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Ozge Akinci

Financial Frictions and Macroeconomic Fluctuations in Emerging Economies*

Ozge Akinci†
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Abstract

Estimated dynamic models of business cycles in emerging markets 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. This paper proposes and estimates a small open economy model of the emerging-market business cycle in which a time-varying country risk premium emerges endogenously. In the proposed model, a firm's borrowing rate adjusts countercyclically as the default threshold of the firm 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 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 70 percent of the variances in the trade balance and in the country risk premium. Finally, I find the predicted contribution of nonstationary productivity shocks in explaining output variations falls between the extremely high and extremely low values reported in the literature.

Keywords: Financial Frictions; Country risk premium; International business cycles; Bayesian Estimation.

JEL classification: E32; E44; F44; G15.

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†Ozge Akinci, Division of International Finance, Federal Reserve Board, 20th and C St. NW, Washington, DC 20551. Email: ozge.akinci@frb.gov.

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 of the trade balance 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 et al. (1999). In the model, due to a costly state verification problem, external funds will be more expensive than internal funds. Assuming that 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 in the international markets 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 them 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 in the model. 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, 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 non-stationary 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 foreign 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 Christiano et al. (2007), Dorofeenko et al. (2008), Christiano et al. (2009).[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 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

[1]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.

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 they 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 volatile country risk premium, which is a good business cycle leading indicator in emerging economies. Finally, as I show, time varying uncertainty shock in the model with financial frictions replaces some of the role of the nonstationary technology shock in explaining fluctuations in investment and trade balance.[2]

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 explain 50 percent of the unconditional variances of output and consumption. This estimate falls between the estimates 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 about 70 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 modify inferences about the sources of macroeconomic fluctuations in emerging markets. Without the financial frictions, the nonstationary technology shock is the main source of fluctuations. With reduced form financial frictions, on the other hand, the data assign a negligible role to the nonstationary technology shock. Its role is replaced by the stationary technology shock, the consumption preferences shock and the country risk premium shock. As I show in this paper, once the model is forced to use information on country risk premium, some of the explanatory power of the consumption preference shock is lost, and time varying uncertainty shock becomes very important.

The present paper is related to a large body of existing literature on emerging-market

[2] Aguiar and Gopinath (2007) argue that the nonstationary technology shock is the single most important shock for the emerging economy in the context of frictionless real business cycle models.

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) and Uribe and Yue (2006) augmented the canonical model with reduced form financial frictions without explicitly incorporating a microfounded default mechanism. In a more recent paper, Aguiar and Gopinath (2007) introduced shocks to trend output in an otherwise standard small open economy business cycle model. However, the estimated frictionless model implies excessive volatility of trade balance to output ratio. Garcia-Cicco et al. (2010) estimated an encompassing model for an emerging economy with both trend shocks and financial frictions. As I show, their model predicts a procyclical interest rate, while it is strongly countercyclical in the data.[3]

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. However, their results crucially depend on the assumption that defaults on public and private foreign obligations occur simultaneously.[4] 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 *ala* Bernanke et al. (1999) (see, for example, Gertler et al. (2007), Elekdag et al. (2006), Curdia (2007)).

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. Section 3 analyzes empirical regularities of business cycles in Argentina. Section 4 estimates both the frictionless and the reduced form financial frictions model for Argentina. The purpose of this section is to evaluate these models in terms of their ability to produce countercyclical interest rates and other stylized facts. Section 5 describes the econometric estimation of the proposed model using Argentine data. Section 6 concludes.

[3]Chang and Fernandez (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.

[4]Aguiar and Gopinath (2006) in a quantitative model of sovereign default based on the classic setup of Eaton and Gersovitz (1981) 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.

2 The Model with Microfounded 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, 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.

2.1 Households

Our 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

$$E_0 \sum_{t=0}^{\infty} \beta^t \nu_t U(C_t, h_t), \tag{1}$$

where

$$U(C,h) \;=\; \frac{\left(C_t - \psi^{-1} X_{t-1} h_t^{\psi}\right)^{1-\sigma} - 1}{1-\sigma}, \tag{2}$$

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 $1/(\psi\text{-}1)$. 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:

$$log(\nu_{t+1}/\nu) = \rho_\nu log(\nu_t/\nu) + \varepsilon_{\nu,t+1};\;\; \varepsilon_{\nu,t} \sim i.i.d.\;\; N(0, \sigma_\nu^2) \tag{3}$$

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

$$I_t \;\; = \;\; K_{t+1} - (1-\delta)K_t, \tag{4}$$

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:

$$C_t + I_t + B_t^d \;\; = \;\; \frac{B_{t+1}^d}{R_t} + W_t h_t + R_{k,t}K_t - \frac{\varphi}{2}\left(\frac{K_{t+1}}{K_t} - \mu_X\right)^2 K_t + \Phi_t^f + \Phi_t^m \tag{5}$$

where μ_X is the steady state growth rate of permanent technology shock, X, and investment, I_t is given in equation (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) subject to capital accumulation equation, (4), their budget constraint, (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 (5) be $\lambda_t X_{t-1}^{-\sigma}$. Optimality conditions of the household's problem are presented in the online Appendix A.[5]

2.2 Firms

2.2.1 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 summarizes the timing of the events. The sequence of events for the firm's problem is presented in detail in online Appendix B.

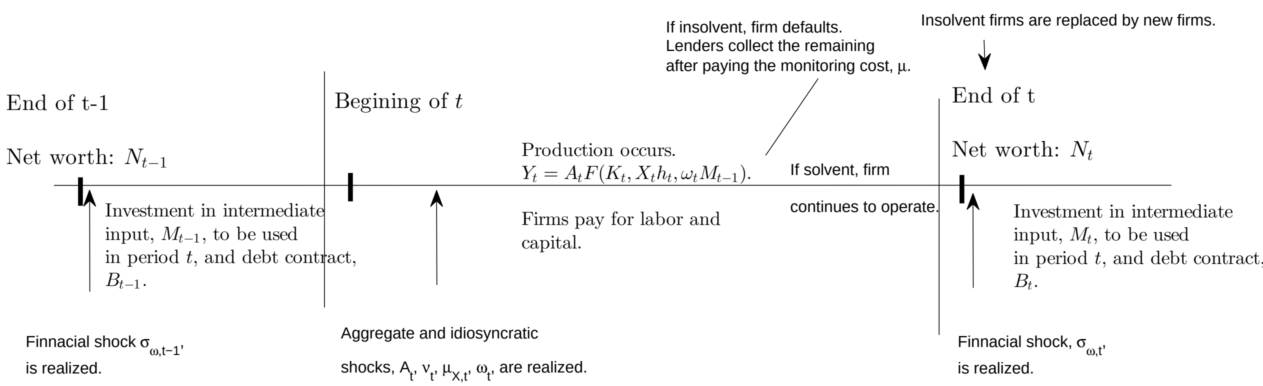

Figure 1: Timeline for Firms

The production technology takes the form:

$$Y_t^i \quad = \quad A_t \left[K_t^i\right]^{\alpha} \left[X_t h_t^{f,i}\right]^{\gamma} \left[\omega_t^i M_{t-1}^i\right]^{\eta} \tag{6}$$

[5]Online appendix is available in the author's webpage at www.ozgeakinci.com.

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

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

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

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

In addition, I assume that the purchased intermediate goods are shifted by a productivity shock, ω_t^i 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 $E_{t-1}[\omega_t^i] = 1$ 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

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

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).[6]

[6] 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.

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

$$\gamma \frac{Y_t^i}{h_t^{f,i}} = W_t \tag{7}$$

$$\alpha \frac{Y_t^i}{K_t^i} = R_{k,t} \tag{8}$$

Intermediate Input Purchase Decision and 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:

$$p_{m,t} M_t^i = N_t^i + B_t^i \tag{9}$$

where $p_{m,t}$ is 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 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:

$$\begin{aligned} R_{m,t+1}^i &= \frac{Y_{t+1}^i - W_{t+1} h_{t+1}^{f,i} - R_{k,t+1} K_{t+1}^i}{p_{m,t} M_t^i} \\ &= \frac{\eta Y_{t+1}^i}{p_{m,t} M_t^i} \end{aligned}$$

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

$$R^i_{m,t+1} \quad = \quad \omega^i_{t+1}\left(\frac{\eta\left(\frac{\gamma}{W_{t+1}}\right)^{\frac{\gamma}{\eta}}\left(\frac{\alpha}{R_{k,t+1}}\right)^{\frac{\alpha}{\eta}}}{p_{m,t}}\right) \equiv \omega^i_{t+1}R_{m,t+1} \tag{10}$$

where $R_{m,t+1}$ is the aggregate component of the return on the investment in intermediate inputs (Proved in the online Appendix C). 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 $\mu\omega^i_{t+1}R_{m,t+1}p_{m,t}M^i_t$ where μ is the real monitoring cost.[7]

The firm chooses intermediate input, M^i_t, and the associated level of borrowing, B^i_t, prior to the realization of the idiosyncratic and aggregate shocks, $(A_{t+1}, \mu_{x,t+1}, \nu_{t+1}, \omega^i_{t+1})$ but after the realization of the standard deviation shock, $\sigma_{\omega,t}$, affecting the distribution of

[7] If there was no costly state verification problem, say ω^i_{t+1} is common knowledge, the total cost of funding would be equal to the amount of borrowing multiplied by the interest paid on the funds borrowed, R_tB_t. Neumeyer and Perri (2005) assume that international investors is willing to lend to the emerging economy any amount at a rate R_t. Loans to the domestic economy are risky because they assume there can be default on payments to foreigners. But their model does not provide microfoundations to for the default decision.

idiosyncratic productivity shock, $F(\omega^i_{t+1};\sigma_{\omega,t})$; hence, the external finance premium paid at time $t+1$. The firm with an idiosyncratic productivity shock, ω^i_{t+1}, above a default threshold value, $\bar{\omega}^i_{t+1}$, pays a gross interest rate, $R^i_{B,t}$, on their loans. The default threshold is set to a level of returns that is just enough to fulfill the debt contract obligations:

$$\bar{\omega}^i_{t+1} R_{m,t+1} p_{m,t} M^i_t = R^i_{B,t} B^i_t \tag{11}$$

Given the constant returns to scale assumption, the cutoff value $\bar{\omega}^i_{t+1}$ determines the division of gross earnings from investing in intermediate inputs, $R_{m,t+1}p_{m,t}M^i_t$, between borrower and lender. If the idiosyncratic shock is greater than or equal to the default threshold, $\bar{\omega}^i_{t+1}$, the firm repays the loan and collects the remainder of the profits, equal to $(\omega^i_{t+1} - \bar{\omega}^i_{t+1})R_{m,t+1}p_{m,t}M^i_t$. This means that if the firm does not default, a lender receives a fixed payment independent of ω^i_{t+1}. Otherwise, the firm defaults and the foreign lender pays the auditing cost, μ and collects everything there is to collect, $(1-\mu)\omega^i_{t+1}R_{m,t+1}p_{m,t}M^i_t$. I define $\Upsilon(\bar{\omega}^i_{t+1};\sigma_{\omega,t})$ as the expected gross share of the aggregate component of earnings retained by the firm and define $\Gamma(\bar{\omega}^i_{t+1};\sigma_{\omega,t})$ as the expected gross share of aggregate component of earnings going to the lender:

$$\Upsilon(\bar{\omega}^i_{t+1};\sigma_{\omega,t}) \equiv \int_{\bar{\omega}^i_{t+1}}^{\infty} (\omega^i_{t+1} - \bar{\omega}^i_{t+1}) dF(\omega^i_{t+1};\sigma_{\omega,t}) \tag{12}$$

$$\begin{aligned}
\Gamma(\bar{\omega}^i_{t+1};\sigma_{\omega,t}) &\equiv \int_0^{\bar{\omega}^i_{t+1}} \omega^i_{t+1} dF(\omega^i_{t+1};\sigma_{\omega,t}) + \int_{\bar{\omega}^i_{t+1}}^{\infty} \bar{\omega}^i_{t+1} dF(\omega^i_{t+1};\sigma_{\omega,t}) && (13)\\
&\equiv \int_0^{\bar{\omega}^i_{t+1}} \omega^i_{t+1} dF(\omega^i_{t+1};\sigma_{\omega,t}) + \left[1 - \int_0^{\bar{\omega}^i_{t+1}} dF(\omega^i_{t+1};\sigma_{\omega,t})\right] \bar{\omega}^i_{t+1} && (14)\\
&\equiv \int_0^{\bar{\omega}^i_{t+1}} \omega^i_{t+1} dF(\omega^i_{t+1};\sigma_{\omega,t}) + \left[1 - F(\bar{\omega}^i_{t+1};\sigma_{\omega,t})\right] \bar{\omega}^i_{t+1} && (15)
\end{aligned}$$

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

$$\Upsilon(\bar{\omega}^i_{t+1};\sigma_{\omega,t}) \;\;\equiv\;\; 1 - \Gamma(\bar{\omega}^i_{t+1};\sigma_{\omega,t}) \tag{16}$$

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.[8]

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 (9), the equation defining the expected gross share of aggregate component of earnings going to the lender, equation (15), with the zero profit condition of the foreign lender given above yields the following expression:[9]

$$E_t\left\{\Omega(\bar{\omega}^i_{t+1};\sigma_{\omega,t}) R_{m,t+1}p_{m,t}M_t\right\} = R^*_t B^i_t \tag{17}$$

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

[9] 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 $\sigma_{\omega,t}$.

where

$$\Omega(\bar{\omega}^i_{t+1};\sigma_{\omega,t}) \equiv \Gamma(\bar{\omega}^i_{t+1};\sigma_{\omega,t}) - \mu G(\bar{\omega}^i_{t+1};\sigma_{\omega,t}) \tag{18}$$

$$G(\bar{\omega}^i_{t+1},\sigma_{\omega,t}) \equiv \int_0^{\bar{\omega}^i_{t+1}} \omega^i_{t+1} dF(\omega^i_{t+1};\sigma_{\omega,t}) \tag{19}$$

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:

$$\Phi^{f,i}_{t+1} = Y^i_{t+1} - W_{t+1}h^{f,i}_{t+1} - R_{k,t+1}K^i_{t+1} - R^i_{B,t}B^i_t - N^i_{t+1} \tag{20}$$

Using the constant returns to scale assumption, I can write dividends as the following:[10]

$$\Phi^{f,i}_{t+1} = \omega^i_{t+1}R_{m,t+1}p_{m,t}M^i_t - R^i_{B,t}B^i_t - N^i_{t+1} \tag{21}$$

Rearranging equation (21) by using the definition of the default threshold, (11), I get the following expression for real dividends distributed to households:

$$\Phi^{f,i}_{t+1} = \left[\int_{\bar{\omega}^i_{t+1}}^{\infty} (\omega^i_{t+1} - \bar{\omega}^i_{t+1})dF(\omega^i_{t+1};\sigma_{\omega,t})\right] R_{m,t+1}p_{m,t}M^i_t - N^i_{t+1} \tag{22}$$

$$= \left[1 - \Gamma(\bar{\omega}^i_{t+1};\sigma_{\omega,t})\right] R_{m,t+1}p_{m,t}M^i_t - N^i_{t+1} \tag{23}$$

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

$$E_t\Phi^{f,i}_{t+1} = E_t\left\{\left[1 - \Gamma(\bar{\omega}^i_{t+1};\sigma_{\omega,t})\right] R_{m,t+1}p_{m,t}M^i_t - N^i_{t+1}\right\} \tag{24}$$

The formal investment and contracting problem then reduces to choosing M^i_t and a sched-

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

ule for $\bar{\omega}^i_{t+1}$ (as a function of realized values of $R_{m,t+1}$) to maximize (24) subject to the participation constraint of the foreign lender,(17).

After the firm has chosen M^i_t and $\bar{\omega}^i_{t+1}$, the firm's net worth, N^i_t is determined. I assume that a new firm is immediately created for the insolvent firm with a level of net worth, N^i_t, 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:

$$\max_{\{M^i_t, \bar{\omega}^i_{t+1}, R^i_{B,t}, N^i_t\}} \Lambda_t \Phi^{f,i}_t + \beta E_t \Lambda_{t+1} \Phi^{f,i}_{t+1} \tag{25}$$

subject to the participation constraint of the foreign lenders, (17) and the default threshold definition, (11), with respect to M^i_t, $\bar{\omega}^i_{t+1}$, $R^i_{B,t}$ and N^i_t.[11]

I eliminate the second constraint by substituting the default threshold by $\bar{\omega}^i_t = \frac{R^i_{B,t-1}(p_{m,t-1}M^i_{t-1} - N^i_{t-1})}{R_{m,t}p_{m,t-1}M^i_{t-1}}$. I denote the lagrange multiplier for the participation constraint of the lender (17) as φ^i_t. The appropriate discount factor is given by Λ_t where $\Lambda_t = \lambda_t X^{-\sigma}_{t-1}$ is the lagrange multiplier associated with the households' budget constraint (5).

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

$$\begin{aligned} E_t \lambda_{t+1} \frac{R_{m,t+1}}{R^*_t} \left[1 - \Gamma(\bar{\omega}^i_{t+1}; \sigma_{\omega,t})\right] &= E_t \lambda_{t+1} \rho(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) \frac{N_t}{p_{m,t} M^i_t} && (26) \\ \frac{R_t}{R^*_t} E_t \lambda_{t+1} &= E_t \left\{ \lambda_{t+1} \rho(\bar{\omega}^i_{t+1}, \sigma_{\omega,t}) \right\} && (27) \\ E_t \Omega(\bar{\omega}^i_{t+1}; \sigma_{\omega,t}) \frac{R_{m,t+1}}{R^*_t} p_{m,t} M^i_t &= [p_{m,t} M^i_t - N^i_t] && (28) \end{aligned}$$

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 online Appendix D.)

Equation (26) 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

[11] Expected dividend for the surviving firms is $\Phi^{f,i}_t = (\omega^i_t - \bar{\omega}^i_t) R_{m,t} p_{m,t-1} M^i_{t-1} - N^i_t$ and for the newly created firms it is given by $\Phi^{f,i}_t = -N^i_t$

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 (27), 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 (28), is the participation constraint of the foreign lender.

2.2.2 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):

$$M_t = \left[\nu^{\frac{1}{\rho i}}(M_t^H)^{\frac{\rho i-1}{\rho i}} + (1-\nu)^{\frac{1}{\rho i}}(M_t^F)^{\frac{\rho i-1}{\rho i}}\right]^{\frac{\rho i}{\rho i-1}} \tag{29}$$

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

$$p_{m,t} = \left(\nu(p_t^H)^{1-\rho i} + (1-\nu)(p_t^F)^{1-\rho i}\right)^{\frac{1}{1-\rho i}} \tag{30}$$

$$M_t^H = \nu M_t\left(\frac{p_t^H}{p_{m,t}}\right)^{-\rho i} \tag{31}$$

$$M_t^F = (1-\nu)M_t\left(\frac{p_t^F}{p_{m,t}}\right)^{-\rho i} \tag{32}$$

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: $p_t^H = W_t/X_{t-1}$.

2.3 Market Clearing Conditions

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

Goods Market Equilibrium:

$$Y_t + p_t^H M_t^H \quad = \quad C_t + I_t + \frac{\varphi}{2}\left(\frac{K_{t+1}}{K_t} - \mu_X\right)^2 K_t + p_{m,t}M_t + NX_t \tag{33}$$

(Proved in the online Appendix E.)

Balance of Payments:

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

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.[12]

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

[12]The complete set of equilibrium conditions in stationary form are presented in online Appendix F.

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 literature which uses quarterly data from 1980s until the beginning of 2000s.[13]

Table 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. Standard errors are shown in parenthesis.

Table 1 presents second moments 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.

[13] See, for example, Aguiar and Gopinath (2007).

The volatility of the 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.

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 these models to match the statistical properties of the interest rates.

The model, the details of the calibration using Argentine data over the period 1983Q1 and 2001Q3, and the estimation results are presented in the online Appendix G. I estimate the parameters of the model using Bayesian methods and Argentine data on output growth, consumption growth, investment growth, and the trade balance–to-output ratio and country interest rate 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 those governing the degree of capital adjustment cost, ϕ.

Table 2 displays second moments predicted by the model. The table shows that both RBC model augmented with trend shock and reduced form financial frictions model perform similarly in explaining 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.

Table 2: 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 3 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.

Table 3: 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 with 4 obs.	94.8	78.8	42.3	3.9	18.2
- Reduced Form Frictions 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 with 4 obs.	**3.9**	**2.6**	**1.7**	**0.5**	**0.6**
- Reduced Form Frictions with 5 obs.	**51.1**	**53.8**	**53.0**	**29.5**	**50.5**
Preference, σ_ν					
- RBC model	-	-	-	-	-
- Reduced Form Frictions with 4 obs.	0.47	11.7	9.7	13.4	22.1
- Reduced Form Frictions with 5 obs.	0.05	9.0	2.5	11.9	4.1
Risk Premium, σ_{μ_R}					
- RBC model	-	-	-	-	-
- Reduced Form Frictions with 4 obs.	**0.74**	**6.85**	**46.2**	**82.0**	**59.1**
- Reduced Form Frictions 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.

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.[14]

5 Estimation and Evaluation of the Model with Micro-founded 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 4 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

[14] 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. I showed in the online Appendix H 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.

$\gamma = 0.40$, 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, ρi and factor income shares are taken from Mendoza and Yue (2011).

Table 4: Baseline Calibration For Microfounded Financial Frictions Model

Param.	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
δ	Depreciation rate of capital	0.1	Average investment ratio
α	Capital share in gross output	0.17	Capital Share = 30%
γ	Labor share in gross output	0.40	Labor Share = 70%
η	Inter. input shr. in gr. output	0.43	Mendoza and Yue (2011)
μ_x	Long-run productivity growth	1.005	GPU (2010)
R^*	Risk free foreign interest rate	1%	Standard RBC Value
β	Discount Factor	0.975	Steady state annual spread
ρi	Home good bias in inter. goods	0.65	Mendoza and Yue (2011)
ν	Weight of domestic inputs	0.73	Mendoza and Yue (2011)
μ	Monitoring cost	0.075	$d^{ss} = 47\%$,
$\sigma_{\omega,ss}$	Std. dev. of ω	0.45	$prem = 10\%$, C.spread=7%
$p_{z,ss}$	World price of intermed. inputs	1.028	Mendoza(2010)

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 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. The values for μ and $\sigma_{\omega,ss}$, important parameters characterizing the financial frictions in the economy, are obtained in the 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 $\sigma_{\omega,ss}$.[15]

[15] 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. 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.

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.

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 5 presents key statistics of the prior and posterior distributions. Several results are worth highligting: 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 5: 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 6 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. 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

Table 6: 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.

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 7 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 discipling 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.

Table 7: Variance Decomposition Predicted by the Model With Microfounded Financial Frictions

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

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

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 2 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.

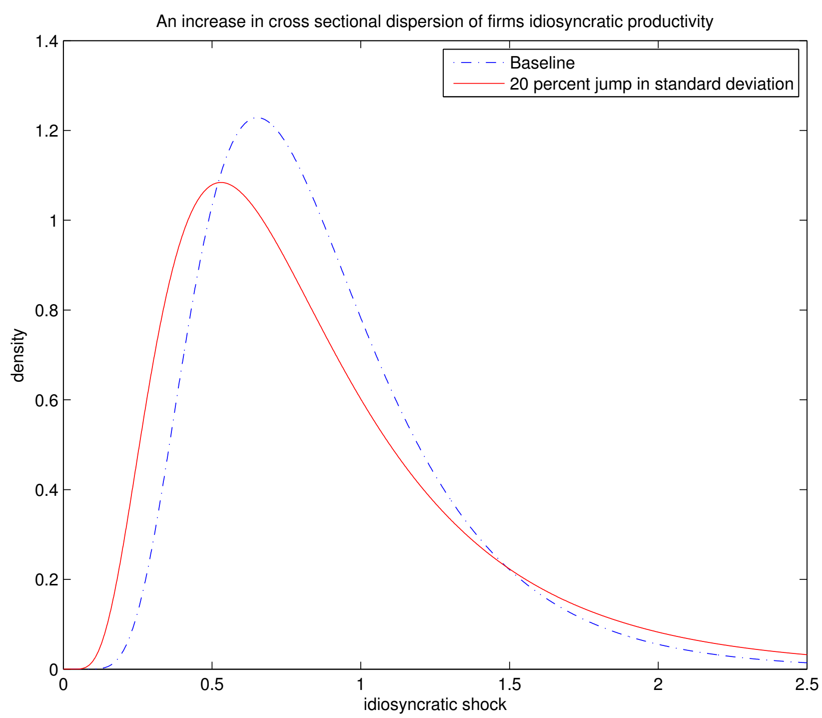

Figure 2: Uncertainty Shock

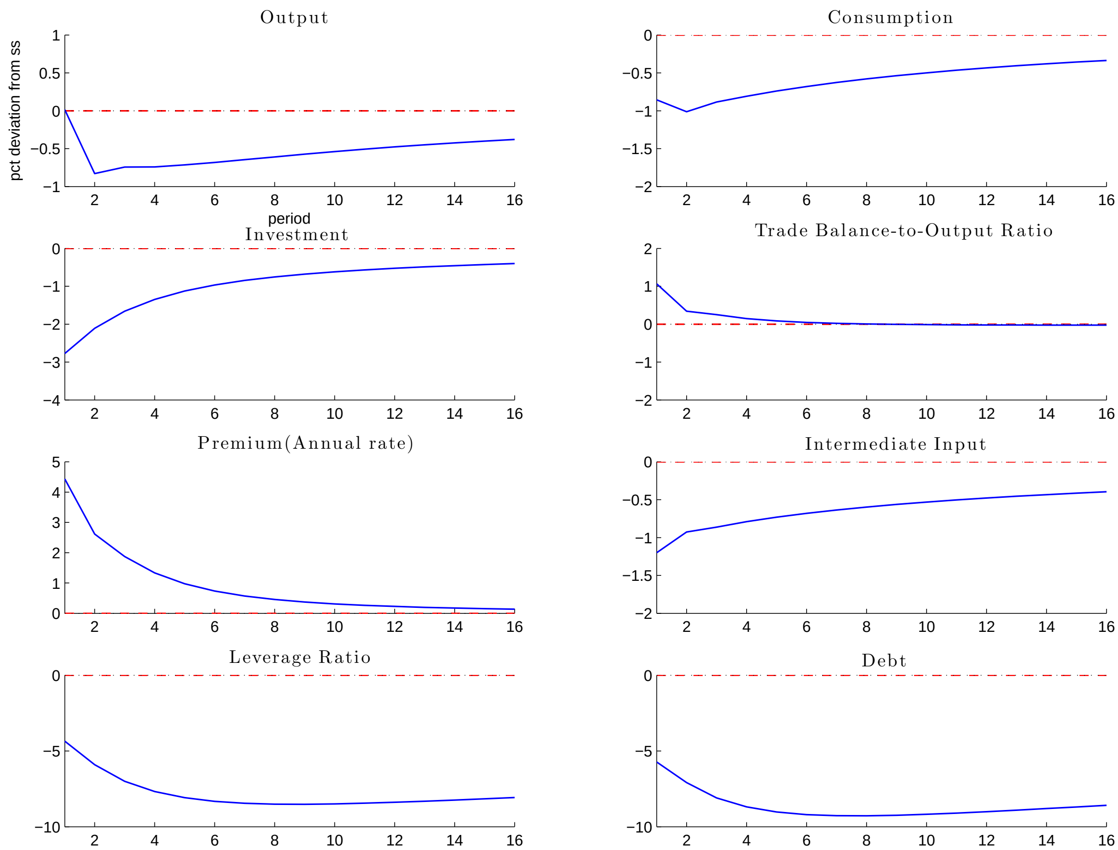

Figure 3: Impulse Responses to Uncertainty Shock

Figure 3 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 results in the model economy.

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 the nonstationary component of productivity explain 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 firm specific productivity explains about 70 percent 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.

Appendix: Data Description

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 Secretara de Politica Economica website.[16] The country spread is measured using data on spreads from J.P.Morgan 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 International Financial Statistics, transformed to quarterly using linear interpolation.

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 methodology for the construction of time series for the real U.S. interest rate is also from Schmitt-Grohe and Uribe (2011).

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

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Online Appendix to Financial Frictions and Macroeconomic Fluctuations in Emerging Economies*

Ozge Akinci†
Federal Reserve Board

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†Ozge Akinci, Division of International Finance, Federal Reserve Board, 20th and C St. NW, Washington, DC 20551. Email: ozge.akinci@frb.gov.

A Optimality Conditions of the Household's Problem

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

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

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

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

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

B 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, $\mu_{x,t}$, ν_t, and ω_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, 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 $t+1$ (ω^i_{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]

C Derivations for Return on Intermediate Input Equation

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

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

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 1, I then get the following expression for return on intermediate inputs,

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

By using labor and capital demand equations, I can express $\tilde{h}^i_{t+1}$ and $\tilde{k}^i_{t+1}$ as a function of

[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.

aggregate variables common to all firms and idiosyncratic productivity shock as the following:

From labor demand equation,

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

From capital demand equation,

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

Substituting (3) into (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 (2),

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

D Solving Firm's Profit Maximization Problem

This section solves the firm's profit maximization problem.

The solvent and insolvent firms choose M^i_t (intermediate inputs), $\bar{\omega}^i_{t+1}$ (default threshold), N^i_t (net worth) and $R^i_{B,t}$ (loan rate) to maximize

$$
\Lambda_t\left[(\omega^i_t-\bar{\omega}^i_t)R_{m,t}p_{m,t-1}M^i_{t-1}-N^i_t\right]+\beta E_t\Lambda_{t+1}\left\{[1-\Gamma(\bar{\omega}^i_{t+1};\sigma_{\omega,t})]R_{m,t+1}p_{m,t}M^i_t-N^i_{t+1}\right\}
$$

OR

$$
\Lambda_t\left[-N^i_t\right]+\beta E_t\Lambda_{t+1}\left\{[1-\Gamma(\bar{\omega}^i_{t+1};\sigma_{\omega,t})]R_{m,t+1}p_{m,t}Z^i_t-N^i_{t+1}\right\}
$$

respectively, subject to

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

I will eliminate the second constraint by substituting $\bar{\omega}^i_t$ with $\frac{R^i_{B,t-1}[p_{m,t-1}M^i_{t-1}-N^i_{t-1}]}{R_{m,t}p_{m,t-1}M^i_{t-1}}$ and $\bar{\omega}^i_{t+1}$ with $\frac{R^i_{B,t}[p_{m,t}M^i_t-N^i_t]}{R_{m,t+1}p_{m,t}M^i_t}$. Note that the contract is "Standard Debt Contract," which means that the default threshold, $\bar{\omega}^i_{t+1}$ is state contingent but the contractual interest rate, $R^i_{B,t}$ is not.

I denote the lagrange multiplier for the participation constraint, by φ_t^i.

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

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

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 :

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

Rearranging, first order conditions can be written as

Z_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

$$
\varphi^i_t = \frac{\beta E_t \Lambda_{t+1} \Gamma_\omega(\bar{\omega}^i_{t+1};\sigma_{\omega,t})}{E_t \Omega_\omega(\bar{\omega}^i_{t+1};\sigma_{\omega,t})} \tag{5}
$$

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:

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

$$\Lambda_t \quad = \quad \frac{\beta E_t \Lambda_{t+1} \Gamma_\omega(\bar{\omega}_{t+1}^i; \sigma_{\omega,t})}{E_t \Omega_\omega(\bar{\omega}_{t+1}^i; \sigma_{\omega,t})} R_t^*$$

Defining $\rho(\bar{\omega}_{t+1}^i; \sigma_{\omega,t}) \equiv \frac{\Gamma_\omega(\bar{\omega}_{t+1}^i; \sigma_{\omega,t})}{E_t \Omega_\omega(\bar{\omega}_{t+1}^i; \sigma_{\omega,t})}$ 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:

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

Finally, I rearrange the first order condition wrt M_t^i after imposing the definition of $\varphi_t^i$and I get the following equation:

$$\begin{aligned} E_t \lambda_{t+1} R_{m,t+1} \left[1 - \Gamma(\bar{\omega}_{t+1}^i; \sigma_{\omega,t})\right] p_{m,t} M_t^i & \\ + E_t \lambda_{t+1} \rho(\bar{\omega}_{t+1}^i; \sigma_{\omega,t}) \left[E_t \Omega(\bar{\omega}_{t+1}^i; \sigma_{\omega,t}) R_{m,t+1} p_{m,t} M_t^i - R_t^* p_{m,t} M_t^i\right] & = 0 \end{aligned}$$

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

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

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

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

I can re-write $\rho(\bar{\omega}^i_{t+1};\sigma_{\omega,t})$ 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 $\Gamma_\omega(\bar{\omega}^i_{t+1};\sigma_{\omega,t}) = 1 - F(\bar{\omega}^i_{t+1};\sigma_{\omega,t})$ and $\Omega_\omega(\bar{\omega}_{t+1};\sigma_{\omega,t}) = 1 - F(\bar{\omega}^i_{t+1};\sigma_{\omega,t}) - \mu\bar{\omega}^i_{t+1}F_\omega(\bar{\omega}^i_{t+1};\sigma_{\omega,t})$.[2] Then, I have:

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

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. That is so because, ex-ante, all firms are identical. The only variable that will differ across firms is the amount of dividend actually distributed to the shareholders, which will absorb all of the idiosyncratic shock. This implies that the above relationships can all be expressed in aggregate terms.

E Deriving Resource Constraint

$$C_t + I_t + \frac{\varphi}{2}\left(\frac{K_{t+1}}{K_t} - \mu_X\right)^2 K_t + B^d_t - \frac{B^d_{t+1}}{R_t} = W_t h_t + R_{k,t}K_t + \Phi^f_t + \Phi^m_t$$

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

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

and

$$\Phi^m_t = p^H_t M^H_t - W_t h^m_t$$

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

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

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

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:

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

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

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

F Equilibrium Conditions in Stationary Form

Define $y_t = Y_t/X_{t-1}$, $c_t = C_t/X_{t-1}$, $k_t = K_t/X_{t-1}$, $i_t = I_t/X_{t-1}$, $m_t = M_t/X_{t-1}$, $m_t^H = M_t^H/X_{t-1}$, $m_t^F = M_t^F/X_{t-1}$, $n_t = N_t/X_{t-1}$, $nx_t = NX_t/X_{t-1}$ and $B_t = B_t/X_{t-1}$. Also, define, $d_t = \frac{B_t}{p_{z,t}Z_t}$ 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:

$$\begin{aligned}
(c_t - \theta\psi^{-1}h_t^{\psi})^{-\sigma} &= \lambda_t \\
\beta\frac{R_t}{\mu_{x,t}^{\sigma}}E_t\left\{\lambda_{t+1}\right\} &= \lambda_t \\
(\theta h_t^{\psi-1}) &= \gamma\frac{y_t}{h_t} \\
\frac{\beta}{\mu_{x,t}^{\sigma}}E_t\lambda_{t+1}\left(\alpha\frac{y_{t+1}}{k_{t+1}} + 1 - \delta + \varphi\left(\frac{k_{t+2}}{k_{t+1}}\mu_{x,t+1}\right)\left(\frac{k_{t+2}}{k_{t+1}}\mu_{x,t+1} - \mu_x\right)\right) & \\
-\frac{\beta}{\mu_{x,t}^{\sigma}}E_t\lambda_{t+1}\frac{\varphi}{2}\left(\frac{k_{t+2}}{k_{t+1}}\mu_{x,t+1} - \mu_x\right)^2 &= \lambda_t\left[1 + \varphi\left(\frac{k_{t+1}}{k_t}\mu_{x,t} - \mu_x\right)\right] \\
\eta\frac{y_t}{p_{m,t-1}(M_{t-1}/\mu_{x,t-1})} &= R_{m,t} \\
A_t\left[k_t\right]^{\alpha}\left[\mu_{x,t}h_t\right]^{\gamma}\left[M_{t-1}/\mu_{x,t-1}\right]^{\eta} &= y_t \\
n_t &= (1-d_t)p_{m,t}m_t \\
b_t &= d_t p_{m,t}m_t \\
\bar{\omega}_t &= \frac{R_{B,t}}{R_{m,t}}d_{t-1} \\
E_t\left\{\Omega(\bar{\omega}_t, \sigma_{\omega,t-1})\frac{R_{m,t}}{R_{t-1}^*}\right\} &= d_{t-1} \\
E_t\left\{\lambda_{t+1}\left(\frac{R_{m,t+1}}{R_t^*}\left[1 - \Gamma(\bar{\omega}_{t+1};\sigma_{\omega,t}) + prem_{t+1}\Omega(\bar{\omega}_{t+1};\sigma_{\omega,t})\right]\right)\right\} &= E_t\left[\lambda_{t+1}prem_{t+1}\right] \\
R_tE_t\left[\lambda_{t+1}\right] &= R_t^*E_t\left[\lambda_{t+1}prem_{t+1}\right] \\
\frac{\Gamma'(\bar{\omega}_t, \sigma_{\omega,t-1})}{E_{t-1}\Omega'(\bar{\omega}_t, \sigma_{\omega,t-1})} &= prem_t \\
c_t + i_t + \frac{\varphi}{2}\left(\frac{k_{t+1}}{k_t}\mu_{x,t} - \mu_X\right)^2 k_t + p_{m,t}M_t + nx_t &= y_t \\
k_{t+1}\mu_{x,t} - (1-\delta)k_t &= i_t \\
nx_t - \Gamma(\bar{\omega}_t, \sigma_{\omega,t-1})R_{m,t}p_{m,t-1}\frac{z_{t-1}}{\mu_{x,t-1}} + b_t &= 0
\end{aligned}$$

G Canonical RBC 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

$$Y_t = A_t K_t^{\alpha} (X_t h_t)^{1-\alpha}, \tag{6}$$

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. We assume that the logarithm of $\mu_{X,t}$ follows a first-order autoregressive process of the form

$$ln\left(\mu_{X,t+1}/\mu_X\right) = \rho_{\mu_X} ln\left(\mu_{X,t}/\mu_X\right) + \epsilon_{t+1}^{\mu_X}; \qquad \epsilon_t^{\mu_X} \sim N(0, \sigma_{\mu_X}^2).$$

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:

$$\frac{D_{t+1}}{1+R_t} \;=\; D_t - Y_t + C_t + S_t + I_t + \frac{\phi}{2}\left(\frac{K_{t+1}}{K_t} - \mu_X\right)^2 K_t, \tag{7}$$

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:

$$K_{t+1} = (1-\delta)K_t + I_t \tag{8}$$

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

$$ln\nu_{t+1} = \rho_\nu ln\nu_t + \epsilon^\nu_{t+1}; \qquad \epsilon^\nu_t \sim N(0, \sigma^2_\nu),$$

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

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

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 (6)). Given the contstant returns to scale assumption, total output, Y_t, in Equation (7) 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. We 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: $R_{K,t} = \alpha \frac{Y_t}{K_t}$.

Reduced Form Financial Frictions Model Estimation Results with Data for Argentina 1983Q1-2001Q3

Table 1: Baseline 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 2: 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 Gewekes modified harmonic mean method.

Table 3: 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 Gewekes modified harmonic mean method.

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

Table 4: 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 5: Estimation Results: Argentina 1900-2005

			Posterior Distribution					
	Prior Distribution		Financial Frictions Model 4 observables			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 6: Variance Decomposition

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

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