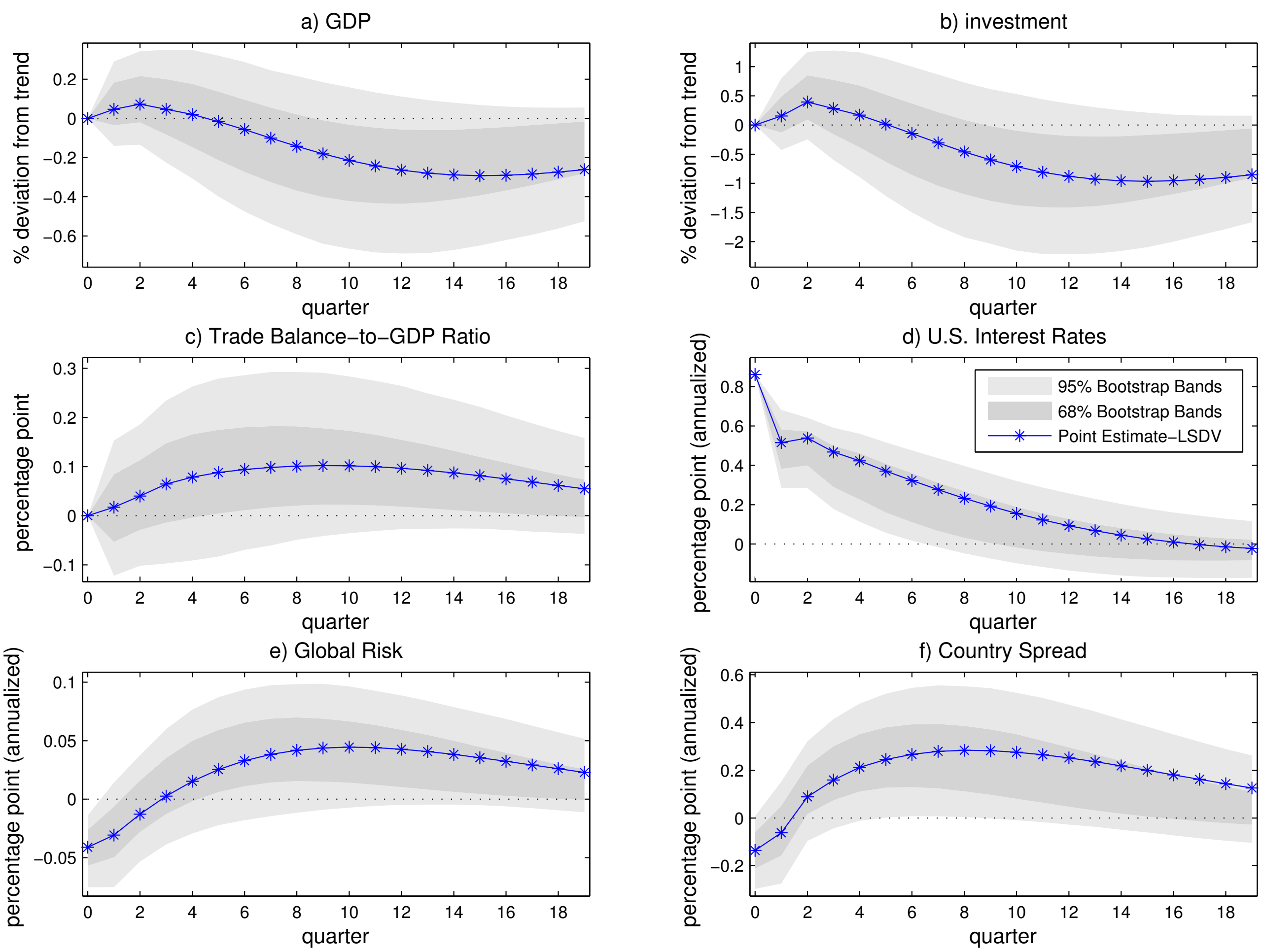
Notes: Solid lines with stars show point estimates of impulse responses; and 68% and 95% Confidence Bands are depicted with dark-grey and light-grey shaded areas respectively. The responses of Output and Investment are expressed in percent deviation from their respective log-linear trends. The response of Trade Balance-to-GDP ratio, the country spread, the U.S. Interest rate and the global risk are expressed (**annualized**) percentage points. Bootstrap confidence bands are based on 10,000 repetitions. U.S. BAA Corporate Spreads are used as a proxy for the global risk.

Figure 2.6: Impulse Response to a one standard deviation shock to the U.S. Real Interest Rate



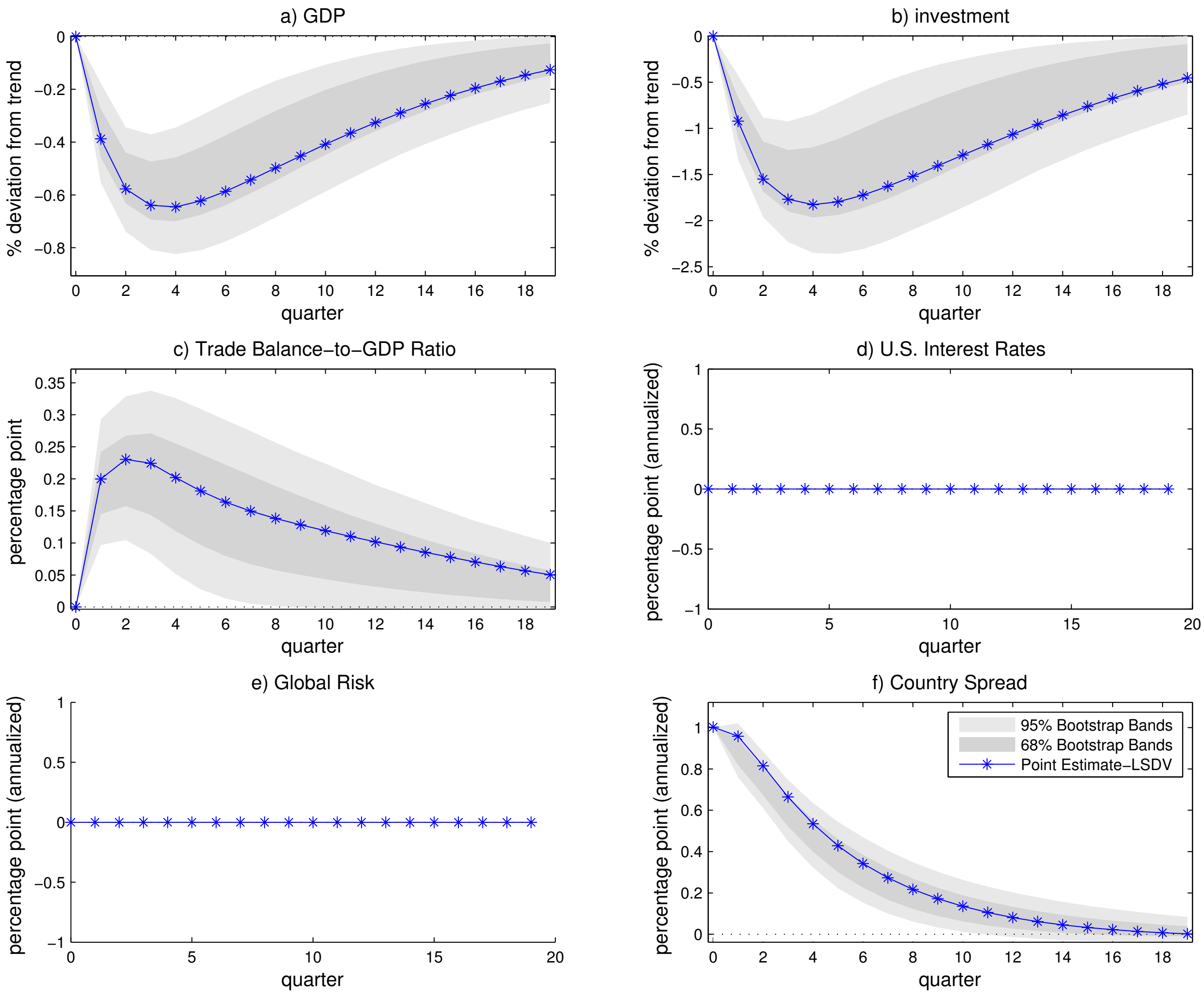
Notes: Solid lines with stars show point estimates of impulse responses; and 68% and 95% Confidence Bands are depicted with dark-grey and light-grey shaded areas respectively. The responses of Output and Investment are expressed in percent deviation from their respective log-linear trends. The response of Trade Balance-to-GDP ratio, the country spread, the U.S. Interest rate and the global risk are expressed (**annualized**) percentage points. Bootstrap confidence bands are based on 10,000 repetitions. U.S. BAA Corporate Spreads are used as a proxy for the global risk.

Figure 2.7: Impulse Response to a one standard deviation shock to the U.S. Real Interest Rate in the Pre-Crises Period



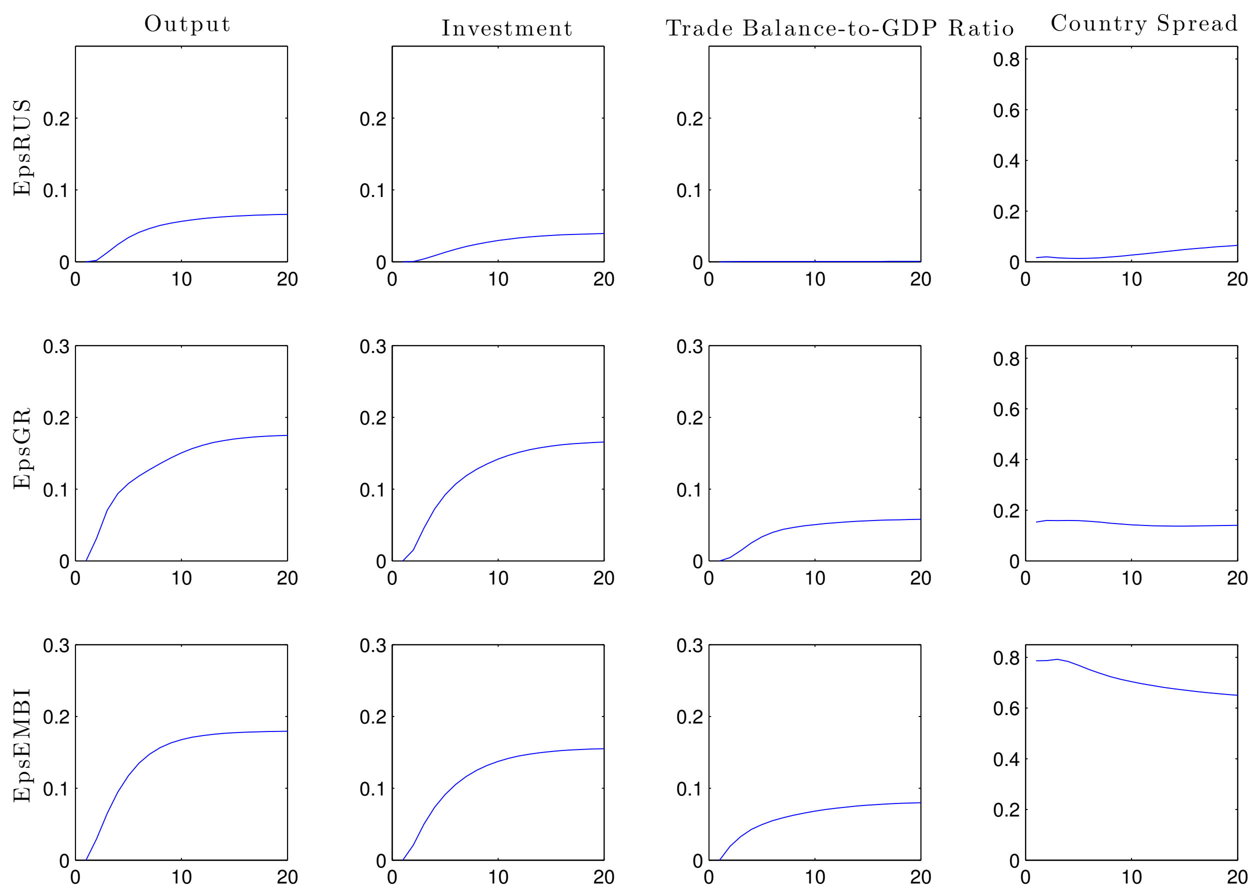
Notes: The estimated impulse responses are for pre-crises period (sample end in 2007Q4). Solid lines with stars show point estimates of impulse responses; and 68% and 95% Confidence Bands are depicted with dark-grey and light-grey shaded areas respectively. The responses of Output and Investment are expressed in percent deviation from their respective log-linear trends. The response of Trade Balance-to-GDP ratio, the country spread, the U.S. Interest rate and the global risk are expressed (**annualized**) percentage points. Bootstrap confidence bands are based on 10,000 repetitions. U.S. BAA Corporate Spreads are used as a proxy for the global risk.

Figure 2.8: Impulse Response to a one standard deviation shock to the country spread



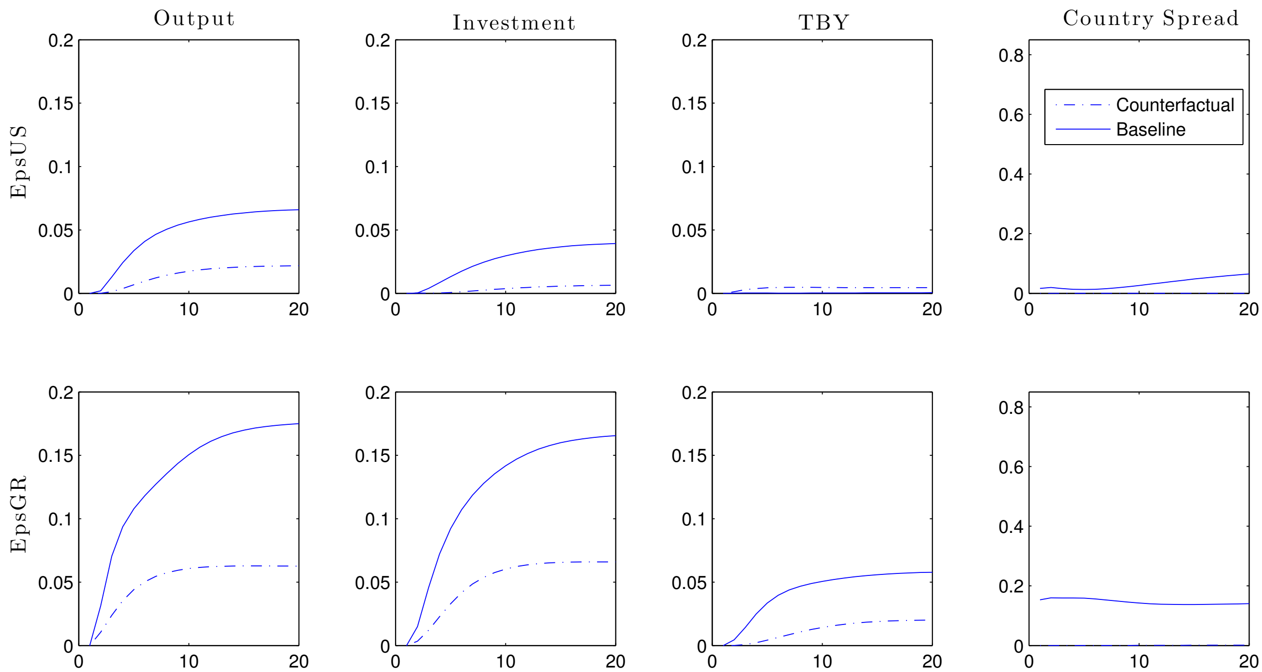
Notes: Solid lines with stars show point estimates of impulse responses; and 68% and 95% Confidence Bands are depicted with dark-grey and light-grey shaded areas respectively. The responses of Output and Investment are expressed in percent deviation from their respective log-linear trends. The response of Trade Balance-to-GDP ratio, the country spread, the U.S. Interest rate and the global risk are expressed (**annualized**) percentage points. Bootstrap confidence bands are based on 10,000 repetitions. U.S. BAA Corporate Spreads are used as a proxy for the global risk.

Figure 2.9: Forecast Error Variance Decomposition at Different Horizons



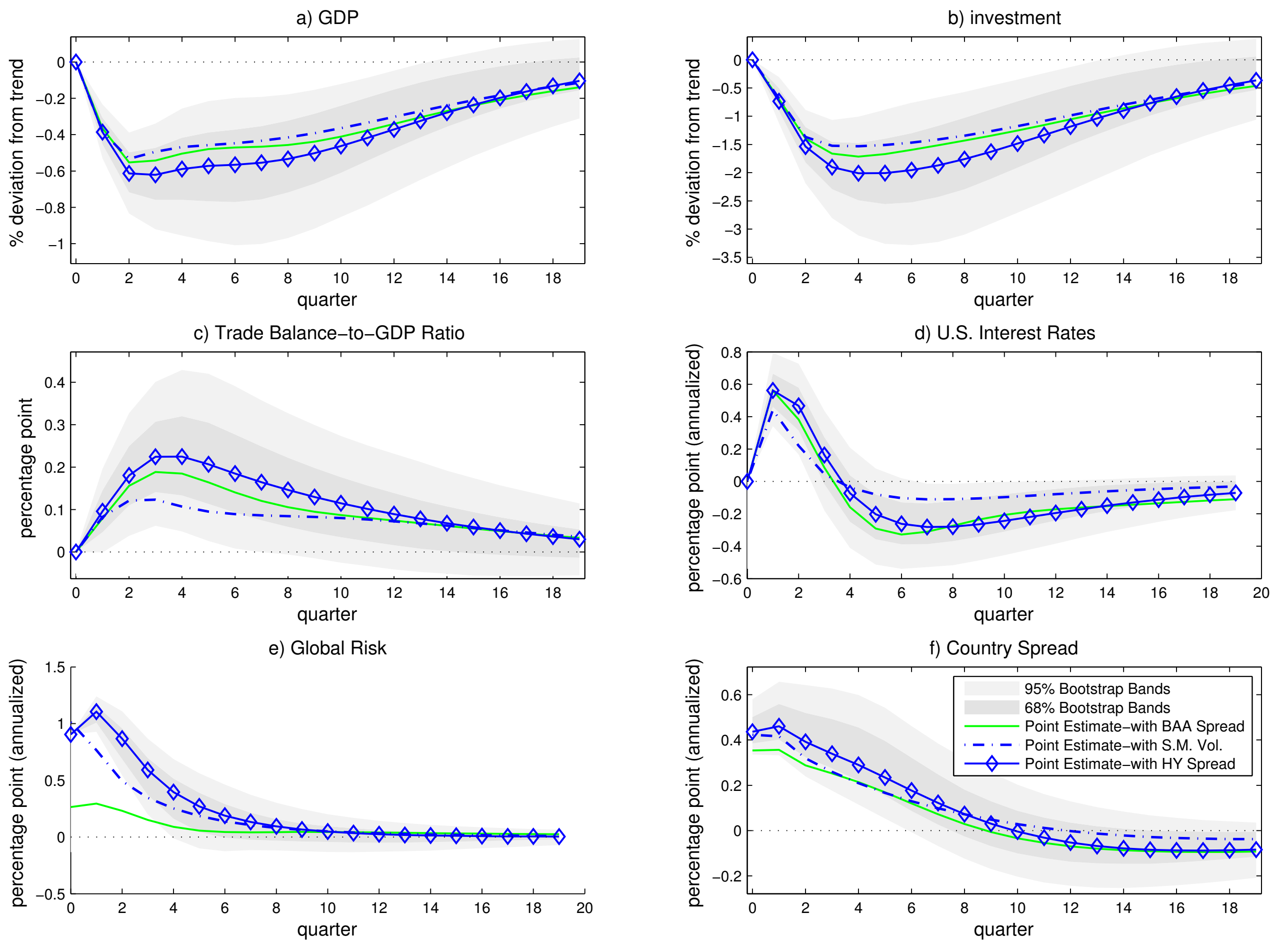
Notes: Solid lines depict the fraction of the variance of the k-quarter ahead forecasting error explained by the US real interest rate shocks (shown in the first row), the Global Risk shocks (shown in the second row); and the Country Spread shocks (shown in the last row) at different horizons. U.S. BAA Corporate Spreads are used as a proxy for the global risk.

Figure 2.10: Forecast Error Variance Decomposition at Different Horizons– Counterfactual



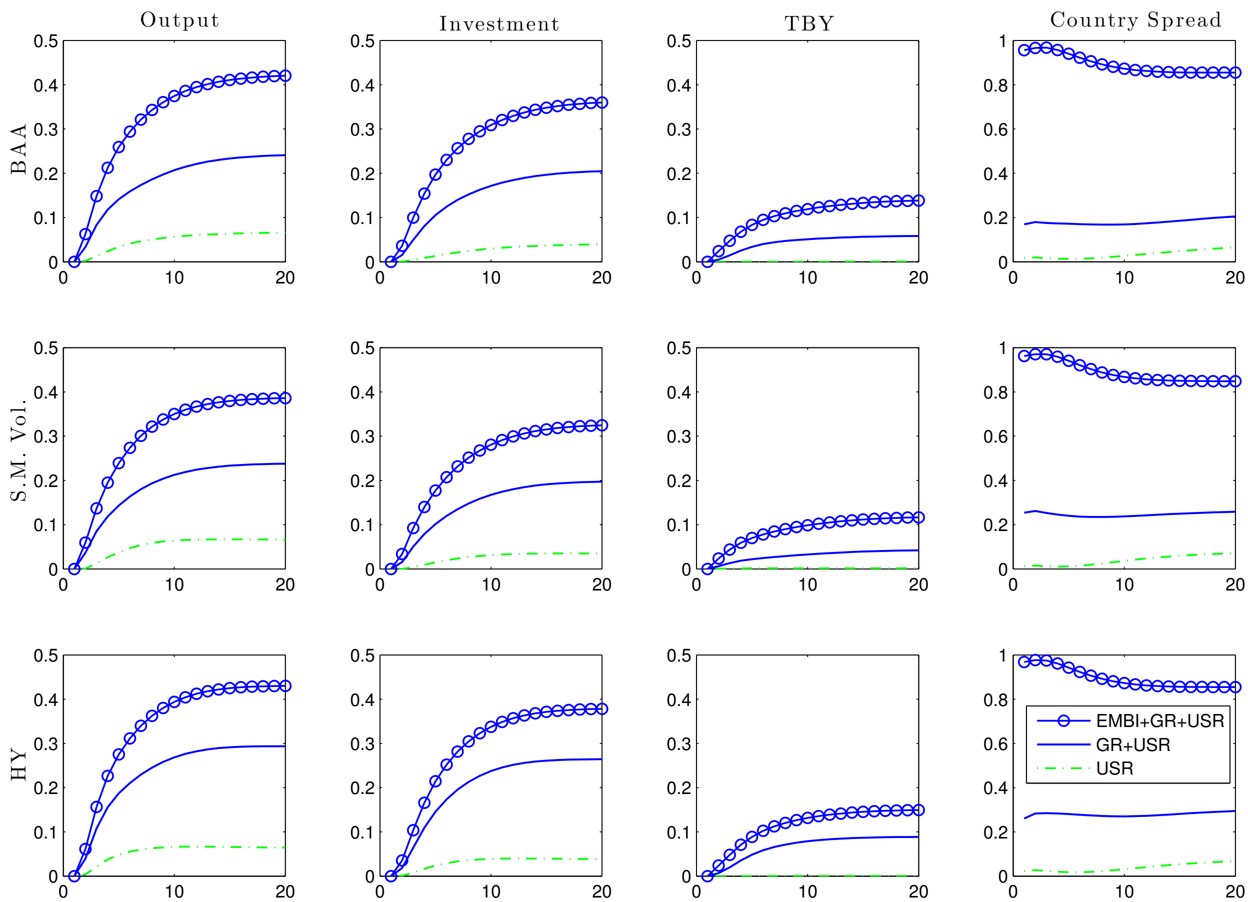
Notes: Solid lines depict the fraction of the variance of the k-quarter ahead forecasting error explained by the US real interest rate shocks (shown in the first row), the Global Risk shocks (shown in the second row). Dashed lines show the fraction of the variance of the k-quarter ahead forecasting error explained by the US real interest rate shocks (shown in the first row), the Global Risk shocks (shown in the second row), when the country spread is assumed not to respond directly to variations in US financial variables. U.S. BAA Corporate Spreads are used as a proxy for the global risk.

Figure 2.11: Impulse Response to a one standard deviation shock to the Global Risk: the U.S. BAA Corporate spread, the U.S. HY Corporate Spread, and the U.S. Stock Market Volatility Index



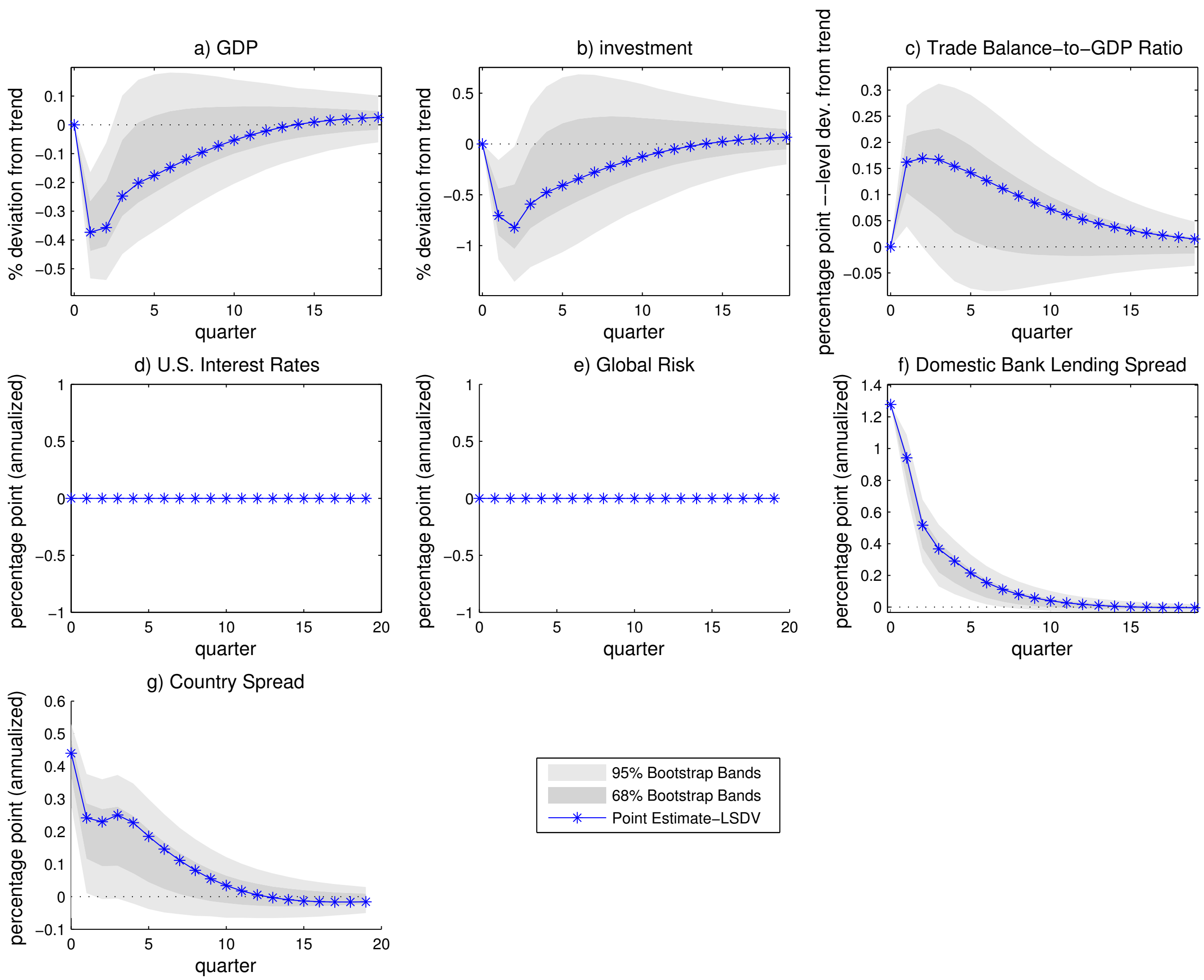
Notes: Solid lines with diamond show point estimates of impulse responses when High Yield Spread is used as a proxy for the global risk; dashed lines depict point estimate when U.S. Stock Market Volatility Index is used as a proxy for the global risk; and solid lines show point estimates of impulse responses when U.S. corporate BAA spread (as in the baseline model) is used as a proxy for the global risk. 68% and 95% Confidence Bands associated with estimates with high yield index are depicted with dark-grey and light-grey shaded areas respectively. The responses of Output and Investment are expressed in percent deviation from their respective log-linear trends. The response of Trade Balance-to-GDP ratio, the country spread, the U.S. Interest rate and the global risk are expressed (**annualized**) percentage points. Bootstrap confidence bands are based on 10,000 repetitions.

Figure 2.12: Forecast Error Variance Decomposition at Different Horizons–Alternative measures of the Global Risk



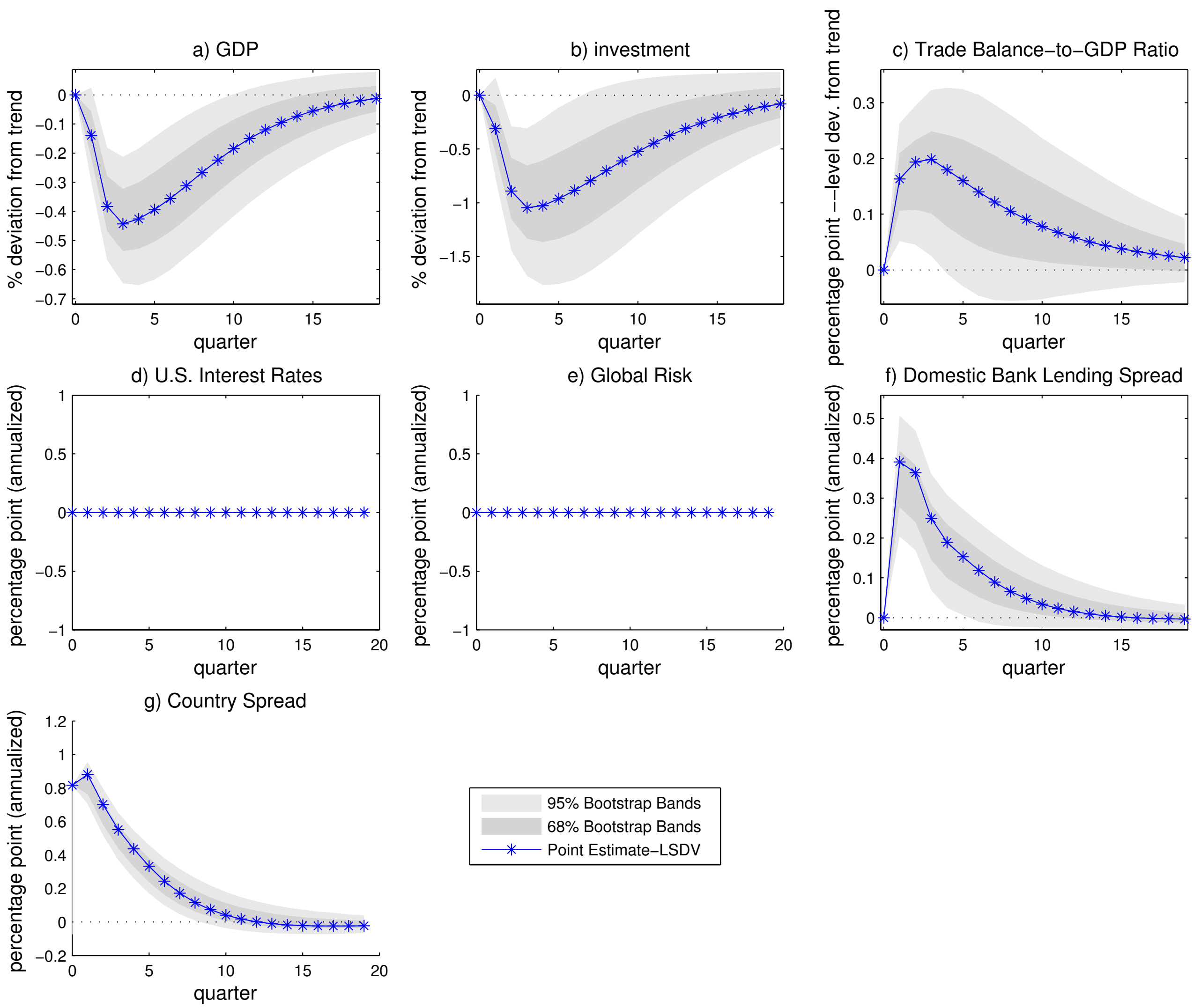
Notes: Note: Solid lines with circles depict the fraction of the variance of the k-quarter ahead forecasting error explained jointly by the US real interest rate, the global risk and country spread shocks. Solid lines shows the fraction of the variance of the k-quarter ahead forecasting error explained jointly by the US real interest rate and the global risk. Broken lines depict the fraction of the variance of the forecasting error explained the US interest rate shock. The first row shows the forecast error variance decomposition at different horizons when US BAA Corporate spread is used as a proxy for the global risk. The second row shows the forecast error variance decomposition at different horizons when US stock market volatility index is used as a proxy for the global risk. The third row shows the forecast error variance decomposition at different horizons when High Yield spread is used as a proxy for the global risk.

Figure 2.13: Impulse Response to a one standard deviation shock to the Bank Lending Spread in the Extended Model



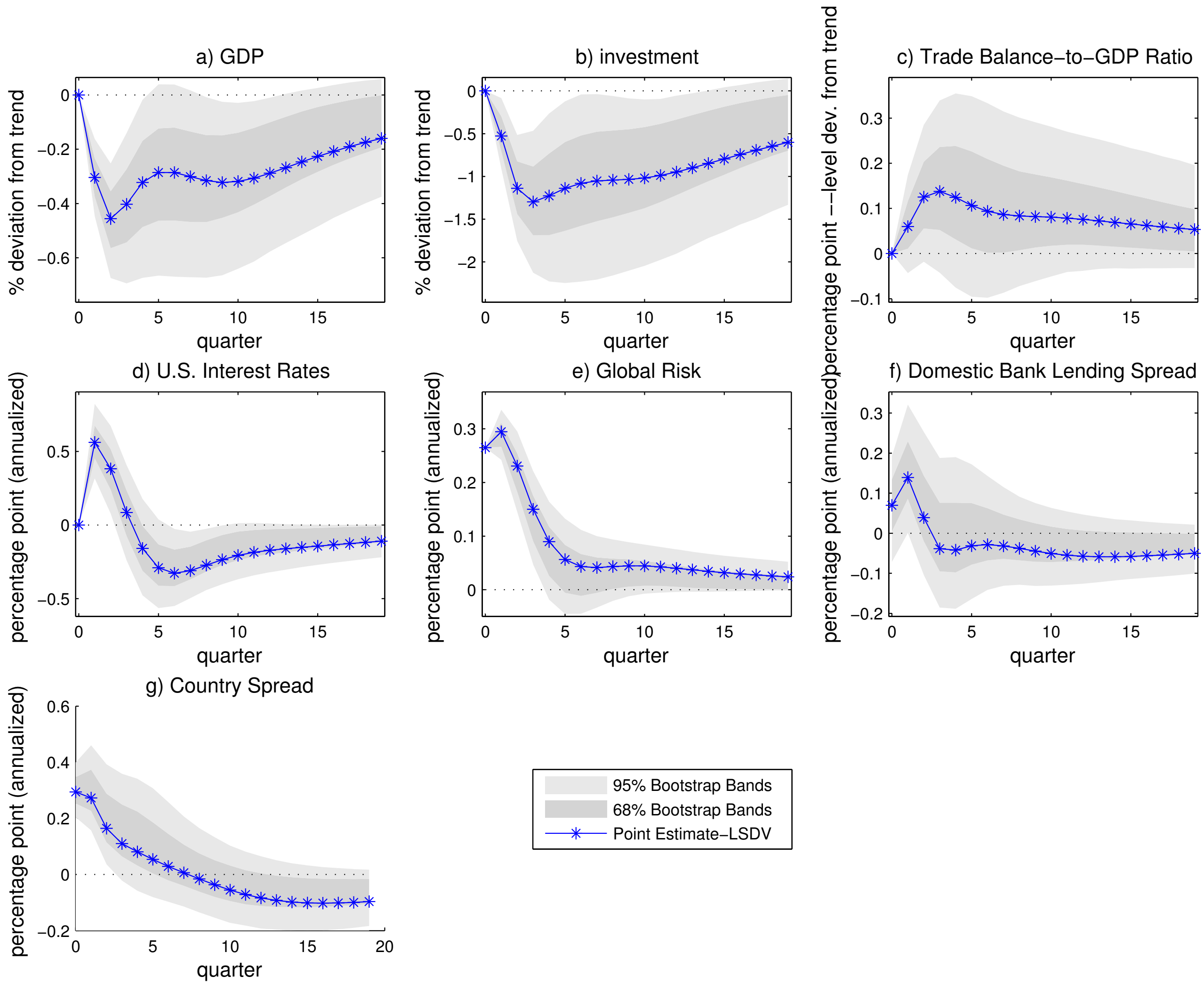
Notes: Solid lines with stars show point estimates of impulse responses; and 68% and 95% Confidence Bands are depicted with dark-grey and light-grey shaded areas respectively. The responses of Output and Investment are expressed in percent deviation from their respective log-linear trends. The response of Trade Balance-to-GDP ratio, the country spread, the U.S. Interest rate, domestic borrowing-lending spread and the global risk are expressed (**annualized**) percentage points. Bootstrap confidence bands are based on 10,000 repetitions. U.S. BAA Corporate Spreads are used as a proxy for the global risk.

Figure 2.14: Impulse Response to a one standard deviation shock to the country spread in the Extended Model



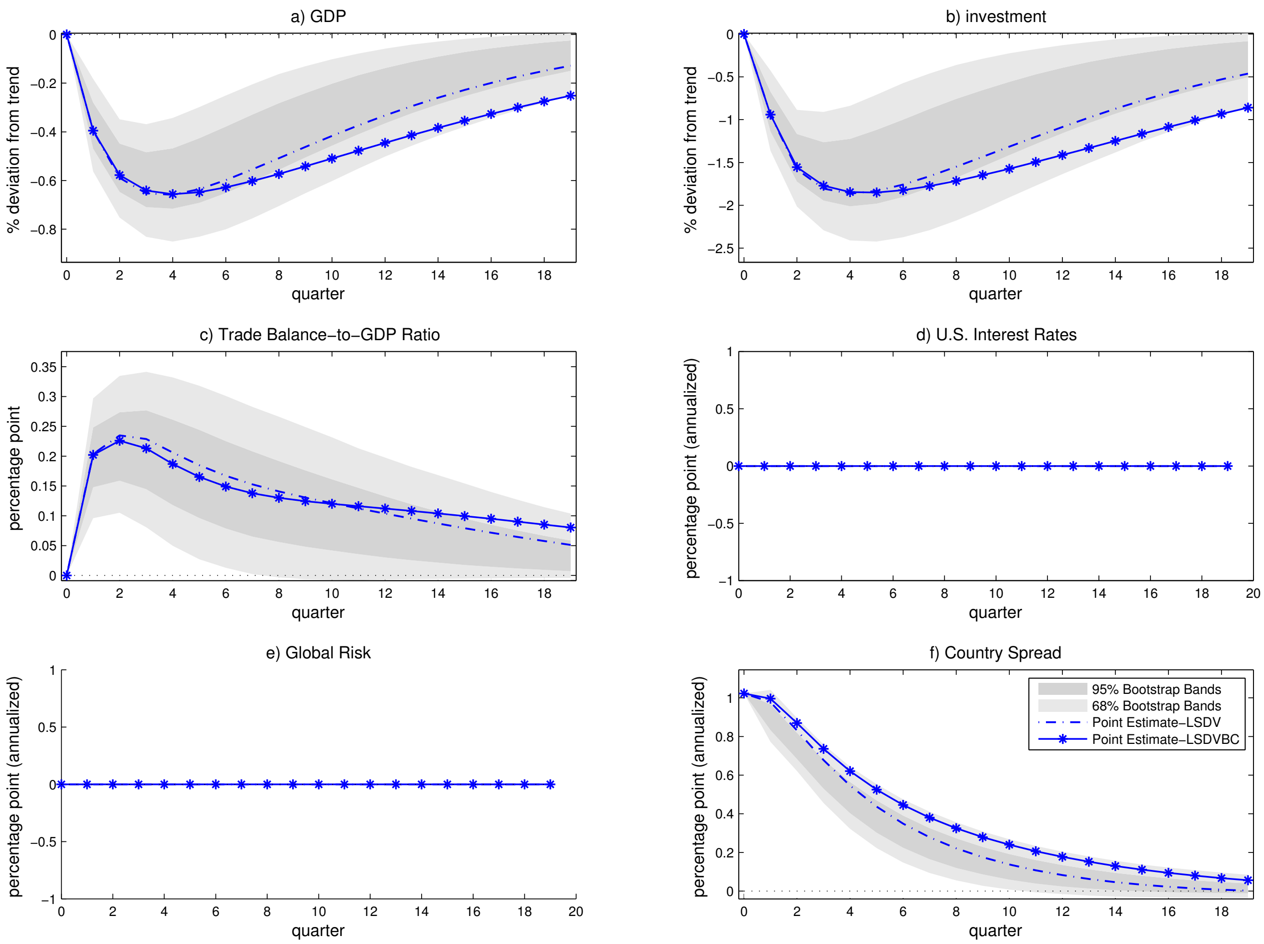
Notes: Solid lines with stars show point estimates of impulse responses; and 68% and 95% Confidence Bands are depicted with dark-grey and light-grey shaded areas respectively. The responses of Output and Investment are expressed in percent deviation from their respective log-linear trends. The response of Trade Balance-to-GDP ratio, the country spread, the U.S. Interest rate, domestic borrowing-lending spread and the global risk are expressed (**annualized**) percentage points. Bootstrap confidence bands are based on 10,000 repetitions. U.S. BAA Corporate Spreads are used as a proxy for the global risk.

Figure 2.15: Impulse Response to a one standard deviation shock to the Global Risk: U.S. BAA Corporate spread in the Extended Model



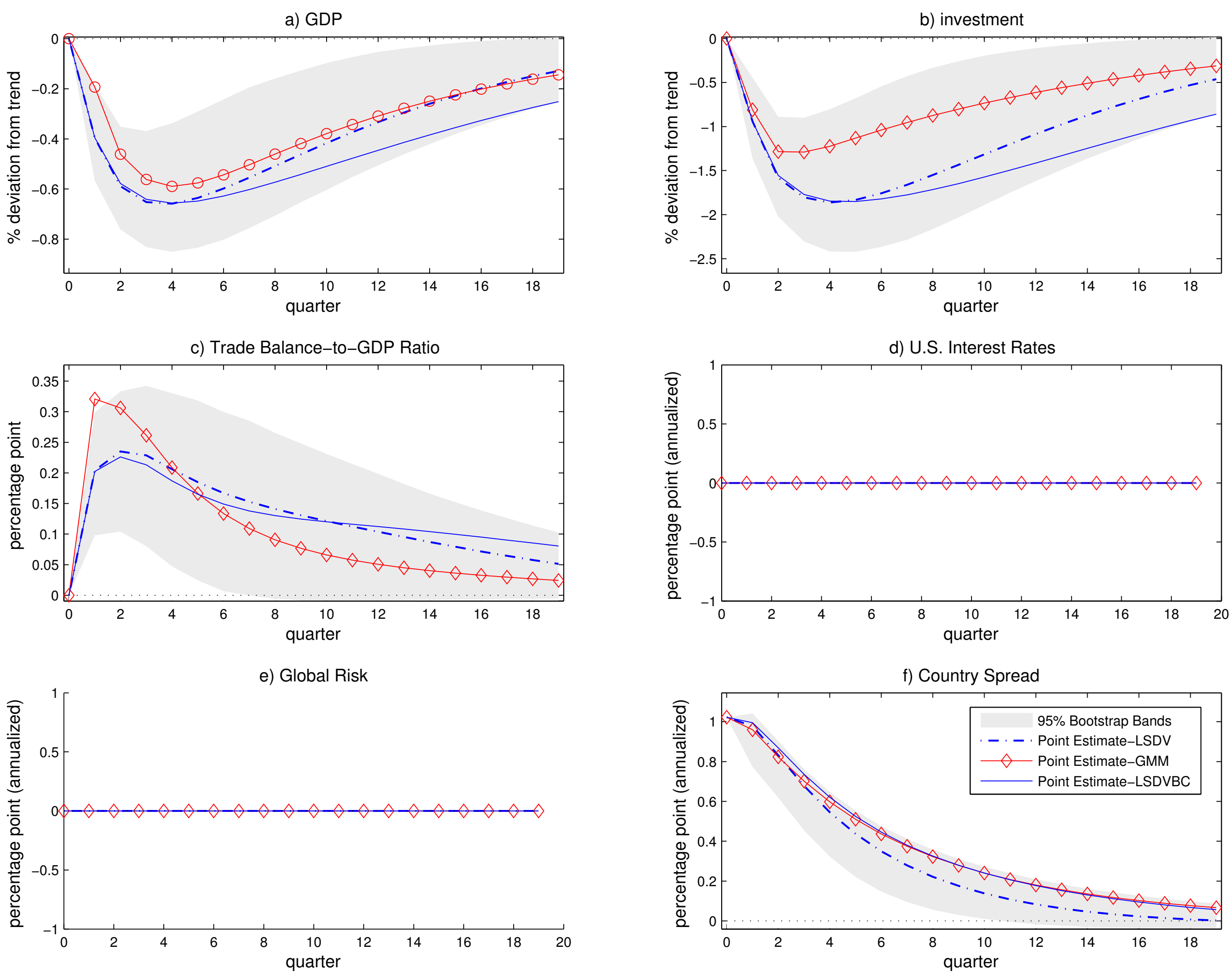
Notes: Solid lines with stars show point estimates of impulse responses; and 68% and 95% Confidence Bands are depicted with dark-grey and light-grey shaded areas respectively. The responses of Output and Investment are expressed in percent deviation from their respective log-linear trends. The response of Trade Balance-to-GDP ratio, the country spread, the U.S. Interest rate, domestic borrowing-lending spread and the global risk are expressed (**annualized**) percentage points. Bootstrap confidence bands are based on 10,000 repetitions. U.S. BAA Corporate Spreads are used as a proxy for the global risk.

Figure 2.16: Impulse Response to a one standard deviation shock to the country spread – Bias Corrected LSDV (LSDVBC)



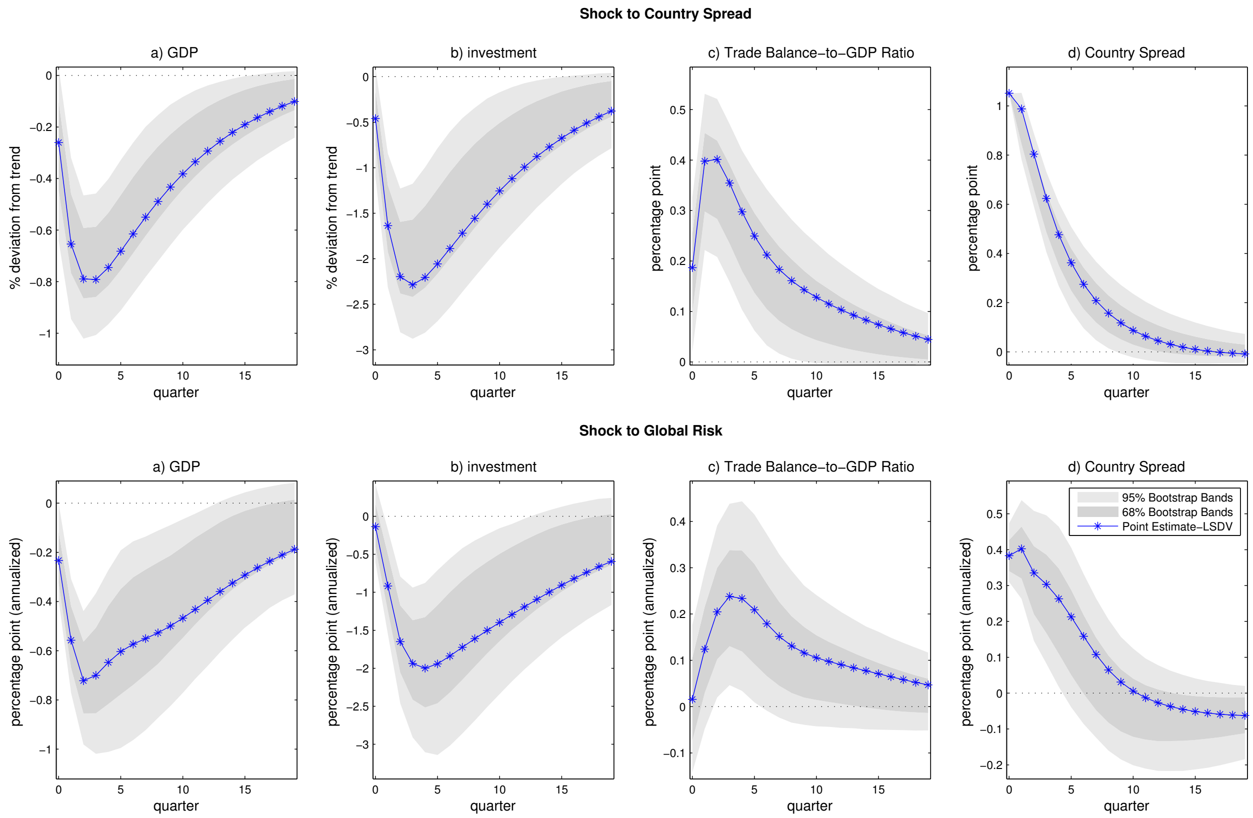
Notes: Solid lines with stars show point estimates of impulse responses; and 68% and 95% Confidence Bands are depicted with dark-grey and light-grey shaded areas respectively. The responses of Output and Investment are expressed in percent deviation from their respective log-linear trends. The response of Trade Balance-to-GDP ratio, the country spread, the U.S. Interest rate, domestic borrowing-lending spread and the global risk are expressed (**annualized**) percentage points. Bootstrap confidence bands are based on 10,000 repetitions. U.S. BAA Corporate Spreads are used as a proxy for the global risk.

Figure 2.17: Impulse Response to a one standard deviation shock to the country spread – GMM



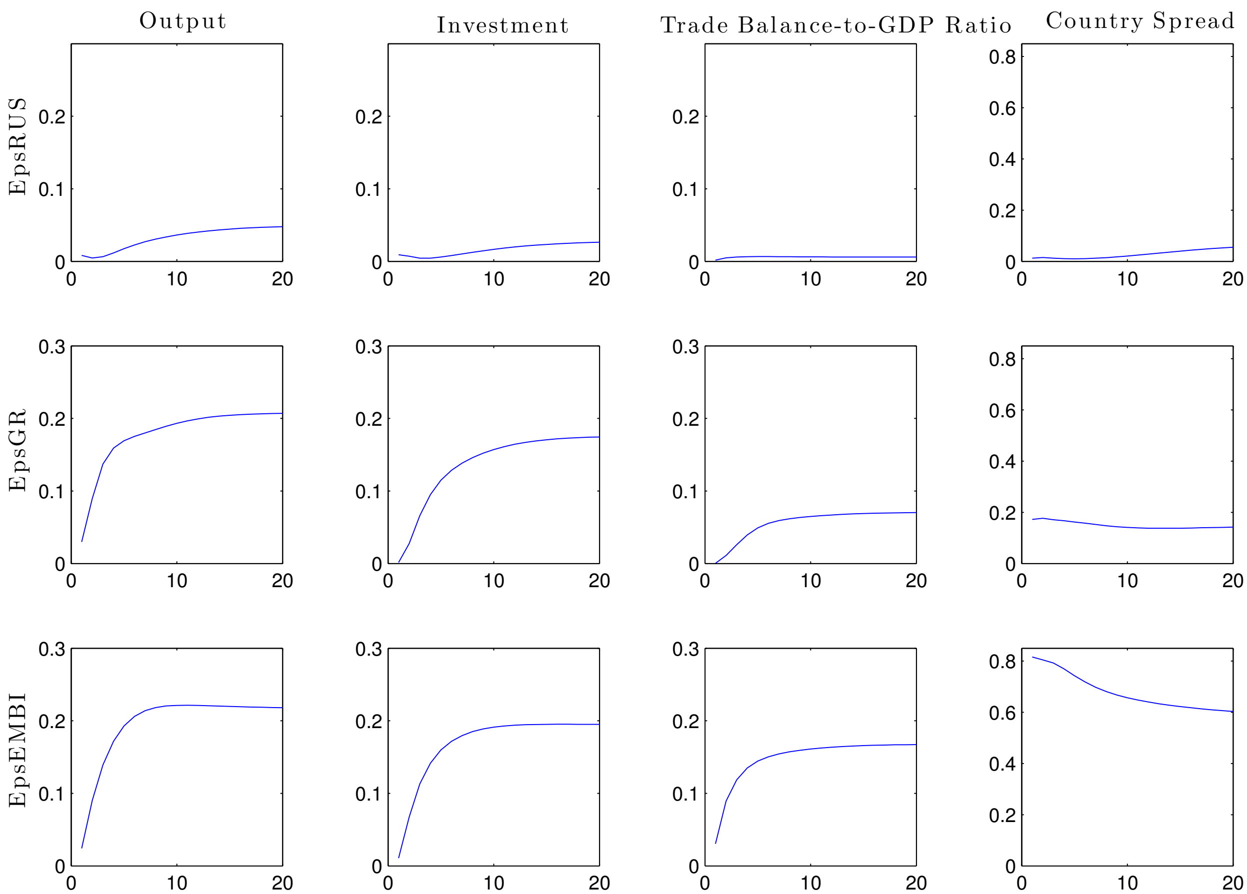
Notes: Solid lines with stars show point estimates of impulse responses; and 68% and 95% Confidence Bands are depicted with dark-grey and light-grey shaded areas respectively. The responses of Output and Investment are expressed in percent deviation from their respective log-linear trends. The response of Trade Balance-to-GDP ratio, the country spread, the U.S. Interest rate, domestic borrowing-lending spread and the global risk are expressed (**annualized**) percentage points. Bootstrap confidence bands are based on 10,000 repetitions. U.S. BAA Corporate Spreads are used as a proxy for the global risk.

Figure 2.18: Impulse Response to a one standard deviation shock to the country spread (Upper panel) and to the Global Risk (Lower panel)



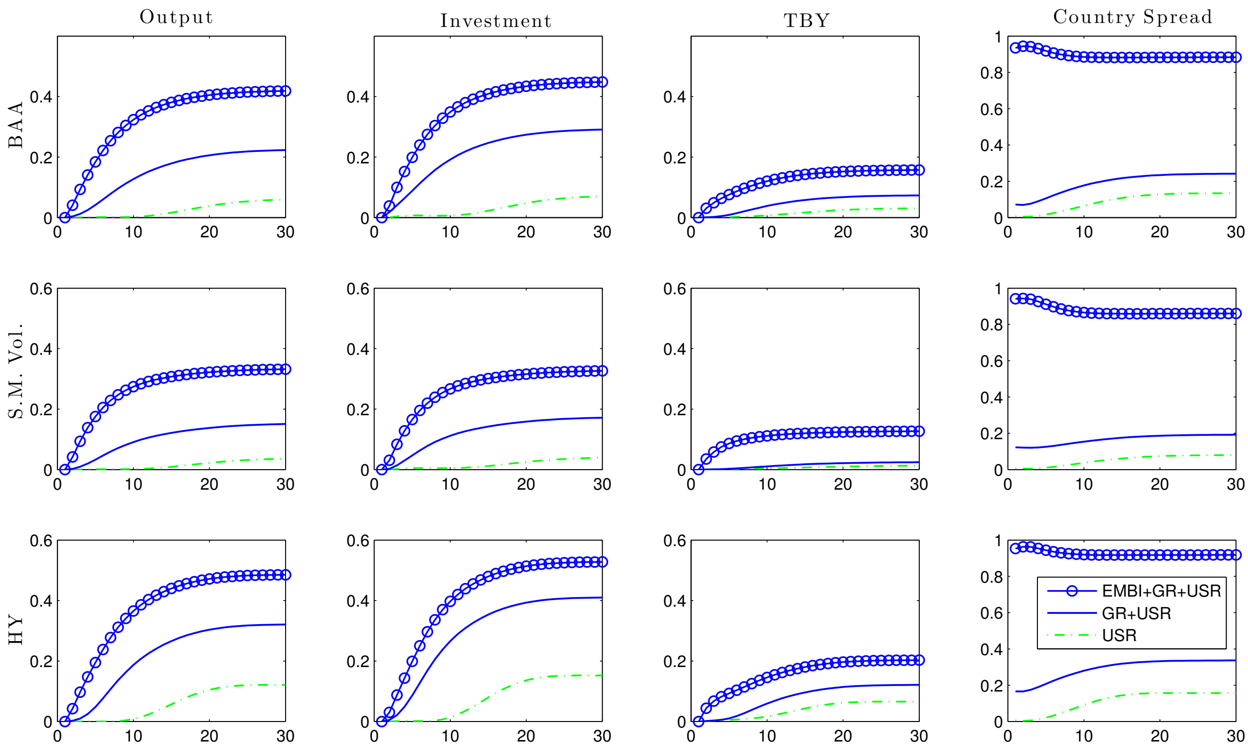
Notes: Solid lines with stars show point estimates of impulse responses; and 68% and 95% Confidence Bands are depicted with dark-grey and light-grey shaded areas respectively. The responses of Output and Investment are expressed in percent deviation from their respective log-linear trends. The response of Trade Balance-to-GDP ratio, the country spread, the U.S. Interest rate, domestic borrowing-lending spread and the global risk are expressed (**annualized**) percentage points. Bootstrap confidence bands are based on 10,000 repetitions. U.S. BAA Corporate Spreads are used as a proxy for the global risk.

Figure 2.19: Forecast Error Variance Decomposition at Different Horizons– Alternative Identification



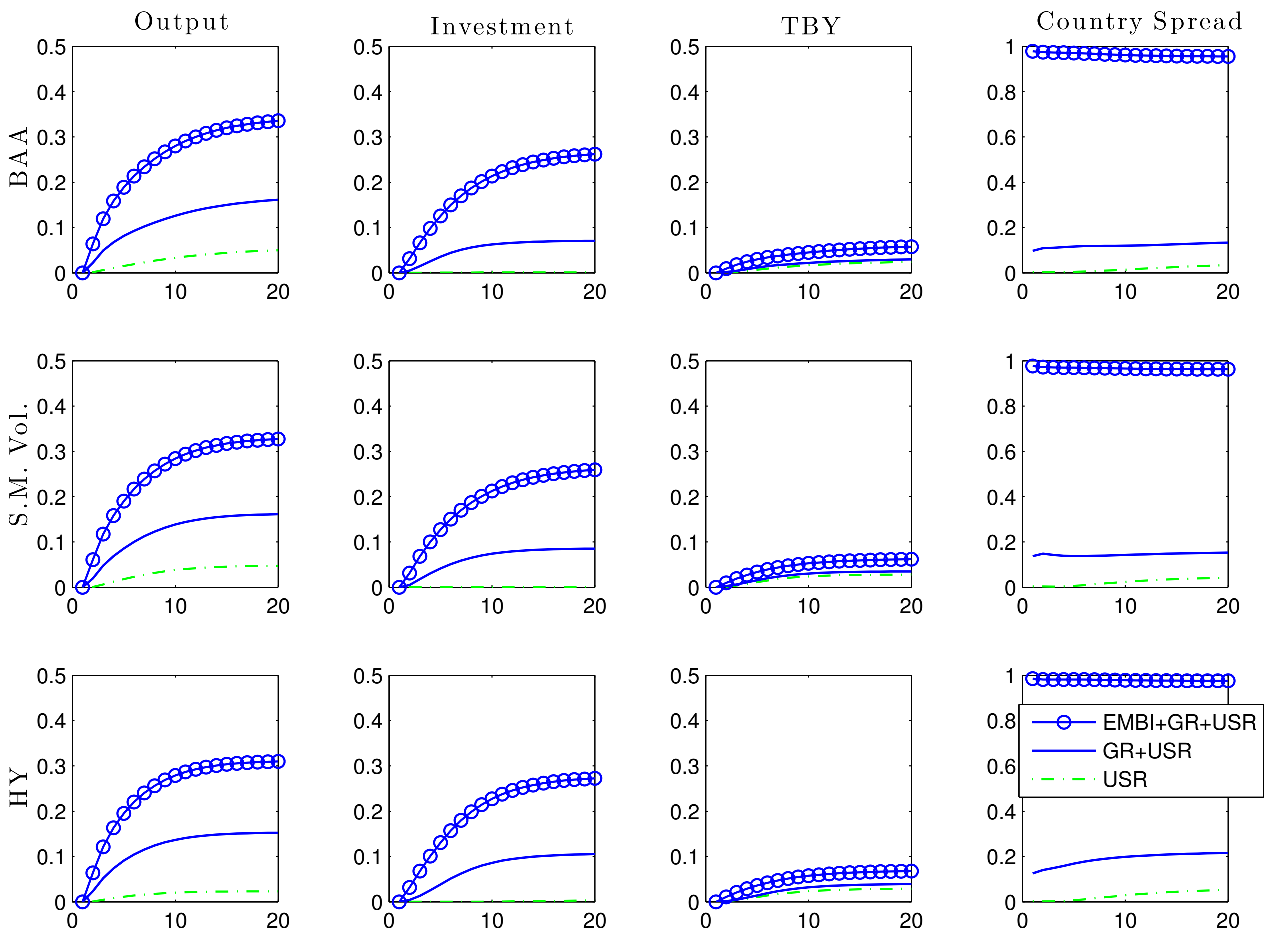
Notes: Solid lines with circles depict the fraction of the variance of the k-quarter ahead forecasting error explained jointly by the US real interest rate, the global risk and country spread shocks. Solid lines shows the fraction of the variance of the k-quarter ahead forecasting error explained jointly by the US real interest rate, the global risk. Broken lines depict the fraction of the variance of the forecasting error explained the US interest rate shock. The first row shows the forecast error variance decomposition at different horizons when the US BAA Corporate spread is used as a proxy for the global risk. The second row shows the forecast error variance decomposition at different horizons when the US stock market volatility index is used as a proxy for the global risk. The third row shows the forecast error variance decomposition at different horizons when the U.S. High Yield spread is used as a proxy for the global risk.

Figure 2.20: Forecast Error Variance Decomposition at Different Horizons– PreCrises Period



Notes: Solid lines with circles depict the fraction of the variance of the k-quarter ahead forecasting error explained jointly by the US real interest rate, the global risk and country spread shocks. Solid lines shows the fraction of the variance of the k-quarter ahead forecasting error explained jointly by the US real interest rate, the global risk. Broken lines depict the fraction of the variance of the forecasting error explained the US interest rate shock. The first row shows the forecast error variance decomposition at different horizons when the US BAA Corporate spread is used as a proxy for the global risk. The second row shows the forecast error variance decomposition at different horizons when the US stock market volatility index is used as a proxy for the global risk. The third row shows the forecast error variance decomposition at different horizons when the U.S. High Yield spread is used as a proxy for the global risk.

Figure 2.21: Forecast Error Variance Decomposition at Different Horizons– 10 Country Case



Notes: Solid lines with circles depict the fraction of the variance of the k-quarter ahead forecasting error explained jointly by the US real interest rate, the global risk and country spread shocks. Solid lines shows the fraction of the variance of the k-quarter ahead forecasting error explained jointly by the US real interest rate, the global risk. Broken lines depict the fraction of the variance of the forecasting error explained the US interest rate shock. The first row shows the forecast error variance decomposition at different horizons when the US BAA Corporate spread is used as a proxy for the global risk. The second row shows the forecast error variance decomposition at different horizons when the US stock market volatility index is used as a proxy for the global risk. The third row shows the forecast error variance decomposition at different horizons when the U.S. High Yield spread is used as a proxy for the global risk.

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Appendix A

Reduced Form Financial Frictions Model

The theoretical framework is the small open economy model presented in Schmitt-Grohe and Uribe (2003) augmented with permanent productivity shocks as in Aguiar and Gopinath (2007). The model is further augmented with domestic preference shocks, country premium shocks and realistic debt elasticity of the country premium as in Garcia-Cicco et al. (2010). The production technology takes the form

$$Y_t = A_t K_t^{\alpha} (X_t h_t)^{1-\alpha}, \tag{A.1}$$

where Y_t denotes output in period t, K_t denotes capital in period t, h_t denotes hours worked in period t, and A_t and X_t represent productivity shocks. The productivity shock A_t is assumed to follow a first-order autoregressive process in logs. That is,

$$lnA_{t+1} = \rho_a lnA_t + \epsilon_{t+1}^A; \qquad \epsilon_t^A \sim N(0, \sigma_A^2).$$

The productivity shock X_t is nonstationary. Let

$$\mu_{X,t} \equiv \frac{X_t}{X_{t-1}}$$

denote the gross growth rate of X_t. I assume that the logarithm of $\mu_{X,t}$ follows a first-order autoregressive process of the form

$$ln\,(\mu_{X,t+1}/\mu_X) = \rho_{\mu_X} ln\,(\mu_{X,t}/\mu_X) + \epsilon^{\mu_X}_{t+1}; \qquad \epsilon^{\mu_X}_t \sim N(0, \sigma^2_{\mu_X}).$$

The parameter μ_X measures the deterministic gross growth rate of the productivity factor X_t. The parameters ρ_A, $\rho_{\mu_X} \in [0,\, 1)$ govern the persistence of A_t and $\mu_{X,t}$, respectively. Households face the following period-by-period budget constraint:

$$\frac{D_{t+1}}{1+R_t} = D_t - Y_t + C_t + S_t + I_t + \frac{\phi}{2}\left(\frac{K_{t+1}}{K_t} - \mu_X\right)^2 K_t, \tag{A.2}$$

where D_{t+1} denotes the stock of debt acquired in period t, R_t denotes the domestic interest rate on bonds held between periods t and $t+1$, C_t denotes consumption, I_t denotes gross investment, and the parameter ϕ introduces quadratic capital adjustment costs. The capital stock evolves according to the following law of motion:

$$K_{t+1} = (1-\delta)K_t + I_t \tag{A.3}$$

where $\delta \in [0,\, 1)$ denotes the depreciation rate of capital. The variable $\tilde{D}_t$ denotes the aggregate level of external debt per capita, which the household takes as exogenous. In equilibrium, we have that $\tilde{D}_t = D_t$. Consumers are subject to a no–Ponzi scheme constraint

The variable S_t represents an exogenous domestic spending shock following the AR(1) processes

$$ln\,(s_{t+1}/s) = \rho_s ln\,(s_t/s) + \epsilon^s_{t+1}; \qquad \epsilon^s_t \sim N(0, \sigma^2_s),$$

where $s_t \equiv S_t/Y_t$. The household seeks to maximize the utility function

$$E_0 \sum_{t=0}^{\infty} \nu_t \beta^t \frac{[C_t - \theta\omega^{-1} X_{t-1} h_t^{\omega}]^{1-\gamma} - 1}{1-\gamma},$$

subject to (1)-(3) and the no–Ponzi game constraint, taking as given the processes A_t, X_t, and R_t (specified below) and the initial conditions K_0 and D_1.

The variables ν_t represents an exogenous and stochastic preference shock following the AR(1) processes

$$ln\nu_{t+1} = \rho_\nu ln\nu_t + \epsilon_{t+1}^{\nu}; \qquad \epsilon_t^{\nu} \sim N(0, \sigma_\nu^2),$$

The country interest rate takes the form

$$R_t \;\; = \;\; R^* + \psi \left(e^{\tilde{D}_{t+1}/X_t - \bar{d}} - 1 \right) + e^{\mu_{R,t} - 1} - 1,$$

where $\mu_{R,t}$ represents an exogenous stochastic country premium shock following the AR(1) process

$$ln\mu_{R,t+1} = \rho_{\mu_R} ln\mu_{R,t} + \epsilon_{t+1}^{\mu_R}; \qquad \epsilon_t^{\mu_R} \sim N(0, \sigma_{\mu_R}^2).$$

As in Garcia-Cicco et al. (2010), I allow the parameter ψ, governing the debt elasticity of the country premium, to be econometrically estimated, rather than fixing it at a small number. In this way, the debt elasticity of the country premium will potentially act as the reduced form of a financial friction shaping the model's response to aggregate disturbances.

The Model with Working Capital Constraint

In this section, I present the model augmented with an additional source of financial frictions; namely, with working capital loans following Neumeyer and Perri (2005) and Uribe and Yue (2006). Output is produced by means of a production function that takes labor services, h_t and physical capital, K_t as inputs (see Equation (A.1)). Given the contstant returns to scale assumption, total output, Y_t, in Equation (A.2) can be written as $Y_t = W_t h_t + R_{K,t} K_t$, where W_t denotes the wage rate and $R_{K,t}$ the rental rate of capital. Firms hire labor and capital services from perfectly competitive markets. The production process is subject to a working-capital constraint that requires firms to borrow in the international markets for transferring a fraction of the resources to the households that provide labor services before the production actually takes place. Therefore, firms borrow $\eta W_t h_t$ units of good at the (gross) domestic interest rate, R_t. I follow Neumeyer and Perri (2005) regarding the timing of the payment of labor input and assume cash-in-advance timing.

In a model with working capital constraints, equilibrium in the labor market is therefore, given by

$$W_t \left[1 + \eta \left(R_t - 1\right)\right] = (1 - \alpha) \frac{Y_t}{h_t}$$

while the equilibrium in the (physical) capital market takes the standard form: $R_{K,t} = \alpha \frac{Y_t}{K_t}$.

Appendix B

Optimality Conditions of the Household's Problem

The first order conditions of the household's problem are:

$$\phi_t(\frac{C_t}{X_{t-1}} - \theta\psi^{-1}h_t^{\psi})^{-\sigma} = \lambda_t$$

$$\frac{\beta}{\mu_{x,t}^{\sigma}} R_t E_t\left\{\lambda_{t+1}\right\} = \lambda_t$$

$$(\frac{C_t}{X_{t-1}} - \theta\psi^{-1}h_t^{\psi})^{-\sigma}(\theta h_t^{\psi-1}) = \lambda_t \frac{W_t}{X_{t-1}}$$

$$\frac{\beta}{\mu_{x,t}^{\sigma}} E_t\lambda_{t+1}\left\{R_{k,t+1} + 1 - \delta_{t+1} + \varphi\left(\frac{K_{t+2}}{K_{t+1}}\right)\left(\frac{K_{t+2}}{K_{t+1}} - \mu_x\right) - \frac{\varphi}{2}\left(\frac{K_{t+2}}{K_{t+1}} - \mu_x\right)^2\right\} = \lambda_t\left[1 + \varphi\left(\frac{K_{t+1}}{K_t} - \mu_x\right)\right]$$

Appendix C

Sequence of Events for Firm's Problem

1. Firm starts the period t with the intermediate inputs purchased in the previous period, M_{t-1}; and financial contract with the foreign lenders, $B_{t-1}, R_{B,t-1}, \bar{\omega}_t$.

2. The exogenous state vector of aggregate and idiosyncratic productivity shocks, $(A_t, \mu_{x,t}, \nu_t, \omega_t^i)$, is realized. Perfectly competitive firm observes real wages, W_t and real return on capital, $R_{k,t}$. Given the available intermediate inputs, M_{t-1}, purchased in the previous period and becoming productive at time t, $(\omega_t^i M_{t-1})$, the firm hires labor and rents capital (h_t^f, K_t) from households, produces and sells output, Y_t, conditional on the realization of shocks. The firm pays for labor and capital inputs hired from households. The solvent firm pays its previous debt, $R_{B,t-1}B_{t-1}$ and retains N_t units of net worth. If the firm is not solvent, the foreign lender takes the residual profit after paying the monitoring cost, μ. I assume that exactly the same number of firms is created to replace insolvent firms, with a level of net worth, N_t, transferred from the households. The firm's net worth, N_t is the only variable characterizing the firm at time t and nothing else about its history is relevant.

3. The standard deviation of the idiosyncratic productivity of the firm at time $t+1$,

$\sigma_{\omega,t}$, is revealed at the end of period t right before the investment decisions are made. The firm makes investment and financing decision, $(M_t, B_t, R_{B,t}, \bar{\omega}_{t+1})$, conditional on the realization of the shock, $\sigma_{\omega,t}$ for a given level of net worth, N_t. The firm finances the purchase of the intermediate input partly with its own net worth available at the end of period t, N_t, and partly by borrowing from risk neutral foreign lenders, B_t; i.e, the firm borrows the difference between the value of its net worth, N_t and the expenditure in the intermediate inputs, $p_{m,t}M_t$. The balance sheet of the firm is then given as $B_t = p_{m,t}M_t - N_t$. The standard debt contract is defined by the contractual interest rate, $R_{B,t}$ and state contingent cutoff level of productivity for the entrepreneurs' productivity shock, $\bar{\omega}_{t+1}$. The firm then chooses N_t to maximize the expected future profits.[1]

[1] The shock $\sigma_{\omega,t}$ has an impact on the external finance premium paid at time $t+1$. Also, note that cumulative distribution function (cdf) of idiosyncratic shock ω^i_{t+1}, $F(\omega^i_{t+1};\sigma_{\omega,t})$ is time variant and subject to uncertainty shock.

Appendix D

Derivations for Return on Intermediate Input Equation

Given the CRS assumption, $\gamma + \alpha + \eta = 1$, the return on intermediate input, (1.14), can be written as:

$$R^i_{m,t+1} = \frac{\eta A_{t+1} \left(\frac{K^i_{t+1}}{M^i_t}\right)^{\alpha} \left(\frac{X_{t+1} h^{f,i}_{t+1}}{M^i_t}\right)^{\gamma} \left(\omega^i_{t+1}\right)^{\eta}}{p_{m,t}} \tag{D.1}$$

Defining $\tilde{h}^i_{t+1} = \frac{X_{t+1} h^{f,i}_{t+1}}{M^i_t}$ and $\tilde{k}^i_{t+1} = \frac{K^i_{t+1}}{M^i_t}$ and rewriting (D.1), I then get the following expression for return on intermediate inputs,

$$R^i_{m,t+1} = \frac{\eta A_{t+1} \left(\tilde{k}^i_{t+1}\right)^{\alpha} \left(\tilde{h}^i_{t+1}\right)^{\gamma} \left(\omega^i_{t+1}\right)^{\eta}}{p_{m,t}} \tag{D.2}$$

By using labor and capital demand equations, (1.10) and (1.11) respectively, I can express $\tilde{h}^i_{t+1}$ and $\tilde{k}^i_{t+1}$ as a function of aggregate variables common to all firms and idiosyncratic productivity shock as the following:

From labor demand equation, (1.10),

$$\tilde{h}^i_{t+1} = \left(\frac{\gamma}{W_{t+1}}\right)^{\frac{1}{1-\gamma}} \left((\omega^i_{t+1})^\eta\right)^{\frac{1}{1-\gamma}} \left(\tilde{k}^i_{t+1}\right)^{\frac{\alpha}{1-\gamma}} \tag{D.3}$$

From capital demand equation, (1.11),

$$\tilde{k}^i_{t+1} = \left(\frac{\alpha}{R_{k,t+1}}\right)^{\frac{1}{1-\alpha}} \left((\omega^i_{t+1})^\eta\right)^{\frac{1}{1-\alpha}} \left(\tilde{h}^i_{t+1}\right)^{\frac{\gamma}{1-\alpha}} \tag{D.4}$$

Substituting (D.3) into (D.4), I get the following expression for $\tilde{k}^i_{t+1}$:

$$\begin{aligned}
\tilde{k}^i_{t+1} &= \left(\frac{\alpha}{R_{k,t+1}}\right)^{\frac{1}{1-\alpha}} \left((\omega^i_{t+1})^\eta\right)^{\frac{1}{1-\alpha}} \left(\left(\frac{\gamma}{W_{t+1}}\right)^{\frac{1}{1-\gamma}} \left((\omega^i_{t+1})^\eta\right)^{\frac{1}{1-\gamma}} \left(\tilde{k}^i_{t+1}\right)^{\frac{\alpha}{1-\gamma}}\right)^{\frac{\gamma}{1-\alpha}} \\
\tilde{k}^i_{t+1} &= \left(\frac{\alpha}{R_{k,t+1}}\right)^{\frac{1}{1-\alpha}} \left(\frac{\gamma}{W_{t+1}}\right)^{\frac{\gamma}{(1-\gamma)(1-\alpha)}} \left((\omega^i_{t+1})^\eta\right)^{\frac{1}{1-\alpha}+\frac{\gamma}{(1-\gamma)(1-\alpha)}} \left(\tilde{k}^i_{t+1}\right)^{\frac{\alpha\gamma}{(1-\gamma)(1-\alpha)}} \\
\left(\tilde{k}^i_{t+1}\right)^{\frac{\eta}{(1-\gamma)(1-\alpha)}} &= \left(\frac{\alpha}{R_{k,t+1}}\right)^{\frac{1}{1-\alpha}} \left(\frac{\gamma}{W_{t+1}}\right)^{\frac{\gamma}{(1-\gamma)(1-\alpha)}} \left((\omega^i_{t+1})^\eta\right)^{\frac{1}{(1-\alpha)(1-\gamma)}} \\
\left(\tilde{k}^i_{t+1}\right) &= \left(\frac{\alpha}{R_{k,t+1}}\right)^{\frac{1-\gamma}{\eta}} \left(\frac{\gamma}{W_{t+1}}\right)^{\frac{\gamma}{\eta}} \left((\omega^i_{t+1})^\eta\right)^{\frac{1}{\eta}} \\
\tilde{k}^i_{t+1} &= \left(\frac{\alpha}{R_{k,t+1}}\right)^{\frac{1-\gamma}{\eta}} \left(\frac{\gamma}{W_{t+1}}\right)^{\frac{\gamma}{\eta}} \omega^i_{t+1}
\end{aligned}$$

By using $\tilde{k}^i_{t+1}$ equation just derived, I can express the $\tilde{h}^i_{t+1}$ as the following:

$$\begin{aligned}
\tilde{h}^i_{t+1} &= \left(\frac{\gamma}{W_{t+1}}\right)^{\frac{1}{1-\gamma}} \left((\omega^i_{t+1})^\eta\right)^{\frac{1}{1-\gamma}} \left(\left(\frac{\alpha}{R_{k,t+1}}\right)^{\frac{1-\gamma}{\eta}} \left(\frac{\gamma}{W_{t+1}}\right)^{\frac{\gamma}{\eta}} \omega^i_{t+1}\right)^{\frac{\alpha}{1-\gamma}} \\
\tilde{h}^i_{t+1} &= \left(\frac{\gamma}{W_{t+1}}\right)^{\frac{1}{1-\gamma}+\frac{\gamma\alpha}{\eta(1-\gamma)}} \left(\frac{\alpha}{R_{k,t+1}}\right)^{\frac{\alpha}{\eta}} \left(\omega^i_{t+1}\right)^{\frac{\eta}{1-\gamma}+\frac{\alpha}{(1-\gamma)}} \\
\tilde{h}^i_{t+1} &= \left(\frac{\gamma}{W_{t+1}}\right)^{\frac{1}{1-\gamma}+\frac{\gamma\alpha}{\eta(1-\gamma)}} \left(\frac{\alpha}{R_{k,t+1}}\right)^{\frac{\alpha}{\eta}} \omega^i_{t+1}
\end{aligned}$$

I will now substitute the derived values for $\tilde{h}^i_{t+1}$ and $\tilde{k}^i_{t+1}$ into (D.2),

$$
\begin{aligned}
R^i_{m,t+1} &= \frac{\eta\left(\omega^i_{t+1}\right)^{\eta}\left(\left(\frac{\gamma}{W_{t+1}}\right)^{\frac{1}{1-\gamma}+\frac{\gamma\alpha}{\eta(1-\gamma)}}\left(\frac{\alpha}{R_{k,t+1}}\right)^{\frac{\alpha}{\eta}}\omega^i_{t+1}\right)^{\gamma}\left(\left(\frac{\alpha}{R_{k,t+1}}\right)^{\frac{1-\gamma}{\eta}}\left(\frac{\gamma}{W_{t+1}}\right)^{\frac{\gamma}{\eta}}\omega^i_{t+1}\right)^{\alpha}}{p_{m,t}} \\
R^i_{m,t+1} &= \omega^i_{t+1}\left(\frac{\eta\left(\frac{\gamma}{W_{t+1}}\right)^{\frac{\gamma}{1-\gamma}+\frac{\gamma^2\alpha}{\eta(1-\gamma)}+\frac{\alpha\gamma}{\eta}}\left(\frac{\alpha}{R_{k,t+1}}\right)^{\frac{\alpha\gamma}{\eta}+\frac{\alpha(1-\gamma)}{\eta}}}{p_{m,t}}\right) \\
R^i_{m,t+1} &= \omega^i_{t+1}\left(\frac{\eta\left(\frac{\gamma}{W_{t+1}}\right)^{\frac{\gamma}{\eta}}\left(\frac{\alpha}{R_{k,t+1}}\right)^{\frac{\alpha}{\eta}}}{p_{m,t}}\right) \\
R^i_{m,t+1} &= \omega^i_{t+1}R_{m,t+1}
\end{aligned}
$$

Appendix E

Solving Firm's Profit Maximization Problem

This section solves the firm's profit maximization problem.

The solvent and insolvent firms choose M_t^i (intermediate inputs), $\bar{\omega}_{t+1}^i$ (default threshold), N_t^i (net worth) and $R_{B,t}^i$ (loan rate) to maximize

$$\Lambda_t \left[(\omega_t^i - \bar{\omega}_t^i) R_{m,t} p_{m,t-1} M_{t-1}^i - N_t^i\right] + \beta E_t \Lambda_{t+1} \left\{[1 - \Gamma(\bar{\omega}_{t+1}^i; \sigma_{\omega,t})] R_{m,t+1} p_{m,t} M_t^i - N_{t+1}^i\right\}$$

OR

$$\Lambda_t \left[-N_t^i\right] + \beta E_t \Lambda_{t+1} \left\{[1 - \Gamma(\bar{\omega}_{t+1}^i; \sigma_{\omega,t})] R_{m,t+1} p_{m,t} Z_t^i - N_{t+1}^i\right\}$$

respectively, subject to

$$\begin{aligned} E_t \left\{\Omega(\bar{\omega}_{t+1}^i; \sigma_{\omega,t}) R_{m,t+1} p_{m,t} M_t^i\right\} &= R_t^* [p_{m,t} M_t^i - N_t^i] \\ \bar{\omega}_{t+1}^i R_{m,t+1} p_{m,t} M_t^i &= R_{B,t}^i [p_{m,t} M_t^i - N_t^i] \end{aligned}$$

I will eliminate the second constraint by substituting $\bar{\omega}_t^i$ with $\frac{R_{B,t-1}^i [p_{m,t-1} M_{t-1}^i - N_{t-1}^i]}{R_{m,t} p_{m,t-1} M_{t-1}^i}$ and $\bar{\omega}_{t+1}^i$ with $\frac{R_{B,t}^i [p_{m,t} M_t^i - N_t^i]}{R_{m,t+1} p_{m,t} M_t^i}$. Note that the contract is "Standard Debt Contract," which means that the default threshold, $\bar{\omega}_{t+1}^i$ is state contingent but the contractual interest rate, $R_{B,t}^i$ is not. I denote the lagrange multiplier for the participation constraint,(1.23), by φ_t^i.

The lagrangian of the problem can then be written as follows:

$$
\begin{aligned}
&= \Lambda_t \left[irr. - N_t^i\right] + \beta E_t \Lambda_{t+1} \left\{[1 - \Gamma\left(\frac{R_{B,t}^i[p_{m,t}M_t^i - N_t^i]}{R_{m,t+1}p_{m,t}M_t^i}; \sigma_{\omega,t}\right)]R_{m,t+1}p_{m,t}M_t^i - N_{t+1}^i\right\} \\
&+ \varphi_t^i E_t \left\{\Omega\left(\frac{R_{B,t}^i[p_{m,t}M_t^i - N_t^i]}{R_{m,t+1}p_{m,t}M_t^i}; \sigma_{\omega,t}\right) R_{m,t+1}p_{m,t}M_t^i - R_t^*[p_{m,t}M_t^i - N_t^i]\right\}
\end{aligned}
$$

First order conditions of the problem with respect to M_t^i, $R_{B,t}^i$ and N_t^i, respectively are as follows:

M_t :

$$
\begin{aligned}
0 &= \beta E_t \Lambda_{t+1} \left\{[1 - \Gamma(\bar{\omega}_{t+1}^i; \sigma_{\omega,t})]R_{m,t+1}p_{m,t} - \Gamma_\omega(\bar{\omega}_{t+1}^i; \sigma_{\omega,t})R_{m,t+1}p_{m,t}M_t\,(.)\right\} \\
&+ \varphi_t^i E_t \left\{\Omega_\omega(\bar{\omega}_{t+1}; \sigma_{\omega,t})R_{m,t+1}p_{m,t}M_t\,(.)\right\}
\end{aligned}
$$

where $(.) = \left(\frac{R_{B,t}p_{m,t}(R_{m,t+1}p_{m,t}M_t^i) - R_{B,t}[p_{m,t}M_t^i - N_t^i](R_{m,t+1}p_{m,t})}{(R_{m,t+1}p_{m,t}M_t^i)^2}\right)$

$R_{B,t}$:

$$
\begin{aligned}
0 &= -\beta_t E_t \Lambda_{t+1}\Gamma_\omega(\bar{\omega}_{t+1}^i; \sigma_{\omega,t})R_{m,t+1}p_{m,t}M_t^i \left(\frac{[p_{m,t}M_t^i - N_t^i]}{(R_{m,t+1}p_{m,t}M_t^i)}\right) \\
&+ \varphi_t^i E_t \left\{\Omega_\omega(\bar{\omega}_{t+1}; \sigma_{\omega,t})R_{m,t+1}p_{m,t}M_t^i \left(\frac{[p_{m,t}M_t^i - N_t^i]}{(R_{m,t+1}p_{m,t}M_t^i)}\right)\right\}
\end{aligned}
$$

N_t :

$$
\begin{aligned}
0 &= -\Lambda_t + \beta E_t \Lambda_{t+1} \left\{ \Gamma_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) R_{m,t+1} p_{m,t} M^i_t \left(\frac{R^i_{B,t+1}}{(R_{m,t+1} p_{m,t} M^i_t)} \right) \right\} \\
&- \varphi^i_t E_t \left(\Omega_\omega(\bar{\omega}_{t+1}; \sigma_{\omega,t}) R_{m,t+1} p_{m,t} M^i_t \left(\frac{R^i_{B,t+1}}{(R_{m,t+1} p_{m,t} M^i_t)} \right) + R^*_t \right)
\end{aligned}
$$

Rearranging, first order conditions can be written as

M_t :

$$
\begin{aligned}
0 &= \beta E_t \Lambda_{t+1} \left\{ [1 - \Gamma(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})] R_{m,t+1} p_{m,t} - \Gamma_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) \left(\frac{R^i_{B,t} N^i_t}{M^i_t} \right) \right\} \\
&+ \varphi^i_t E_t \left\{ \left(\Omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) R_{m,t+1} p_{m,t} - R^*_t p_{m,t} \right) + \Omega_\omega(\bar{\omega}_{t+1}; \sigma_{\omega,t}) \left(\frac{R^i_{B,t} N^i_t}{M^i_t} \right) \right\}
\end{aligned}
$$

$R_{B,t}$: $0 = -\beta E_t \Lambda_{t+1} \left\{ \Gamma_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) [p_{m,t} M^i_t - N^i_t] \right\} + \varphi^i_t E_t \left\{ \Omega_\omega(\bar{\omega}_{t+1}; \sigma_{\omega,t}) [p_{m,t} M^i_t - N^i_t] \right\}$

N_t : $0 = -\Lambda_t + \beta E_t \Lambda_{t+1} \left\{ \Gamma_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) R^i_{B,t} \right\} - \varphi^i_t E_t \left(\Omega_\omega(\bar{\omega}_{t+1}; \sigma_{\omega,t}) R^i_{B,t} + R^*_t \right)$

From the first order condition wrt $R^i_{B,t}$, I can write the lagrange mutliplier of the participation constraint φ^i_t, as the following

$$
\varphi^i_t = \frac{\beta E_t \Lambda_{t+1} \Gamma_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})}{E_t \Omega_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})} \tag{E.1}
$$

Using the definition of φ^i_t, I can re-write the first order condition wrt N^i_t and get the following equation:

$0 = -\Lambda_t + \beta E_t \Lambda_{t+1} \left\{ \Gamma_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) R^i_{B,t} \right\} - \frac{\beta E_t \Lambda_{t+1} \Gamma_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})}{E_t \Omega_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})} E_t \Omega_\omega(\bar{\omega}_{t+1}; \sigma_{\omega,t}) R^i_{B,t} + \frac{\beta E_t \Lambda_{t+1} \Gamma_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})}{E_t \Omega_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})} R^*_t$

Rearranging it further, I get:

$$\Lambda_t = \frac{\beta E_t \Lambda_{t+1} \Gamma_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})}{E_t \Omega_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})} R^*_t$$

Defining $\rho(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) \equiv \frac{\Gamma_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})}{E_t \Omega_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})}$ and imposing Λ_t from the household's problem ($\Lambda_t = \beta R_t E_t \Lambda_{t+1}$), where $\Lambda_{t+1} = \lambda_{t+1} X_t^{-\sigma}$), I get:

$$R^*_t E_t \lambda_{t+1} \rho(\bar{\omega}^i_{t+1}, \sigma_{\omega,t}) = R_t E_t \lambda_{t+1}$$

$$\Lambda_t = \frac{\beta E_t \Lambda_{t+1} \Gamma_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})}{E_t \Omega_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})} R^*_t$$

Defining $\rho(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) \equiv \frac{\Gamma_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})}{E_t \Omega_\omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})}$ and imposing Λ_t from the household's problem ($\Lambda_t = \beta R_t E_t \Lambda_{t+1}$), where $\Lambda_{t+1} = \lambda_{t+1} X_t^{-\sigma}$, I get:

$$R^*_t E_t \lambda_{t+1} \rho(\bar{\omega}^i_{t+1}, \sigma_{\omega,t}) = R_t E_t \lambda_{t+1}$$

Finally, I rearrange the first order condition with respect to M^i_t after imposing the definition of $\varphi^i_t$and I get the following equation:

$E_t \lambda_{t+1} R_{m,t+1} \left[1 - \Gamma(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) \right] p_{m,t} M^i_t + E_t \lambda_{t+1} \rho(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})$
$\left[E_t \Omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) R_{m,t+1} p_{m,t} M^i_t - R^*_t p_{m,t} M^i_t \right] = 0$

Using the foreign lender's participation constraint, this equation can be further simplified to:

$$E_t\lambda_{t+1}\frac{R_{m,t+1}}{R_t^*}\left[1-\Gamma(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})\right] = E_t\lambda_{t+1}\rho(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})\frac{N_t}{p_{m,t}M_t}$$

Optimality conditions of the firm's problem under the Standard Debt Contract are then given by the following equations:

$$\begin{aligned}
E_t\lambda_{t+1}\frac{R_{m,t+1}}{R_t^*}\left[1-\Gamma(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})\right] &= E_t\lambda_{t+1}\rho(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})\frac{N_t}{p_{m,t}M_t^i} \\
\frac{R_t}{R_t^*}E_t\lambda_{t+1} &= E_t\left\{\lambda_{t+1}\rho(\bar{\omega}_{t+1}^i,\sigma_{\omega,t})\right\} \\
E_t\Omega(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})\frac{R_{m,t+1}}{R_t^*}p_{m,t}M_t^i &= [p_{m,t}M_t^i - N_t^i]
\end{aligned}$$

for $t = 0, 1, 2, ...\infty$ for equations, (1.32) and (1.33), and fot $t = -1, 0, 1, 2, ...\infty$ for equation (1.34). I can re-write $\rho(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})$ in terms of default probabilities by taking the derivative of $\Gamma(.)$ and $\Omega(.)$ functions with respect to default threshold, $\bar{\omega}$. It can be shown that $\Gamma_\omega(\bar{\omega}_{t+1}^i;\sigma_{\omega,t}) = 1 - F(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})$ and $\Omega_\omega(\bar{\omega}_{t+1};\sigma_{\omega,t}) = 1 - F(\bar{\omega}_{t+1}^i;\sigma_{\omega,t}) - \mu\bar{\omega}_{t+1}^i F_\omega(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})$.[1] Then, I have:

$$\rho(\bar{\omega}_{t+1}^i;\sigma_{\omega,t}) = \frac{1-F(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})}{E_t\left(1-F(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})-\mu\bar{\omega}_{t+1}^i F_{\bar{\omega}}(\bar{\omega}_{t+1}^i;\sigma_{\omega,t})\right)}$$

Because the idiosyncratic shock is independent from all other shocks and across time, and identical across firms, then all firms will make the same decisions in face of the expectations about the future. This implies that the above relationships can all be expressed in aggregate terms.

[1] $F(.)$ denotes cdf and $F_\omega(.)$ denotes the derivative of cdf of the idiosnycratic shock, ω^i wrt $\bar{\omega}$.

Appendix F

Deriving Resource Constraint

$$C_t + I_t + \frac{\varphi}{2}\left(\frac{K_{t+1}}{K_t} - \mu_X\right)^2 K_t + B_t^d - \frac{B_{t+1}^d}{R_t} = W_t h_t + R_{k,t} K_t + \Phi_t^f + \Phi_t^m$$

Using the aggregate (real) profits by goods producing and intermediate goods producing firms distributed to households,

$$\Phi_t^f = (1 - \Gamma(\bar{\omega}_{t+1}; \sigma_{\omega,t})) R_{m,t} p_{m,t-1} M_{t-1} - N_t$$

and

$$\Phi_t^m = p_t^H M_t^H - W_t h_t^m$$

respectively, I simplify the intertemporal budget constraint of the household as follows (note that $B_{t+1}^d = 0 \, for \ t -$ domestic bonds exist in zero supply in equilibrium):

$$C_t + I_t + \frac{\varphi}{2}\left(\frac{K_{t+1}}{K_t} - \mu_X\right)^2 K_t = W_t h_t^f + R_{k,t} K_t + \\ \{(1 - \Gamma(\bar{\omega}_{t+1}; \sigma_{\omega,t})) R_{m,t} p_{m,t-1} M_{t-1} - N_t\} + p_t^H M_t^H$$

Using the CRS assumption, I further impose

$$Y_t = W_t h_t^f + R_{k,t} K_t + R_{m,t} p_{m,t-1} M_{t-1}$$

and get the following:

$$C_t + I_t + \frac{\varphi}{2}\left(\frac{K_{t+1}}{K_t} - \mu_X\right)^2 K_t = Y_t - \Gamma(\bar{\omega}_{t+1}; \sigma_{\omega,t}) R_{m,t} p_{m,t-1} M_{t-1} - N_t + p_t^H M_t^H$$

I finally impose balance of payments identity to get the resource constraints of the economy:

$$\begin{aligned} C_t + I_t + \frac{\varphi}{2}\left(\frac{K_{t+1}}{K_t} - \mu_X\right)^2 K_t + p_{m,t} M_t = Y_t - \Gamma(\bar{\omega}_{t+1}; \sigma_{\omega,t}) R_{m,t} p_{m,t-1} M_{t-1} + \\ (p_{m,t} M_t - N_t) + p_t^H M_t^H \end{aligned}$$

$$\begin{aligned} C_t + I_t + \frac{\varphi}{2}\left(\frac{K_{t+1}}{K_t} - \mu_X\right)^2 K_t + p_{m,t} M_t + NX_t = Y_t + NX_t \\ -\Gamma(\bar{\omega}_{t+1}; \sigma_{\omega,t}) R_{m,t} p_{m,t-1} M_{t-1} + \\ B_t + p_t^H M_t^H \end{aligned}$$

$$C_t + I_t + \frac{\varphi}{2}\left(\frac{K_{t+1}}{K_t} - \mu_X\right)^2 K_t + p_{m,t} M_t + NX_t = Y_t + p_t^H M_t^H$$

Appendix G

Equilibrium Conditions in Stationary Form

Define $y_t = Y_t/X_{t-1}$, $c_t = C_t/X_{t-1}$,$s_t = S_t/X_{t-1}$, $gdp_t = GDP_t/X_{t-1}$, $k_t = K_t/X_{t-1}$, $i_t = I_t/X_{t-1}$, $m_t = M_t/X_{t-1}$, $m_t^H = M_t^H/X_{t-1}$, $m_t^F = M_t^F/X_{t-1}$, $w_t = W_t/X_{t-1}$, $n_t = N_t/X_{t-1}$, $nx_t = NX_t/X_{t-1}$ and $b_t = B_t/X_{t-1}$. Also, define, $d_t = \frac{B_t}{p_{m,t}M_t}$ as being the leverage ratio of the firm at time t. Then, a stationary competitive equilibrium is given by a set of stationary solution to the following equations:

$$
\begin{aligned}
(c_t - \theta\psi^{-1}h_t^{\psi})^{-\sigma} &= \lambda_t \\
\beta\frac{R_t}{\mu_{x,t}^{\sigma}}E_t\left\{\lambda_{t+1}\right\} &= \lambda_t \\
R_t^* E_t\left[\lambda_{t+1} prem_{t+1}\right] &= R_t E_t\left[\lambda_{t+1}\right] \\
(\theta h_t^{\psi-1}) &= w_t \\
\frac{\beta}{\mu_{x,t}^{\sigma}}E_t\lambda_{t+1}\left(R_t^k + 1 - \delta + \varphi\left(\frac{k_{t+2}}{k_{t+1}}\mu_{x,t+1}\right)\left(\frac{k_{t+2}}{k_{t+1}}\mu_{x,t+1} - \mu_x\right)\right) & \\
-\frac{\beta}{\mu_{x,t}^{\sigma}}E_t\lambda_{t+1}\frac{\varphi}{2}\left(\frac{k_{t+2}}{k_{t+1}}\mu_{x,t+1} - \mu_x\right)^2 &= \lambda_t \\
E_t\left[1 + \varphi\left(\frac{k_{t+1}}{k_t}\mu_{x,t} - \mu_x\right)\right] & \\
k_{t+1}\mu_{x,t} - (1-\delta)k_t &= i_t
\end{aligned}
$$

$$
\begin{aligned}
A_t\,[k_t]^{\alpha}\left[\mu_{x,t}h_t^f\right]^{\gamma}[m_{t-1}/\mu_{x,t-1}]^{\eta} &= y_t \\
\gamma\frac{y_t}{h_t^f} &= w_t \\
\alpha\frac{y_t}{k_t} &= R_t^k \\
\eta\frac{y_t}{p_{m,t-1}(m_{t-1}/\mu_{x,t-1})} &= R_{m,t} \\
\bar{\omega}_t &= \frac{R_{B,t}}{R_{m,t}}d_{t-1} \\
E_{t-1}\left\{\Omega(\bar{\omega}_t,\sigma_{\omega,t-1})\frac{R_{m,t}}{R_{t-1}^*}\right\} &= d_{t-1} \\
E_t\lambda_{t+1}\frac{R_{m,t+1}p_t^m m_t}{N_t}[1-\Gamma(\bar{\omega}_{t+1};\sigma_{\omega,t}) &= R_t^* E_t\left[\lambda_{t+1}prem_{t+1}\right] \\
\frac{\Gamma'(\bar{\omega}_t,\sigma_{\omega,t-1})}{E_{t-1}\Omega'(\bar{\omega}_t,\sigma_{\omega,t-1})} &= prem_t \\
c_t+i_t+\frac{\varphi}{2}\left(\frac{k_{t+1}}{k_t}\mu_{x,t}-\mu_X\right)^2 k_t+nx_t+s_t &= gdp_t \\
y_t-p_t^F m_t^F &= gdp_t \\
nx_t-\Gamma(\bar{\omega}_t,\sigma_{\omega,t-1})R_{m,t}p_{m,t-1}\frac{m_{t-1}}{\mu_{x,t-1}}+b_t &= 0 \\
(1-d_t)p_{m,t}m_t &= n_t \\
d_t p_{m,t}m_t &= b_t \\
h_t^f+h_t^m &= h \\
m_t^H &= h_t^m \\
p_t^H &= w_t \\
(\nu {p_t}^{H,1-\rho^i}+(1-\nu){p_t}^{F,1-\rho^i})^{\frac{1}{1-\rho^i}} &= p_t^m \\
(1-\nu)m(\frac{p_t^F}{p_t^m})^{-\rho^i} &= m_t^F \\
\nu m(\frac{p_t^H}{p_t^m})^{-\rho^i} &= m_t^H
\end{aligned}
$$

Appendix H

Data Description for Chapter 1

The dataset includes quarterly data for Argentina between 1983Q1-2001Q3.

For the period 1983:Q1 to 1992:Q4, real GDP, real private consumption, real investment, the trade balance and the country interest rate are from Neumeyer and Perri (2005) and posted at www.fperri.net/data/neuperri.xls. The country spread is measured as the difference between the country interest rate from Neumeyer and Perri (2005) and the real U.S. three month Treasury Bill rate.

For the period 1993:Q1 to 2001:Q3, real GDP, real private consumption, the trade balance are downloaded from Secretaría de Politica Economica website.[1]The country spread is measured using data on spreads from J.P.Morgan's Emerging Markets Bond Index Plus (EMBI+) downloaded from Global Financial Data. I construct the time series for the quarterly real Argentine interest rate following Schmitt-Grohe and Uribe (2011). I measure Argentine interest rate as the sum of the EMBI+ spread and the 90-day Treasury bill rate, which is in line with the definition used in Neumeyer and Perri. Output, consumption and investment are transformed in per-capita terms using an annual population series from the IMF's International Financial Statistics, transformed to quarterly using linear interpolation.

[1]http://www.mecon.gov.ar/peconomica/informe/indice.htm.

The U.S. real interest rate is measured by the interest rate on three-month US treasury bill minus a measure of US expected inflation. Both U.S. treasury bill rate and U.S. CPI inflation are from St Louis Fred database. The details of the methodology for the construction of time series for the real U.S. interest rate can be found in Schmitt-Grohe and Uribe (2011).

Appendix I

Reduced Form Financial Frictions Model Estimation Results with Annual Data for Argentina 1900-2005

Table I.1: Calibration Annual

Parameter	γ	δ	α	ω	θ	β	d
Value	2	0.1255	0.32	1.6	2.24	0.9224	0.007

Table I.2: Estimation Results: Argentina 1900-2005

	Prior Distribution		Posterior Distribution: Financial Frictions Model, 4 observables			Posterior Distribution: Financial Frictions Model, 5 observables		
Parameter	Min	Max	Median	5%	95%	Median	5%	95%
$\mu_{X,ss}$	1	1.03	1.01	1.003	1.017	1.0054	1.00	1.013
σ_{μ_X}	**0**	**0.2**	**0.0071**	**0.000**	**0.027**	**0.036**	**0.01**	**0.06**
ρ_{μ_X}	**-0.99**	**0.99**	**0.35**	**-0.66**	**0.83**	**0.44**	**0.11**	**0.74**
σ_A	0	0.2	0.033	0.028	0.038	0.0229	0.008	0.0334
ρ_A	-0.99	0.99	0.87	0.79	0.93	0.83	0.53	0.99
ϕ	0	8	4.6	3	6.5	1.8	1.2	2.3
σ_ν	0	1	0.51	0.37	0.8	0.31	0.11	0.75
ρ_ν	-0.99	0.99	0.86	0.74	0.93	0.68	0.48	0.87
σ_s	0	0.2	0.015	0.001	0.05	0.016	0.00	0.05
ρ_s	-0.99	0.99	0.29	-0.73	0.92	0.16	-0.69	0.99
σ_{μ_R}	**0**	**0.2**	**0.056**	**0.034**	**0.08**	**0.016**	**0.011**	**0.021**
ρ_{μ_R}	**-0.99**	**0.99**	**0.91**	**0.83**	**0.97**	**0.90**	**0.82**	**0.98**
ψ	**0**	**5**	**2.8**	**1.3**	**4.6**	**0.32**	**0.1**	**0.6**

Notes: Notes: Estimation is based on Argentine data on per capita output, consumption and investment growth and the trade balance-to-output ratio from 1990 to 2005. In the five observables case, interest rate data is included in the estimation (from 1900 to 2001). Posterior statistics are based on a two million MCMC chain from which the first million draws were discarded. The estimated standard deviations for measurement errors are smaller than 25 percent of the standard deviation of the corresponding empirical time series and omitted from the table for brevity.

Table I.3: Variance Decomposition: Argentina 1900-2005

Shock	g^Y	g^C	g^I	tby	R
Stationary Technology, σ_a					
- 4 observables	84.2	51.3	15.9	1.3	4.2
- 5 observables (w/ R)	44.1	23.8	16.7	4.2	8.1
Nonstationary Technology, σ_{μ_X}					
- 4 observables	7.4	4.3	1.5	0.4	0.09
- 5 observables (w/ R)	51	29.0	23.9	4.9	6.3
Preference, σ_ν					
- 4 observables	5.5	39.1	20.2	19.3	39.9
- 5 observables (w/ R)	0.7	45	3.1	32.4	19.7
Risk Premium, σ_{μ_R}					
- 4 observables	2.9	5.2	62.4	78.9	55.8
- 5 observables (w/ R)	3.7	1.8	56.1	58.3	65.9

Appendix J

Data Description for Chapter 2

The dataset includes quarterly data for Argentina, Brazil, Mexico, Peru, South Africa and Turkey. The sample periods vary across countries. They are: Argentina 1994Q1-2001Q3, Brazil 1995Q1-2011Q3, Mexico 1994Q1-2011Q3, Peru 1997Q1-2011Q3, South Africa: 1994Q4-2011Q3, and Turkey: 1999Q3-2011Q3. The default period in Argentina is excluded from the analysis as the country interest rate in that period was not allocative. In total, the dataset contains 345 observations. My choice of countries and sample period is guided by data availability. The countries I consider belong to the set of countries included in J. P. Morgan's EMBI+ data set for emerging-country spreads. In the EMBI+database, time series for country spreads begin in 1994:1 or later.

Quarterly series for GDP, investment and net exports are from the IMF's International Financial Statistics. All of these variables are deflated using the GDP deflator. The country spread is measured using data on spreads from J.P.Morgan's Emerging Markets Bond Index Plus (EMBI+). The U.S. real interest rate is measured by the interest rate on three-month US treasury bill minus a measure of US expected inflation. EMBI+ is a composite index of different US dollar-denominated bonds on four markets: Brady bonds, Eurobonds, U.S. dollar local markets and loans.

The spreads are computed as an arithmetic, market-capitalization-weighted average of bond spreads over US treasury bonds of comparable duration. Domestic bank borrowing lending spread in emerging economies is the difference between domestic lending rate by banks to corporate sector and the deposit rate, as reported in the International Financial Statistics of the International Monetary Fund. The data for Turkey is from the Central bank of the Republic of Turkey.

U.S. Stock Market Volatility is the monthly (averages of daily values) U.S. Implied Stock Market Volatility (VXO index: Chicago Board of Options Exchange VXO index of percentage implied volatility, on a hypothetical at the money S&P500 option 30 days to expiration). U.S. High Yield Corporate Spread is the spread between the yield of the Merrill Lynch High Yield Master II Index (YTM) and U.S. 20 Year Government Bond Yields. U.S. BAA Corporate Spread is calculated as the difference between U.S. BAA Corporate Rate and U.S. 20 Year Government Bond Yields. U.S. Real Interest Rate is measured as the 3-month gross U.S. Treasury Bill rate deflated using a measure of expected U.S. inflation (see Schmitt-Grohe and Uribe (2011) for details of the calculation of expected U.S. Inflation). I use 2 lags of inflation when calculating expected U.S. inflation. The results are robust to using higher lags of inflation in calculating real interest rates. Sovereign spreads (EMBI+) are downloaded from Global Financial Data and Bloomberg. The U.S. 3M TBILL Rate, the U.S. CPI, the U.S. BAA Corporate Rate and 20Y Government Bond Yield are obtained from St. Louis Fed. FRED Database. The Merrill Lynch High Yield Master II Index (YTM) is from Bloomberg.