BUSINESS CYCLE IMPLICATIONS OF RISING HOUSEHOLD CREDIT MARKET PARTICIPATION IN EMERGING COUNTRIES

Zulma Barrail

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Zulma Barrail*

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Abstract

A small open emerging-economy model is extended with a household sector financial constraint to investigate business cycle implications of a rise in household access and use of financial services. Estimating the model on Mexican data and consistent with empirical findings, this paper finds that a rise in household credit market participation: (1) yields larger aggregate consumption volatility and (2) amplifies the effects of shocks in the domestic economy, particularly those transmitted through the interest rate channel. The estimated model also highlights that: (3) the lesser financial frictions are, the lower is the increase of consumption growth and trade balance volatility driven by a rise in household credit market participation and (4) trend productivity shocks become a more relevant source of business cycle fluctuations. Finally, standard measures of predictive accuracy suggest that the extended model outperforms the baseline emerging market model.

Keywords: Limited asset markets participation, Rule-of-thumb consumers, Aggregate Fluctuations, RBC model, Small open economy, Emerging markets

JEL Classification: E13, E32 , E44, O11,O16

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Introduction

During the period 1995-2010, emerging countries in Latin America were observing a significant increase in their middle income class population as poverty rates declined (Ferreira et al., 2013). This not only increased credit demand but also motivated the entry of new suppliers in the consumer credit market. According to Obermann (2006) and Montero and Tarzijan (2010), in countries such as Mexico, Colombia, Chile and Brazil, new providers from international and national-level retail chains emerged as main credit suppliers for "new middle class shoppers". Indeed, many countries in the region experienced a credit boom in the second half of the 2000s (Hansen and Sulla, 2013). More importantly, these credit booms -as identified by the authors - were mainly driven by unsecured credit to households.

Both the increase in the fraction of population that is more likely to have access to financial services and the increase in unsecured credit supply particularly for lower income households suggest a rise in household credit market participation.

As a larger fraction of households can freely save and incur in debt to smooth income fluctuations, aggregate consumption would tend to be less volatile. However, for emerging economies, the empirical literature has found the opposite result. Greater ability to borrow and increased access to credit may be associated with either a short term boom in consumption (Fulford, 2013) or an increase in consumption volatility in emerging markets - see Basu and Macchiavelli (2015) and Bhattacharya and Paitnaik (2015). In this paper, I provide further evidence of this phenomenon and illustrate the role of financial frictions - acting through the interest rate channel - in the relationship between household credit market participation and business cycle dynamics. The paper contributes to the discussion by finding that the level of financial access is an additional channel through which the effect of interest rate fluctuations on business cycles may be amplified in an emerging economy.

To explicitly derive business cycle implications of rising household credit market participation and explore the role of financial frictions, a household sector financial constraint is added in an otherwise standard small open economy. In particular, Chang and Fernández (2013) model is extended with an exogenous fraction of rule-of-thumb consumers coexisting with households that are able to smooth income fluctuations. This model is chosen as baseline since it encompasses two alternative mechanisms typically used by the literature to explain business cycles in emerging markets: financial frictions and shocks to the trend. In the extended model, rule of thumb consumers are households that do not own any assets nor have any liabilities; they just consume their current labor income. While there may be several interpretations for this behavior, one is their lack of access to capital markets [1].

[1]Other interpretations include myopia, fear of saving and ignorance of intertemporal trading

The model focuses on two types of financial frictions that have proved to be important when explaining empirical regularities in emerging markets.

The first relates to cyclical changes in access to international credit or in particular, the volatile and highly countercyclical interest rates that these economies face. This empirical regularity was documented by Neumeyer and Perri (2005) and Uribe and Yue (2006) and is usually attributed to countercyclical default risk. Real interest rates in these economies are sensitive to fluctuations in output as these influence international investors' perception of country default risk ; for its microfoundations see, for example, Eaton and Gersovitz (1981), Arellano (2008) and Mendoza and Yue (2012).

The second financial friction is the working capital constraint introduced due to its importance in explaining output contractions in emerging countries (Mendoza (2005), Oviedo (2005), Uribe and Yue (2006) and Chang and Fernández (2013)). The presence of a working capital constraint introduces a direct supply side effect of changes in the cost of borrowing in international financial markets. This implies input demand is sensitive to the real interest rate and adds an indirect effect of the interest rate on consumption growth. Besides the direct effect proportional to the intertemporal elasticity of substitution, exogenous shocks moving the real interest rate would have an indirect effect through employment growth.

I find that estimation of the extended model still favors a high degree of the aforementioned financial frictions in an emerging economy. In such environment, rising household credit market participation yields greater consumption growth and trade balance volatility. In particular, the larger the fraction of households using financial services in an emerging country, the more amplified are the effects of shocks in the domestic economy, particularly those transmitted through the interest rate channel. The model also predicts that lessening financial frictions dampen the increase of consumption growth and trade balance volatility driven by a rise in household credit market participation.

This paper is related to a growing body of research that uses dynamic general equilibrium models to account for business cycles in small open emerging economies. When assessing the role of particular shocks in emerging market business cycles, many papers have found that financial frictions are significant and have an amplifying effect through the interest rate channel. Whether the shocks under study were productivity related (Aguiar and Gopinath (2007),Chang and Fernández (2013)), external financial shocks (Neumeyer and Perri (2005), Lubik and Teo (2005), Uribe and Yue (2006)),García-Cicco et al. (2010), Fernández-Villaverde et al. (2011), Akinci (2013)) or commodity prices (Fernández et al. (2017), Shousha (2016), Drechsel and Tenreyro (2018), Fernandez et al. (2018)), the domestic real interest rate is a key channel through which the effect of these shocks are amplified in the economy. Unlike this paper, none of these works

opportunities.

explicitly model household limited credit market participation. By doing so, this paper, illustrates an additional channel through which the effect of interest rate fluctuations on aggregate consumption may be amplified. As byproduct of the main research, the estimation of the extended model contribute to this literature in three ways. First, standard measures of predictive accuracy suggest that a model including rule of thumb consumers outperforms the baseline model. Second, when there is limited credit market participation by households, trend productivity shocks become a more relevant source of business cycle fluctuations. Finally, financial frictions acting through the interest rate channel remain quite significant after the inclusion of rule of thumb consumers in the model.

This paper also builds on a large literature on two-agent models: rule-of-thumb and unconstrained households or those with full access to financial markets. The simplistic two-agent model assumption is chosen not only for its tractability. The important lesson emerging from this literature is that allowing for simple deviations from the strict Ricardian behavior helps capturing the aggregate effect of policy shocks (Galí et al. (2004), Galí et al. (2007), Bilbiie (2008), Bilbiie and Straub (2013), Broer et al. (2019)) and/or other sources of fluctuations (see Debortoli and Galí (2017) and references therein).

A growing literature has emerged in recent years that aims at re-examining these important questions through the lens of richer models with heterogeneous agents and allowing the presence of occasionally binding borrowing constraints. However, Debortoli and Galí (2017) show that for the purpose of approximating the effects of aggregate shocks on aggregate variables or consequences of changes in the environment, a tractable two-agent model approximates reasonably well the predictions of richer models with heterogeneous agents. Based on these findings and the purpose of this paper, adopting the simple two-agent model assumption is an interesting first step to take in the literature studying business cycles in small open emerging economies. It is left for future research the exciting task of endogenizing the fraction of households with rule-of-thumb behavior using a richer model with occasionally binding borrowing constraints. A much richer model may not only assess more adequately welfare implications but also answer other interesting questions such as the effect of monetary or fiscal policy on income and wealth distribution.

The rest of the paper is organized as follows. Section 1 presents empirical evidence that an increase in indicators of the degree to which the public can access financial services would tend to amplify the responses of macroeconomic aggregates to a country interest rate shock in an emerging economy. Motivated by this empirical evidence, Section 2 embeds a household financial constraint in an otherwise standard open economy model with financial frictions. In Section 3, the extended model is taken to Mexican data and results regarding posterior distributions of key parameters of interest and model evaluation are presented. Section 4 illustrates the relationship between rising credit market participation and aggregate volatility of key aggregates and explores the role of financial frictions. In Section 5, I examine whether an increase in household credit market participation was behind the rise in consumption growth volatility observed in Mexico during the decade 2005-2014. Section 6 presents robustness checks. Finally, Section 7 concludes.

1 Empirical analysis

As found by previous literature and described in the introduction, the domestic real interest rate is a key channel through which the effect of various sources of shocks are amplified in an emerging economy. Due to the presence of financial frictions affecting the dynamics of real interest rates and/or magnifying their effect on labor demand, a rise in household access and use of financial services in emerging countries may amplify the effect of interest rate fluctuations on key aggregate variables. The goal of the empirical analysis is to identify exogenous shocks to domestic real interest rates and examine whether the data is consistent with this conjecture.

The dataset used in this section consists of quarterly data over the period 1996:I to 2017:4, for sixteen emerging countries: Argentina, Brazil, Chile, Colombia, Ecuador, Egypt, India, Indonesia, Malaysia, Mexico, Peru, Philippines, Southafrica, Thailand, Turkey and Uruguay. The choice of countries and their corresponding final sample period is guided by availability of country real interest rates, national accounts and financial access data. Furthermore, these countries are typically considered as emerging economies by the small open economy RBC literature and are included in J.P. Morgan's EMBIG data set for emerging-country spreads[2].

1.1 The empirical model

The empirical model closely follows the model specification in Uribe and Yue (2006):

$$A y_{i,t} = \gamma X_{i,t} + \sum_{l=1}^{L} \Phi_l y_{i,t-l} + \epsilon_{i,t} \tag{1}$$

where $X_{i,t}$ is the vector of controls which includes country specific intercepts η_i and other exogenous controls, L is the number of lags, i denotes countries, t time period and

$$y_{i,t} = \left[\hat{gdp}_{i,t}, \hat{inv}_{i,t}, tby_{i,t}, \hat{R}^*_t, \hat{R}_{i,t}\right]$$
$$\epsilon_{i,t} = \left[\epsilon^{gdp}_{it}, \epsilon^{inv}_{it}, \epsilon^{tby}_{it}, \epsilon^{R^*}_{t}, \epsilon^{R}_{it}\right]$$

[2] JP Morgan's Emerging Markets Bond Index Global (EMBIG) tracks total returns for traded external debt instruments (i.e. foreign currency denominated fixed income) in emerging markets.

Variable *gdp* is real gross domestic product, *inv* is real gross domestic investment, *tby* is the trade balance-to-output ratio, R^* is the real interest rate for the US[3] and R is the country specific gross real interest rate. Data sources are the International Financial Statistics, OECD and local statistics institutions for certain countries. The country borrowing rate in international financial markets, R, is measured as the sum of J.P. Morgan's EMBIG sovereign spread and the US real interest rate. More details on the data and variable construction are provided in Appendix.

Output, investment and the trade balance are in constant local currency units and seasonally adjusted. Following Akinci (2013) and Uribe and Yue (2006), a hat on a *gdp* and *inv* denotes log deviations from their corresponding log-linear trend. A hat on R and R^* denotes the log. The trade balance-to output ratio, tby, is expressed in percentage points.

As it is common in the literature, real interest rate shocks are identified by assuming that exogenous changes in the interest rate have no contemporaneous effect on any macroeconomic aggregate, only at lags. The standard recursive identification imposed on matrix A assumes real domestic shocks contemporaneously affect financial markets. An additional standard restriction that is imposed when estimating the VAR system is that R^* follows a simple univariate AR(1) process. This follows the assumption that disturbances in a particular (small) emerging country will not affect the real interest rate of the United States.

Towbin and Weber (2013) approach is adopted and the model allows certain coefficients in matrix Φ_l to be deterministically varying coefficients, potentially as function of country characteristics. Since the main question is whether household access and use of financial services play a significant role on the impact of real interest rate shocks in aggregate activity, the recursive Interacted Panel Var considered for estimation takes the following form:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{0,t}^{2,1} & 1 & 0 & 0 & 0 \\ a_{0,t}^{3,1} & a_{0,t}^{3,2} & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ a_{0,t}^{5,1} & a_{0,t}^{5,2} & a_{0,t}^{5,3} & a_{0,t}^{5,4} & 1 \end{bmatrix} \begin{bmatrix} \hat{gdp}_{i,t} \\ \hat{inv}_{i,t} \\ tby_{i,t} \\ \hat{R}_t^* \\ \hat{R}_{i,t} \end{bmatrix} = \gamma X_{i,t} + \sum_{l=1}^{L} \begin{bmatrix} \phi_{l,t}^{1,1} & \phi_{l,t}^{1,2} & \phi_{l,t}^{1,3} & \phi_{l,t}^{1,4} & \phi_{l,i,t}^{1,5} \\ \phi_{l,t}^{2,1} & \phi_{l,t}^{2,2} & \phi_{l,t}^{2,3} & \phi_{l,t}^{2,4} & \phi_{l,i,t}^{2,5} \\ \phi_{l,t}^{3,1} & \phi_{l,t}^{3,2} & \phi_{l,t}^{3,3} & \phi_{l,t}^{3,4} & \phi_{l,i,t}^{3,5} \\ 0 & 0 & 0 & \phi_{l,t}^{4,4} & 0 \\ \phi_{l,t}^{5,1} & \phi_{l,t}^{5,2} & \phi_{l,t}^{5,3} & \phi_{l,t}^{5,4} & \phi_{l,t}^{5,5} \end{bmatrix} \begin{bmatrix} \hat{gdp}_{i,t-l} \\ \hat{inv}_{i,t-l} \\ tby_{i,t-l} \\ \hat{R}_{t-l}^* \\ \hat{R}_{i,t-l} \end{bmatrix} + \epsilon_{i,t} \tag{2}$$

where all coefficients in Φ_l matrix that are indexed by i are function of the country's measure of household access and use of financial services (ACCESS). In particular,

$$\phi_{l,i,t}^{j,k} = \theta_{l,1}^{j,k} + \theta_{l,2}^{j,k} \cdot ACCESS_{i,t} \quad for\ j = 1, 2, 3 \tag{3}$$

The deterministically varying coefficients $\phi_{l,i,t}^{1,5}$, $\phi_{l,i,t}^{2,5}$ and $\phi_{l,i,t}^{3,5}$ correspond to the coefficients

[3] The real interest rate for the US is constructed as the 3-month gross U.S. Treasury Bill rate (%) deflated using a measure of the expected U.S. inflation. This measure is the average of annual inflation of 4 previous quarters (including current).

pre-multiplying real interest rate at each lag l in the equation of gdp,i and tby respectively. Note that $\phi_{l,t}^{5,5}$ doesn't depend on ACCESS. This implies measures of access and use of financial services don't affect directly the process of the real interest rate but indirectly through their interaction with other macroeconomic variables[4]. The variable ACCESS also enters in levels in the vector of exogenous controls X_{it}.

The main proxies of household access and use of financial services considered are *Financial system deposits as % of GDP* and *Credit to Households as % of GDP*. The former is annual and extracted from the World Bank's Global Financial Development database. The latter is quarterly and come from Bank for International Settlements (BIS) "Long series on credit to the private non-financial sector" database. Alternative proxies are also added following financial access measures described in Cihak et al. (2012). These include *bank accounts per 10 adults*, *bank branches per 1000 adults* and *ATMs per 1000 adults*. Data is annual and extracted from the World Bank's Global Financial Development database. Descriptive statistics and detailed country sample description are presented in Appendix A, see Tables 13, 14 and 15.

The Interacted Panel VAR is estimated using OLS, allowing for country fixed effects and one lag[5]. The procedure followed for estimation, impulse response analysis and bootstrap standard errors adjusted for the fact that there are interaction terms are outlined in Towbin and Weber (2013)[6].

1.2 Results

Figure 1 shows the impulse responses to a domestic real interest rate shock under two financial access scenarios. For illustration purposes, *Financial system deposits as % of GDP* is used as measure of household access and use of financial services. The first scenario evaluates impulse response functions at the 25th percentile value of this measure for the entire sample. The second scenario is that of high financial access, corresponding to the 75th percentile of the sample.

Under high financial access, the responses for all series after an interest rate shock appear to be significantly greater than under low financial access. This is again illustrated in Table 1 which reports impulse responses at the horizon of 1, 2 and 3 years, conditional to financial access size. Results using our main measures of financial access size: *Financial system deposits as % of GDP* and *Credit to Households as % of GDP*, suggest that after a 1 standard deviation shock to the domestic real interest rate, the response of Output, Investment and the Trade Balance ratio is significantly larger under high financial access

[4]Results are robust if this restriction is relaxed and the domestic real interest rate can be directly influenced by financial access characteristics. Results available upon request.

[5]I choose one lag as suggested by the Bayesian information criterion and the Hannan and Quinn information criterion.

[6]I thank Pascal Towbin and Sebastian Weber for sharing their matlab codes.

at all horizons.

Considering the alternative financial access measures of *bank accounts per 10 adults*, *bank branches per 1000 adults* and *ATMs per 1000 adults* presented in Table 16 in Appendix, the response of the Trade Balance ratio is the only one that remains robust at the horizon of 1, 2 and 3 years. Regardless the specification, after a 1 standard deviation shock to the domestic real interest rate, the response of the Trade Balance ratio is significantly larger under high financial access. By contrast, the larger response of Output and Investment under high financial access is either no longer significant or have distinct signs across proxies.

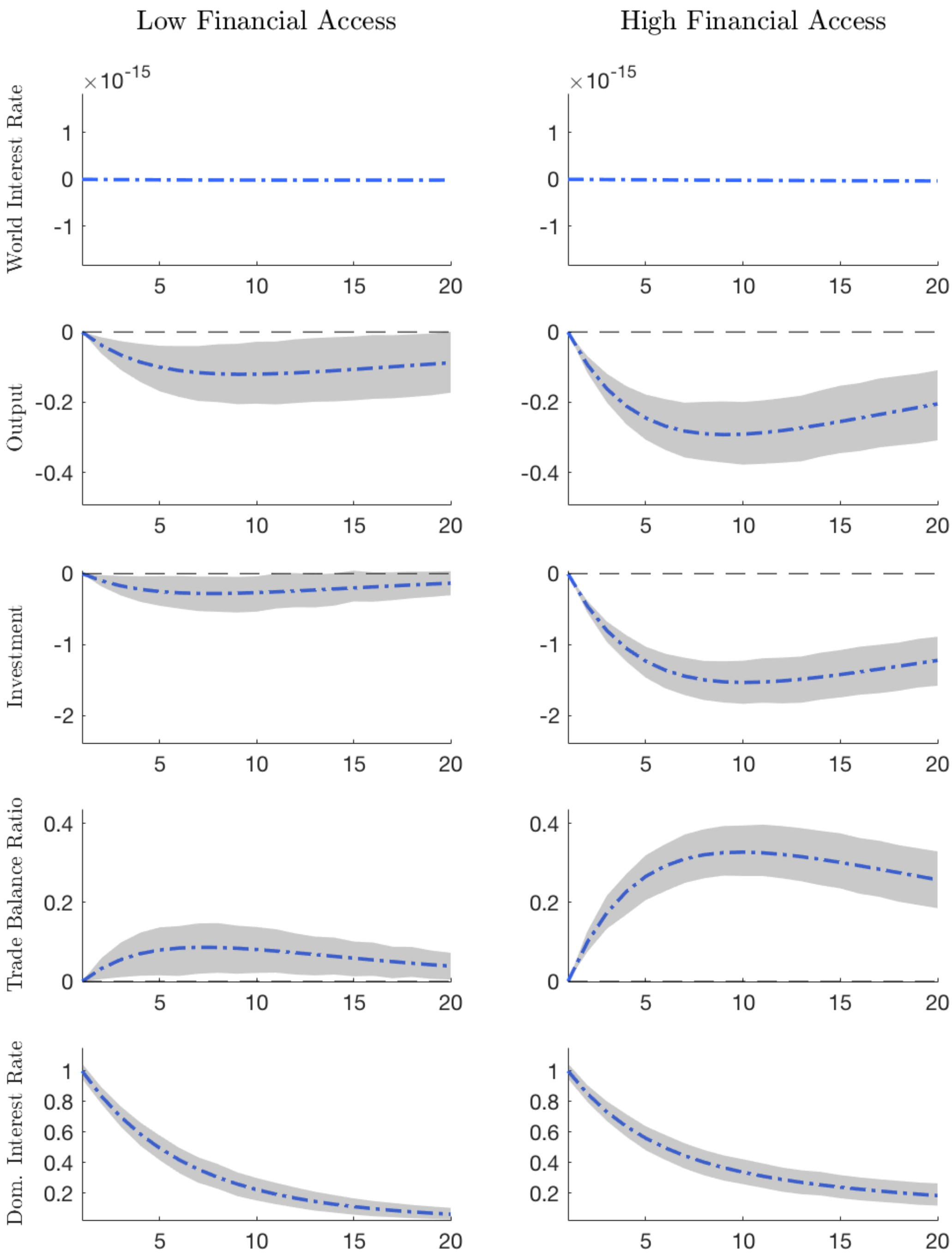
Since the US real interest rate is also included in the system, the analysis can also be extended to derive responses of each macroeconomic series to a shock in this foreign variable conditional to financial access size. As in Uribe and Yue (2006), the effects of US interest-rate shocks on domestic variables are measured with significant uncertainty. In addition, regardless the financial access measure and the horizon, there is either no significant effect on domestic aggregates or the responses of domestic aggregates are no significantly different across financial access scenarios.[7].

Results from this empirical analysis support the conjecture that an increase in indicators of the degree to which the public can access financial services would tend to amplify the responses of macroeconomic aggregates to a country interest rate shock in an emerging economy. One caveat: ACCESS measures used in this section are not the exact empirical counterpart of the structural parameter capturing the degree of limited household credit market participation in the model. Since there is no available data on household credit market participation for the majority of emerging economies considered in the panel, the selected measures of access are the closest we can get to household usage of financial services. Indeed, Beck et al. (2005) argue that measures of bank penetration (both geographic and demographic) closely predict harder-to-collect micro-level statistics of households.

Motivated by the empirical evidence and through embedding a household financial constraint in an otherwise standard model, the following sections examine the role of financial frictions - acting through the interest rate channel - in the relationship between household usage of financial services and business cycle dynamics in emerging economies.

[7]There are no findings emerging from the analysis of impulse responses to a shock in US real interest rate that remain robust across financial access measures. Results available upon request.

Figure 1: Impulse response to a domestic real interest rate shock conditional to financial access size.



Notes: (1) Dash-dot lines depict point estimates of impulse responses, and grey area depict the corresponding 90 % confidence interval. (2) The responses of Output and Investment are expressed in percent deviations from their respective log-linear trends. The responses of the Trade Balance-to-GDP ratio, the country interest rate, and the US interest rate are expressed in percentage points.

Table 1: Impulse response to a one standard deviation shock to the domestic real interest rate conditional to financial access size

	Low Fin. Access	High Fin. Access	Diff.
1 std. shock in R Access:Financial system deposits to (%)			
Output			
1st year	-0.2***	-0.49***	0.29***
2nd year	-0.28***	-0.67***	0.4***
3rd year	-0.27***	-0.65***	0.38***
Investment			
1st year	-0.51***	-2.41***	1.91***
2nd year	-0.65**	-3.43***	2.79***
3rd year	-0.56*	-3.46***	2.9***
Trade Balance Ratio			
1st year	0.17**	0.53***	-0.37***
2nd year	0.2***	0.74***	-0.54***
3rd year	0.17***	0.74***	-0.58***
1 std. shock in R Access: Credit to Households (%)			
Output			
1st year	-0.13	-0.58***	0.46***
2nd year	-0.06	-1.06***	1***
3rd year	0.11	-1.41***	1.51***
Investment			
1st year	0.25	-2.05***	2.29***
2nd year	0.81	-3.8***	4.6***
3rd year	1.4	-5.1***	6.49***
Trade Balance Ratio			
1st year	0.09*	0.16***	-0.07***
2nd year	0.11	0.29***	-0.19***
3rd year	0.08	0.39***	-0.32***

*,**,*** indicate that zero lies outside the 80,90,95 % confidence bands.

2 The general model

This section investigates business cycle implications of a rise in household access and use of financial services through the lens of an extended dynamic general equilibrium model suitable for emerging markets. For simplicity, household access and use of financial services is referred as household credit market participation. I extend Chang and Fernández (2013) model (CF **hereafter**) with an exogenous fraction of rule-of-thumb consumers coexisting with households that are able to smooth income fluctuations.

2.1 CF model

2.1.1 Firms

Firms are perfectly competitive. They hire labor h_t and rent capital K_t to produce the final good. Technology is characterized by a Cobb-Douglas production function:

$$Y_t = A_t {K_t}^{\alpha} (\Gamma_t h_t)^{1-\alpha} \tag{4}$$

where α is capital's share of output, A_t is temporary productivity and Γ_t reflects trend productivity. These two productivity processes are characterized by the following stochastic properties:

$$ln\left(\frac{A_t}{\mu_A}\right) = \rho_A \left(\frac{A_{t-1}}{\mu_A}\right) + \epsilon_t^A \qquad \epsilon_t^A \sim N(0, \sigma_A^2) \tag{5}$$

$$\Gamma_t = g_t \Gamma_{t-1} = \prod_{s=0}^{t} g_s \tag{6}$$

$$ln\left(\frac{g_t}{\mu}\right) = \rho_g \left(\frac{g_{t-1}}{\mu}\right) + \epsilon_t^g \qquad \epsilon_t^g \sim N(0, \sigma_g^2) \tag{7}$$

A positive realization of ϵ_t^g has a permanent effect on total productivity. In what follows, realizations of g will be loosely referred as "trend shocks" since they constitute the stochastic trend of productivity.

To produce, firms need to borrow working capital at the beginning of the period due to a friction in the technology for transferring resources to households providing labor services. In order to transfer wage payments to workers firms need to set aside a fraction θ of the wage bill at the beginning of the period and a fraction $(1-\theta)$ at the end of the period. Because production becomes available only at the end of the period, firms have to borrow $\theta W_t h_t$ units of goods (the working capital) between the beginning and end of period t, at rate R_{t-1}.

There is no friction in the technology for transferring resources to households that supply capital to firms. At the end of the period, once output becomes available, firms pay wages ($W_t h_t$), rental fees to owners of capital ($u_t K_t$) and repay the working capital loan plus interest ($\theta W_t h_t R_{t-1}$). Each period they solve a static problem:

$$\begin{aligned} &\max Y_t - W_t h_t - u_t K_t - (R_{t-1} - 1)\theta W_t h_t \\ &s.t: \\ &Y_t = A_t {K_t}^{\alpha} (\Gamma_t h_t)^{1-\alpha} \end{aligned} \tag{8}$$

The term $(R_{t-1} - 1)\theta W_t h_t$ represents the net interest on the fraction of the wage bill that was paid with borrowed funds.

First order conditions give capital demand and labor demand equations, respectively

$$\alpha A_t {K_t}^{\alpha-1} (\Gamma_t h_t)^{1-\alpha} = u_t \tag{9}$$

$$(1-\alpha) A_t {K_t}^{\alpha} (\Gamma_t h_t)^{-\alpha} \Gamma_t = (1 + (R_{t-1} - 1)\theta) W_t \tag{10}$$

2.1.2 Interest rates and country risk

As discussed in Schmitt-Grohé and Uribe (2003), since households face an incomplete asset market and the rate of return is partly exogenously determined, the steady state of the model depends on initial conditions; in particular, on net foreign asset position. Put differently, the equilibrium dynamics are no longer stationary. Therefore, serious computational difficulties arise.

To induce stationarity of the equilibrium dynamics, the model assumes a debt elastic interest rate premium $p(.)$. Interest on foreign borrowing is therefore specified as the sum of the real interest rate and the premium:

$$\frac{1}{q_t} = R_t + p(.) \tag{11}$$

with

$$p(D_{t+1}, \Gamma_t) = \psi \left(exp \left(\frac{D_{t+1}}{\Gamma_t} - d \right) - 1 \right)$$

Note that in choosing the optimal amount of debt, households do not internalize the fact that there is an upward-sloping supply of loans.

The real interest rate at which international investors are willing to lend to the emerging economy has two sources of fluctuations: the perceived default risk and international investors preferences for risky assets. As in Neumeyer and Perri (2005), these two sources of fluctuations are captured by decomposing the interest rate faced by the emerging economy as

$$R_t = S_t {R_t}^* \tag{12}$$

where R_t^* is an international rate for risky assets (not specific to any emerging economy) and S_t is the country spread paid by borrowers to international investors. The CF model assumes a simple country risk determination[8]. Similar to their model, expected total productivity - measured by Solow Residual - drives country risk. Formally,

$$ln\left(\frac{S_t}{S}\right) = -\eta E_t ln\left(\frac{SR_{t+1}}{SR}\right) + \epsilon_t^S \qquad \epsilon_t^S \sim N(0, \sigma_S^2) \tag{13}$$

where SR_{t+1} is the Solow residual. Under Cobb-Douglas production technology with constant returns to scale

$$SR_t = A_t {g_t}^{1-\alpha}$$

Finally, the foreign rate of risky assets is modeled as a stochastic process completely independent from domestic conditions

$$ln\left(\frac{R_t^*}{R^*}\right) = \rho_{R^*} ln\left(\frac{R_{t-1}^*}{R^*}\right) + \epsilon_t^{R^*} \qquad \epsilon_t^{R^*} \sim N(0, \sigma_{R^*}^2) \tag{14}$$

2.2 Extension

There is a continuum of infinitely-lived households, indexed by $i \in [0, 1]$. A fraction $1 - \lambda$ of households have access to an international financial market where they can trade a non-contingent real bond. In addition, these households have access to a competitive capital market where they can buy and sell physical capital (which they accumulate and rent it to firms). This subset will be refereed as unconstrained households. The remaining fraction λ of households do not own any assets nor have any liabilities; they just consume their current labor income and will be referred as rule-of-thumb consumers.

2.2.1 Unconstrained households

Let C_t^u and L_t^u represent consumption and leisure for unconstrained consumers. Preferences are defined by the discount factor $\beta \in (0, 1)$ and the period utility $U(C_t^u, L_t^u)$. These consumers seek to solve the following problem:

$$\max \sum_{t=0}^{\infty} \beta^t U(C_t^u, L_t^u) \tag{15}$$

[8]This idea is based on models of default and incomplete markets in which default probabilities are high when expectations of positive shocks to productivity are low. See Eaton and Gersovitz (1981) and Arellano (2008)

subject to the sequence of budget constraints

$$C_t^u + I_t^u - q_t D_{t+1}^u \leq W_t h_t^u + u_t K_t^u - D_t^u - T_t^u \tag{15a}$$

and the capital accumulation equation

$$K_{t+1}^u = (1-\delta)K_t^u + I_t^u - \frac{\phi}{2} K_t^u \left(\frac{K_{t+1}^u}{K_t^u} - \mu \right)^2 \tag{15b}$$

$$L_t^u + h_t^u = 1 \tag{15c}$$

Hence, at the beginning of the period the representative unconstrained household receives labor income $W_t h_t$ (where W_t denotes real wage), and income from renting her capital holdings K_t to firms at (real) rental cost u_t. Besides these factor receipts in period t, the household pays taxes to the government T_t^u and has access to a world capital market for noncontingent debt at price q_t. At this price, they can sell a promise to deliver one unit of goods at $t+1$ and D_{t+1} is number of such promises issued. The household uses the sum of these four income sources to finance consumption goods, investment and current debt payments. The capital accumulation constraint indicates that there is a cost when adjusting the capital stock. This is commonly used in business cycles of small open economies in order to avoid excessive volatility of investment in response to variations in the domestic-foreign interest rate differential.

Following both Neumeyer and Perri (2005) and CF, this model assumes GHH preferences, i.e :

$$U(C_t, h_t, \Gamma_{t-1}) = \frac{\left(C_t - \tau \Gamma_{t-1} (h_t)^{\omega}\right)^{1-\sigma}}{1-\sigma}$$

Note that Γ_{t-1} is included in the period utility function U to allow for a balanced growth[9]. For this type of preferences, a well-behaved steady state of the deterministic linearized model requires $\beta \frac{1}{q} = \mu^{\sigma}$.

The first order conditions for the household's problem can be written as:

$$\tau \Gamma_{t-1} \omega (h_t^u)^{\omega - 1} = W_t \tag{2}$$

$$\left(1 + \phi \left(\frac{K_{t+1}^u}{K_t^u} - \mu \right)\right) = E_t \Lambda_{t,t+1} \left(u_{t+1} + 1 - \delta - \frac{\phi}{2} \left(\mu^2 - \left(\frac{K_{t+2}^u}{K_{t+1}^u} \right)^2 \right)\right) \tag{3}$$

$$q_t = E_t \Lambda_{t,t+1} \tag{4}$$

[9] Since supply of work hours is independent of consumption, the absence of Γ_{t-1} would imply non stationary hours. Benhabib et al. (1991) show that these preferences can be interpreted as reduced form preferences for an economy with home production and technological progress in the home production sector.

where $\Lambda_{t,t+k}$ is the stochastic discount factor for real k-period ahead payoffs given by

$$\Lambda_{t,t+k} \equiv \beta^k \left(\frac{C^u_{t+k} - \tau\Gamma_{t+k-1}(h^u_{t+k})^\omega}{C^u_t - \tau\Gamma_{t-1}(h^u_t)^\omega} \right)^{-\sigma} \tag{5}$$

2.2.2 Rule of thumb households

By definition, these households behave in a "hand-to-mouth" fashion; i.e., each period they fully consume their labor income and government transfers if any. While there may be several interpretations for rule of thumb consumers, one is their lack of financial access and (continuously) binding borrowing constrains. Other reasons are myopia, fear of saving and ignorance of intertemporal trading opportunities. Each period they solve a static problem:

$$\begin{aligned} &\max U(C^r_t, L^r_t) \\ &s.t: \end{aligned} \tag{6}$$

$$C^r_t \leq W_t h^r_t + T^r_t \tag{6a}$$

$$L^r_t + h^r_t = 1 \tag{6b}$$

Preferences are symmetric to those of unconstrained households and their first order condition is:

$$\tau\Gamma_{t-1}\omega(h^r_t)^{\omega-1} = W_t \tag{7}$$

Substituting hours in the budget constraint yields:

$$C^r_t = (\tau\Gamma_{t-1}\omega)^{\frac{-1}{\omega-1}} W_t^{\frac{\omega}{\omega-1}} + T^r_t \tag{8}$$

2.2.3 Aggregation

Consumption good aggregate demand and hours aggregate supply are a weighted average of individual demand and supply, respectively. Formally:

$$C_t \equiv \lambda C^r_t + (1-\lambda)C^u_t \tag{9}$$

$$h^S_t \equiv \lambda h^r_t + (1-\lambda)h^u_t \tag{10}$$

Note, under symmetrically parameterized GHH preferences and homogenous labor productivity, $h^r_t = h^u_t = h^S_t$.

Similarly, aggregate investment, aggregate supply of capital stock and aggregate debt stock:

$$I_t \equiv (1-\lambda) I_t^u \tag{11}$$

$$K_t^S \equiv (1-\lambda) K_t^u \tag{12}$$

$$D_t \equiv (1-\lambda) D_t^u \tag{13}$$

Aggregate euler for investment

$$\begin{aligned}
&\left(1+\phi\left(\frac{K_{t+1}}{K_t}-\mu\right)\right)= \\
&E_t\beta\left(\frac{C_{t+1}-\tau\Gamma_t h_t^{\omega}\Omega-\lambda T_{t+1}^r}{C_t-\tau\Gamma_{t-1}h_t^{\omega}\Omega-\lambda T_t^r}\right)^{-\sigma}\left(u_{t+1}+1-\delta+\frac{\phi}{2}\left(\left(\frac{K_{t+2}}{K_{t+1}}\right)^2-\mu^2\right)\right)
\end{aligned} \tag{14}$$

Aggregate euler for international bonds

$$q_t = E_t\beta\left(\frac{C_{t+1}-\tau\Gamma_t h_t^{\omega}\Omega-\lambda T_{t+1}^r}{C_t-\tau\Gamma_{t-1}h_t^{\omega}\Omega-\lambda T_t^r}\right)^{-\sigma} \tag{15}$$

where $\Omega = \lambda(\omega-1)+1$

2.2.4 Government

As assumption, the government runs a balanced budget period by period. Transfers to rule of thumb households are financed by lump sum taxes collected from unconstrained households.

$$(1-\lambda)T_t^u = \lambda T_t^r$$

Transfers and taxes are exogenous variables in the model. Since it is assumed there is no time variation of λ in the estimation section, the ratio T_t^r/T_t^u also remains stable.

2.3 Market equilibrium

Given initial conditions on capital stock K_{-1}, debt stock D_{-1}, labor augmenting productivity Γ_{-1} and sequences of real interest rates $\{R_t\}_{-1}^{\infty}$, prices for noncontingent debt $\{q_t\}_0^{\infty}$, productivity $\{A_t\}_0^{\infty}$ and trend shocks $\{g_t\}_0^{\infty}$, an *equilibrium* is a sequence of allocations $\{C_t, h_t, D_{t+1}, I_t, K_{t+1}\}$ and of prices $\{W_t, u_t\}$ such that

1. Allocations solve the firm's and the household problem at the equilibrium prices
2. Markets for inputs clear

A balanced growth path for the economy is an equilibrium in which R_t, A_t and g_t are constant. Along a balanced growth path u_t, h_t and q_t are constant and all other variables grow at rate μ.

The aggregate resource constraint[10]

$$C_t + I_t - q_t D_{t+1} = \frac{Y_t(1 + (R_{t-1} - 1)\theta\alpha)}{1 + (R_{t-1} - 1)\theta} - D_t \tag{16}$$

Aggregate investment

$$I_t = K_{t+1} - (1-\delta)K_t + \frac{\phi}{2} K_t \left(\frac{K_{t+1}}{K_t} - \mu \right)^2 \tag{17}$$

Country's net exports (NX_t) is production net of working capital loan payments and that are not spent in consumption or investment:

$$NX_t = \frac{Y_t(1 + (R_{t-1} - 1)\theta\alpha)}{1 + (R_{t-1} - 1)\theta} - C_t - I_t = D_t - q_t D_{t+1} \tag{18}$$

3 Empirical approach

3.1 Does data support a model with limited credit market participation?

3.1.1 Calibrated and estimated parameters

The choice of which parameters to estimate or calibrate is guided by the research interest. The parameter λ is the most relevant object of estimation as it reflects the fraction of rule of thumb households in the economy.

In addition to the exogenous processes for all shocks to productivity (ρ_a, ρ_g, σ_a, σ_g) and to spread component (σ_S), financial frictions represented by the spread elasticity to domestic fundamentals (η) and working capital requirement (θ) are also included in the estimation. Introducing working capital requirement in production is useful to match the volatility of output.

Following most papers, the parameter (ϕ) governing the capital adjustment function and the long run yearly growth rate (ζ) are also estimated. Note that the latter implies that the value of long run productivity quarterly growth μ will be determined by posterior estimates of ζ, since $\mu = (\zeta/100 + 1)^{1/4}$.

The remaining parameters of the model are calibrated. A period is taken to be one quarter. Calibrated values are given in Table 2 and set at conventional values following CF, Akinci (2014) and references therein. The coefficient of risk aversion (σ) affecting

[10] See model derivations in Supplementary Material.

the intertemporal elasticity of substitution is set to the conventional value of 2. The parameters ω and τ are set so that labor supply elasticity equals 1.67 and the fraction of time spent working equals 1/3 in the long run, respectively[11].

The parameter α is set so that labor share of income is 0.68. Following CF and Aguiar and Gopinath (2007), the baseline value of debt to GDP ratio is set to 10%[12].

Calibration of steady state interest rate and spread is based on corresponding historical data, calculated as Uribe and Yue (2006) and described further in the next subsection. Annualized foreign interest rate and country gross spreads are set to 1.004 and 1.008 respectively. Parameters related to the foreign interest rate process (σ_{R^*} and ρ_{R^*}) are calibrated to match its standard deviation and first order serial correlation for the sample period used (1995:II-2018:IV).

The quarterly depreciation rate is assumed to be 5% as in Aguiar and Gopinath (2007) and CF. The elasticity of interest rates to debt (ψ) is set to a small value equal to 0.001. The main purpose of this parameter is to guarantee the equilibrium solution to be stationary[13].

Furthermore, note that a well behaved steady state of the deterministic linearized model requires $\beta R = \mu^\sigma$. As previously explained, long run productivity quarterly growth μ is linked to the posterior distribution of ζ. Therefore the bounds of the discount factor β ($= \frac{\mu^\sigma}{R_{ss}}$), the calibrated steady state value of gross domestic interest rate and the calibrated coefficient of risk aversion σ will impose restrictions on the domain of ζ when its prior is defined.

Finally, the ratio of net transfers to gdp (γ_t) is calibrated at 6.5%. Transfers as % of GDP were extracted for Mexico from OECD (2014). The series correspond to average annual social expenditures as % of GDP for the period 1995-2012. It is the total of cash benefits and benefits in kind for all social policy areas (Active labour market programmes, family, health etc).

[11]In Robustness Section, I estimate these parameters assuming asymmetric preference parameters for uncontrained and rule of thumb households. All main results of this section hold.

[12]Results are insensitive to alternate levels of steady state debt to GDP. See Robustness Section.

[13]Supplementary Material includes a robustness check that calibrates ψ using the median estimate found by Garcia-Cicco et al ($= 2.8$). Results in this section remain robust.

Table 2: Calibrated parameters

Parameter	Description	Value
α	Capital share of income	0.32
δ	Depreciation rate of capital	0.05
dy_{ss}	Debt to GDP ratio	0.1
rf_{ss}	Gross foreign interest rate	1.004
ψ	Debt elastic interest rate parameter	0.001
μ_a	Mean of Transitory Tech. process	1
γ_t	Ratio net transfers/ GDP	0.065
σ	Intertemporal elasticity of substitution (=$1/\sigma$)	2
ω	Labor supply elasticity ($1/(\omega-1)=1.67$)	1.6
r_{ss}	Long run country interest rate	1.012
s_{ss}	Long run gross country interest rate premium	1.008
τ	Leisure preference parameter so that hss=1/3	1.78
ρ_r	AR(1) coef. Foreign interest rate process	0.98
σ_{R^*}	S.D of foreign interest rate shock (%)	0.394

Notes: The value used as σ_{R^*} matches a foreign interest rate with a standard deviation of 1.978% , given the calibrated value of ρ_{R^*}.

Table 3: Parameters linked to estimated parameters

Parameter	Description	Linked with	Linking equation
μ	Long run gross quarterly growth rate	ζ	$\mu=(\zeta/100+1)^{1/4}$
β	Discount factor	ζ	$\beta=\frac{\mu^\sigma}{r_{ss}}$
Ω	Parameter in aggregate Euler	λ	$\Omega=\lambda(\omega-1)+1$

3.1.2 Data and implementation

Observables

Aggregate series of Output (Y), final private consumption (C), gross fixed capital formation (I) and the trade balance (TB) for Mexico are retrieved from the OECD database. All series are measured in national currency at constant prices (national base year) and are seasonally adjusted. The initial sample for Mexican data covers the years 1993 to 2018 (quarterly frequency). The period 1993:I-1995:I is dropped as it is common in the literature on mexican business cycles; fluctuations during this period were mostly driven by the Tequila crisis.

In addition, quarterly data of foreign risky interest rate and spreads are included by following Uribe and Yue (2003) in constructing these series. Real interest rates in the US are used to calibrate the process of foreign risky interest rate.

The real interest rate (r_t^*) for the US is constructed as the 3-month Treasury Bill Secondary market rate (%) (TB3MS) minus a measure of expected annual inflation. This measure is the average of annual inflation of 4 previous quarters (including current).

$$r_t^* = TB3MS_t - \sum_{t-3}^{t} (ln(DEF_t) - ln(DEF_{t-4}))/4$$

The price index used to calculate inflation is the GDP Implicit Price Deflator (DEF). The inputs for constructing US real interest rate are extracted from FRED.

Country spreads are based on JP Morgan's Emerging Markets Bond Index Plus (EMBI+) which tracks total returns for traded external debt instruments (i.e. foreign currency denominated fixed income) in emerging markets.

Following CF, the model is estimated using log differences of C, I and Y and the first difference of TBy. As García-Cicco et al. (2010) and CF pointed out, although TBy has no trend, it is convenient to feed the model with its first differences when fitting small open economy models. The reason is that these models typically and counterfactually deliver a quasi random walk process in the trade balance level inherited by the nature of the endowment process. The observables therefore considered are

$$DATA_t = \left[\Delta ln(Y_t), \Delta ln(C_t), \Delta ln(I_t), \Delta TBy_t, ln(\bar{S}_t)\right]$$

where: $\Delta ln(Y_t)$ is real GDP growth, $\Delta ln(C_t)$ is real consumption growth, $\Delta ln(I_t)$ is real Investment growth, ΔTBy_t is the first difference of trade balance to GDP ratio and $ln(\bar{S}_t)$ is log of gross spreads for Mexican bonds (demeaned)[14].

Implementation and choice of priors

To sample from the posterior distribution, I implement a Random Walk Metropolis Algorithm described in An and Schorfheide (2007). I make 4 million draws from posterior and burn the first 1 million draws[15].

A considerable diffuse prior for ϕ is chosen since previous studies have found different values when trying to mimic investment volatility. In addition, prior distributions for η, θ and ζ are set following CF and prior distributions for parameters related to shock processes (ρ_a, σ_a, ρ_g, σ_g, σ_s) follow Akinci (2014) [16].

[14]Variable X is demeaned in the following way :

$$ln(\bar{X}_t) = ln(X_t) - \sum_{t=0}^{T} \frac{ln(X_t)}{T}$$

. See Supplementary Material for derivation of model counterpart of selected series.

[15]Convergence analysis of chains (running means plot) can be sent upon request.

[16]I follow Akinci (2014) since CF assumes a Gamma prior distribution for the standard deviation of

The choice of a prior distribution for the parameter of interest λ follows similar previous studies. Bilbiie and Straub (2013) used a beta prior distribution centered at 0.35 and with a standard deviation of 10% for the US supported by previous empirical estimates. There is far less evidence on estimates for developing countries. One paper is that of Vaidyanathan (1993). The author estimates λ using aggregate data on consumption growth and output growth for a sample of 94 countries and found a mean of 0.6 for the southamerican sample. Ponce (2003) estimated similar reduced form regressions for Mexico and his results suggest that the fraction of rule of thumb in Mexico would be around 0.4. Therefore, the assumed beta prior distribution is centered at a mean of 0.4 and has a relatively high dispersion of 10 %.

Since there are five observables and four structural shocks, measurement error shocks are added for all our observables. I assume flat priors with a standard deviation not larger than 25% of each corresponding series total standard deviation.

Table 4: Prior distributions

	Description	Density	Mean	S.D (%)	min	max
λ	Fraction of rule of thumb households	Beta	0.4	10	0	1
ρ_a	AR(1) coef. transitory tech. process	Beta	0.8	10	0.001	0.999
σ_a	S.D of transitory tech. shock (%)	Inv. Gamma	0.02	1.5	0.001	0.03
ρ_g	AR(1) coef. permanent tech. process	Beta	0.8	10	0.001	0.999
σ_g	S.D of permanent tech. shock (%)	Inv. Gamma	0.02	1.5	0.001	0.03
η	Spread elasticity	Gamma	1	10	0.001	10
ϕ	Capital adjustment cost parameter	Gamma	40	500	1	100
σ_s	S.D of exogenous shock to spreads	Inv. Gamma	0.01	1.5	0.001	0.02
θ	Working cap. requirement	Beta	0.6	10	0	1
ζ	Long run yearly growth rate (%)	Gamma	2	20	0	2.4
$\sigma_{me}^{\gamma_Y}$	S.D (%) measurement error in γ_Y	Uniform			0.01	0.296
$\sigma_{me}^{\gamma_C}$	S.D (%) measurement error in γ_C	Uniform			0.01	0.282
$\sigma_{me}^{\gamma_I}$	S.D (%) measurement error in γ_I	Uniform			0.01	0.758
σ_{me}^{dTby}	S.D (%) measurement error in $dTby$	Uniform			0.01	0.209
σ_{me}^{S}	S.D (%) measurement error in S	Uniform			0.01	0.139

technology and spread shocks.

3.1.3 Posterior estimates

Table 5 summarizes estimated posterior distributions of the parameters of both restricted and unrestricted models[17].

The most important result is that related to the posterior distribution of the fraction of rule of thumb households (λ). Data is very informative regarding the key parameter of interest; the posterior distribution is to the right of its prior. The parameter λ in the model would represent households with no savings nor access to (or demand of) consumption loans. Its posterior median is 0.834 and this estimate is slightly higher that financial exclusion measures derived from household surveys in Mexico. The National Report of Financial Inclusion in Mexico (CONAIF, 2016) provides evidence that in 2011, 73 % of adults in Mexico not only didn't have any account (savings, deposits etc) in a financial institution, but also spent at least all their income and therefore have not saved during the previous 12 months of the survey.

Several other results are also worth mentioning.

First, data seems very informative when estimating both versions. The estimated posteriors for almost all parameters appear much more precise than the priors. However, data has little to say about the long run annual growth parameter ζ which basically reproduces the prior in both versions. Regarding this parameter, CF found that its posterior mode is only slightly higher than the prior mode.

Second, the parameters related to financial frictions appear quite significantly different than zero and the inclusion of rule of thumb households does not affect the estimated posterior distribution. The tight posterior distribution of η, with a median above 0.80 is robust when restricting the model and is fairly close to the estimates in CF. This result reveals a significant elasticity of the spread to expected fluctuations in the Solow residual. The posterior median, mode and mean values of the parameter θ governing working capital requirement are also robust when restricting the model and are found to be lower than those found in CF. While in CF the posterior distribution shifts right relative to the prior, here it shifts left.

Third, unlike CF, trend shocks seem dominant in both versions. In CF , the estimated ratio between the implied unconditional volatility of trend shocks to that of stationary shocks is significantly lower than estimates in this paper. To further assess the importance of trend shocks and following Aguiar and Gopinath (2007), the Random Walk Component measure (RWC) is derived from recognizing the Solow residual (in logs) implied by the model $log(SR_t) = log(A_t) + (1-\alpha)log(\Gamma_t)$ can be rewritten as the sum of a random walk component τ_t and a transitory component s_t. Then, a measure of the importance of trend

[17]See Figures 9 and 10 in Appendix that plot priors and posterior distributions for the restricted model and the unrestricted model, respectively.

shocks is the variance of the random walk component $\Delta\tau$ relative to the overall variance in $\Delta log(SR)$. As Table 5 shows, in the model of limited credit market participation ($\lambda \geq 0$), the implied RWC calculated at the median, mode and mean of the relevant parameters seem far above the values found under the restricted version ($\lambda = 0$). In simple words, when there are rule of thumb households in the economy, trend shocks increase its relative relevance.

$$RWC = \frac{\frac{(1-\alpha)^2}{(1-\rho_g)^2}\sigma_g^2}{\frac{2}{(1+\rho_a)}\sigma_a^2 + \frac{(1-\alpha)^2}{(1-\rho_g^2)}\sigma_g^2}$$

The second and third results are important findings contributing to the RBC literature on emerging markets. In a typical emerging economy where financial frictions are high, consumption from unconstrained households tend to be more volatile than output. As it will be proved in Section 4, the inclusion of a fraction of households that cannot smooth consumption would imply a lower volatility of aggregate consumption and trade balance ratio. In addition, it will also dampen the countercyclicality in the trade balance ratio. In order to match the data, the unrestricted model will require higher unconditional volatility in growth shocks and no change in the posterior distribution of financial friction parameters.

Finally, the estimated values of the capital adjustment cost parameter ϕ is not identified in the restricted model but its posterior distribution shifts right relative to the prior in the unrestricted version. Even though, rule of thumb households have no effect on investment dynamics per se (as only unconstrained households accumulate capital), they have an indirect effect through their implications on aggregate consumption and trade deficits. A higher value of λ would increase (slightly) the volatility of investment. Section 4 derives this result and provides the intuition.

Table 5: Estimation results. Period 1995:II-2018:IV

		Restricted model ($\lambda = 0$)					Unrestricted model ($\lambda \geq 0$)				
		Mode	Mean	Median	90% credible set		Mode	Mean	Median	90% credible set	
λ	Fraction of rule of thumb households	-	-	-	-	-	0.812	0.832	0.834	0.790	0.872
ρ_a	AR(1) transitory tech. process	0.833	0.880	0.887	0.821	0.928	0.914	0.931	0.938	0.884	0.967
σ_a	S.D transitory tech. shock (%)	0.301	0.338	0.335	0.276	0.403	0.370	0.348	0.345	0.288	0.412
ρ_g	AR(1) permanent tech. process	0.554	0.729	0.736	0.647	0.810	0.812	0.807	0.813	0.737	0.867
σ_g	S.D permanent tech. shock (%)	0.345	0.413	0.410	0.329	0.500	0.356	0.475	0.472	0.375	0.577
η	Spread elasticity	1.082	0.861	0.858	0.754	0.972	0.746	0.841	0.838	0.736	0.950
ϕ	Capital adjustment cost parameter	38.649	41.483	41.238	35.739	47.488	61.332	54.192	53.838	48.458	60.505
σ_s	S.D spread shock (%)	0.162	0.227	0.221	0.157	0.306	0.145	0.227	0.220	0.156	0.305
θ	Capital work. Requirement	0.351	0.353	0.348	0.255	0.465	0.555	0.376	0.376	0.260	0.498
σ^{γ_Y}	S.D m.e. output growth (%)	0.010	0.011	0.011	0.010	0.012	0.010	0.011	0.010	0.010	0.011
σ^{γ_C}	S.D m.e. C growth (%)	0.010	0.011	0.011	0.010	0.012	0.010	0.011	0.010	0.010	0.011
σ^{γ_I}	S.D m.e. investment growth (%)	0.072	0.061	0.060	0.048	0.075	0.027	0.019	0.017	0.011	0.029
σ^{dTby}	S.D m.e. dTBy (%)	0.010	0.011	0.011	0.010	0.012	0.010	0.011	0.011	0.010	0.012
σ^{S}	S.D m.e. spread (%)	0.010	0.010	0.010	0.010	0.011	0.010	0.010	0.010	0.010	0.011
ζ	Long run yearly growth rate (%)	2.149	1.960	1.955	1.735	2.198	1.922	2.020	2.025	1.777	2.251
RWC	Random walk component	1.548	3.715	3.856	2.361	6.338	5.283	6.593	6.921	4.081	10.947

3.1.4 Model evaluation

a) *Marginal data densities*

Table 6 reports standard measures of predictive accuracy: log values of the likelihood, the posterior -both computed at the posterior mode- and model comparison based on posterior odds (marginal data density). The last measure captures the relative one-step ahead predictive performance. All measures suggest that the unrestricted model outperforms the restricted version.

Table 6: Model comparison. Period 1995:II-2018:IV

	Restricted model ($\lambda = 0$)	Unrestricted model ($\lambda \neq 0$)
Log posterior at mode	1362.90	1431.55
Log likelihood at mode	1365.46	1446.73
Log marginal data density	1291.41	1354.87

Notes: The log marginal data densities are computed based on Geweke (1999) modified harmonic mean with truncation parameter 0.5. Results hold when used different truncation values.

b) *Matching moments*

Another metric to evaluate the relative merits of alternative models is the comparison on how well model implied moments fit those observed by data.

Results are gathered in Table 7 where sample moments of the data, in terms of standard deviation, serial correlation and cross correlation with output growth are compared to the theoretical moments implied by median estimates from the two models. Regarding its ability to match observed moments, the unrestricted model does a better job at matching standard deviation, serial correlation and correlation with gdp growth of all series but one (spreads). In particular, the unrestricted model yields lower volatilities of the trade balance-to-GDP ratio and consumption growth.

The fact that the restricted model generates higher volatility in consumption growth may seem counter-intuitive. A neoclassical model featuring no distortions and driven mostly by shocks to stationary factor productivity would suggest that aggregate consumption is less volatile in a model where all agents are able to smooth consumption. However, estimation results presented in Subsection 3.1.3, show that financial frictions are highly significant and non stationary productivity shocks tend to be important drivers of domestic fluctuations in both versions.

In such environment, when the non stationary component of productivity is behind the rise in total factor productivity, agents in these economies observe there is a positive growth rate in productivity not only in the current period but also in the future. As a consequence, those with access to the credit market choose to smooth consumption by borrowing against future income and current consumption increases beyond current output. Rule of thumb consumers have no choice other than consume their income period. Therefore, as we include them in the model, aggregate consumption will become less volatile. Even if non stationary productivity shocks are negligible and standard stationary productivity shocks are the main drivers of domestic fluctuations, the presence of financial frictions (if strong enough) will yield the same implication. More intuition is presented in section 4.1 where we analyze impulse responses.

It is worth to remark that estimating the domestic interest rate elasticity to net foreign debt position (ψ) might be an alternative way to match the volatility of consumption and the trade balance implied by the restricted model. In the influential work by García-Cicco et al. (2010), the authors find that a higher estimated value of ψ in the otherwise frictionless RBC model of Aguiar and Gopinath (2007) would also yield lower implied volatilities of consumption growth and the trade balance ratio. A counterfactual exercise presented in Supplementary Material finds that this result will also hold in the model of financial frictions by CF[18]. However, besides the different interpretation of what a change in the parameter means, the main difference with a higher estimated value of λ is its implication on investment volatility. Whereas García-Cicco et al. (2010) find that a higher ψ would yield lower volatility in investment, a higher λ yields higher investment volatility. When λ is higher, trade deficit and net foreign debt position responses are dampened regardless the shock hitting the economy[19]. Given country premia sensitivity to net foreign debt position, there is a smaller effect on the domestic interest rate path and investment volatility is higher relative to an economy in which all households are unconstrained. When ψ is higher, the domestic interest is more sensitive to any given level of net foreign debt position and thus, private investment is less volatile[20].

[18]Unfortunately, we cannot resort to estimation. When estimating the CF model using the same set of observables and sample period, the parameter ψ can not be identified.

[19]The intuition is presented in Section 4.1.

[20]The intuition based on the CF model is presented in Supplementary Material.

Table 7: Matching moments at median estimates. Period 1995:II-2018:IV

	γ_Y	γ_C	γ_I	$dTby$	S
Standard deviation (%)					
Data	1.184	1.128	3.031	0.836	0.556
Restricted model ($\lambda = 0$)	0.950	2.709	3.457	2.632	0.750
Unrestricted model ($\lambda \neq 0$)	1.035	1.180	3.271	0.862	0.977
Serial correlation					
Data	0.267	0.341	0.249	-0.176	0.767
Restricted model ($\lambda = 0$)	0.150	0.039	0.008	-0.051	0.777
Unrestricted model ($\lambda \neq 0$)	0.221	0.156	0.015	-0.066	0.862
Correlation with γ_Y					
Data	1.000	0.760	0.794	-0.379	-0.167
Restricted model ($\lambda = 0$)	1.000	0.463	0.341	-0.068	-0.422
Unrestricted model ($\lambda \neq 0$)	1.000	0.990	0.481	-0.159	-0.436

3.1.5 Comparing variance decomposition results across models

This Subsection assesses the role of each exogenous shock by computing the variance decomposition implied by both the unrestricted and restricted models at their median estimates and over a time horizon of 40 quarters.

First, there are important differences when comparing the variance decomposition analysis predicted by the restricted model ($\lambda = 0$) for the recent period 1995:II-2018:IV to that predicted by CF estimates for the earlier period of 1980:I-2003:II for Mexico. First, even though fluctuations in gdp growth are still mostly generated by transitory technology shocks; unlike CF, this is not anymore the case for fluctuations in consumption growth, investment growth and the first difference in trade balance ratio. For these aggregate series, their fluctuations are mostly generated by foreign interest rate shocks. Second, for all observables, estimation results from the restricted model indicate that for the recent period there is a larger role played by trend shocks. In CF, the largest contribution of trend shocks is in the variance of consumption growth (2.16%) while our estimates suggest that the largest share is for gdp growth (35.1%) and consumption growth (13.8%). These findings are mostly driven by two main differences when comparing CF parameter estimates/calibrated values with those in this paper: a recent increase in the estimated ratio between the implied unconditional volatility of trend shocks to that of stationary shocks and a recent increase in the unconditional volatility of the foreign interest rate[21].

[21] Table 17 in Appendix B.2 presents the variance decomposition of three counterfactual experiments that support this argument. The analysis focuses on the most significant differences observed in CF

A more relevant comparison for the purpose of this paper is the variance decomposition implied by unrestricted model estimates versus that implied by the restricted model estimates. Table 8 suggests that 44.2% of gdp growth variance, 44.4% of consumption growth variance and 13.2% of investment growth variance are driven by shocks to the trend when the fraction of financially excluded households is not restricted to zero. These contributions are far larger than those implied by the restricted model estimates, particularly in the case of consumption growth. The inclusion of λ in the estimation, enhances the contribution of non stationary technology shocks on consumption growth volatility by approximately 31 percentage points. Finally, the unrestricted model decreases substantially the contribution of the foreign interest rate on the volatility of all observables, particularly of consumption. Under the unrestricted model, productivity shocks account for at least 87% of total consumption growth variance, distributed somewhat equally across stationary and non stationary components.

Four counterfactual experiments confirm that limited credit market participation is the friction driving the greater role of trend shocks and lower contribution of the foreign interest rate particularly in consumption growth volatility. Table 18 in Appendix B.2 presents the variance decomposition of four counterfactual experiments that shut off each or all financial frictions, that is, set $\lambda = 0$ (no limited credit market participation), $\eta = 0$ (no endogenous spread), $\theta = 0$ (no working capital requirements) or $\lambda = \eta = \theta = 0$. Changes in the variance decomposition analysis are relatively negligible when there are no endogenous spreads $\eta = 0$ or when the working-capital assumption is dropped ($\theta = 0$). In contrast, when $\lambda = 0$, interest rate shocks have a much greater role and trend shocks a much lower role in accounting for the variance of consumption growth.

estimates; i.e higher financial frictions measured by a higher working capital requirement θ, a lower ratio between the implied unconditional volatility of trend shocks to that of stationary shocks and a lower unconditional volatility of the foreign interest rate.

Table 8: Variance decomposition predicted by model. Period 1995:II-2018:IV

	γ_Y	γ_C	γ_I	$dTby$	S
Restricted model ($\lambda = 0$)					
Stationary technology (ϵ_t^A)	49.30	12.00	7.10	0.60	69.10
Nonstationary technology (ϵ_t^g)	35.10	13.80	6.20	2.00	22.20
World Interest rate ($\epsilon_t^{R^*}$)	14.80	74.00	86.70	97.40	0.00
Exogenous spread (ϵ_t^S)	0.70	0.20	0.00	0.10	8.70
Unrestricted model ($\lambda \geq 0$)					
Stationary technology (ϵ_t^A)	43.70	42.70	13.10	2.30	72.50
Nonstationary technology (ϵ_t^g)	44.20	44.40	13.20	3.90	22.40
World Interest rate ($\epsilon_t^{R^*}$)	11.40	10.50	73.70	93.60	0.00
Exogenous spread (ϵ_t^S)	0.70	2.40	0.00	0.20	5.10

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

4 The predicted macroeconomic effect of a rise in credit market participation in an emerging economy

4.1 Impulse response implications

This section conducts impulse response analyses to illustrate the intuition on the role of an increase in credit market participation in an emerging economy. Figure 2 presents the impulse responses of key macro aggregates to a 1 standard deviation shock on trend productivity, foreign interest rate and stationary productivity. The continuous line depicts the responses after setting parameters at their median estimates. The dashed line illustrates the counterfactual responses if there is a higher credit market participation ($\lambda = 0.3$) in this economy.

The first column in Figure 2 plots the responses (deviation from steady state) to a one standard deviation reduction in the foreign risky rate ($\epsilon_t^{R^*}$). On impact, consumption of unconstrained households observes a rise proportional to the intertemporal elasticity of substitution. Given that the working capital requirement links current labor demand with the predetermined interest rate, output doesn't change on impact. However, labor demand increases in the subsequent period, leading to a further increase of aggregate consumption. In addition, the increase in expected marginal productivity of capital yields a rise of investment on impact. As output responds less and more slowly to the shock on the real interest rate relative to both consumption and investment, there is a trade deficit.

The second column in Figure 2 illustrates the responses of one standard deviation impulse in the stationary productivity component (ϵ_t^A). A positive productivity shock increases marginal product of inputs and labor demand increases. Given GHH preferences, an increase in labor demand induces a movement along the labor supply curve and an increase of hours (and output) in equilibrium. Foreign lenders perceive a lower probability of default and therefore real interest rate declines. Unconstrained households have a temporary increase in income which leads them to increase savings in order to smooth consumption through a PIH reasoning. However, the decrease in real interest rates provides these households stronger incentives to consume and consumption rises a bit more than output. This translates in a trade deficit.

The last column in Figure 2 illustrates a one standard deviation shock in trend (ϵ_t^g). A positive trend shock increases marginal product of inputs and labor demand increases; thus hours and output rise on impact. As before, foreign lenders perceive a lower probability of default in the economy and real interest rate declines. Households observe an increasing profile of income and the unconstrained ones increase consumption beyond current income. Furthermore, the decrease in real interest rates provides these type of households further reasons to incur in debt.

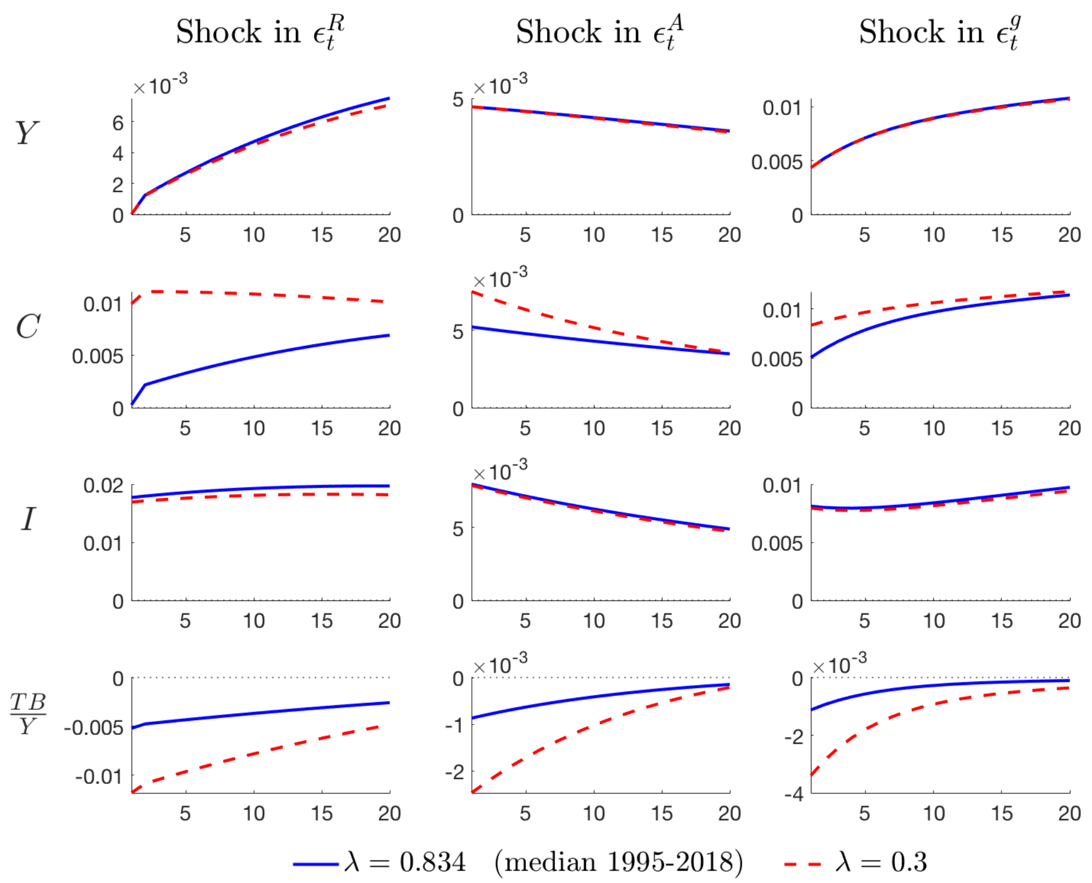
The key message delivered by the dashed line responses is that for all shocks, a lower fraction λ of rule of thumb households (rise in credit market participation), would amplify the response of consumption and the trade balance ratio, ceteris paribus. The impulse responses suggest that among the most sensitive moments to a change in λ are the comovement of net exports with output and the volatilities of consumption and the trade balance ratio.

Figures in Appendix C analyze the sensitivity of selected moments to different levels of λ and conditional to other parameters reflecting financial frictions. Interesting results emerge and are described as follows.

As expected, a decrease in the financial exclusion measure ($\downarrow \lambda$) increase the volatility of both consumption and the trade balance and at any given level of η and θ. On the contrary, as a greater percentage of households can smooth income fluctuations, volatility of investment is reduced regardless the degree of financial frictions. The reason is that changing the fraction of rule of thumb households would have an indirect effect on investment through their implications on aggregate consumption and trade deficits. To provide intuition, we use a reduction in the foreign risky interest rate as an example. As described earlier in impulse response analyses, investment increases and unconstrained households have incentives to consume. However, in an environment where there is a higher fraction of households with access to credit markets, aggregate consumption have a larger increase and thus, there is a greater trade deficit. In turn, the implied higher net foreign debt position cause a larger rise in country premia in the subsequent period, discouraging current private investment by more.

A second result is that a decrease in λ will tend to reduce the correlation between consumption growth and income growth and increase the countercyclicality of the trade balance ratio. This is due to the amplified effect on the responses of aggregate consumption relative to output as more households can smooth consumption.

Figure 2: Impulse response functions



4.2 The role of financial frictions

Since there are two other sources of financial frictions in the model: endogenous spread (η) and working capital requirement (θ), it is of interest to examine how these forms of financial imperfections amplify or dampen the effect of a rise in credit market participation on the transmission of exogenous disturbances to emerging economies. For this analysis, all financial frictions ($\lambda = \eta = \theta = 0$) are first shut off in order to derive impulse responses implied by a frictionless economy model. Next, each financial friction is activated one at a time by setting the corresponding parameter at its median estimate from the previous section.

Figure 3 shows what happens when credit market participation rises in an economy with no other frictions such as endogenous spreads or working capital requirements. This is illustrated by switching from an economy with a high fraction of rule of thumb households (continuos lines) to a complete frictionless economy model (dashed lines). An increase in credit market participation in this setting would amplify the responses of aggregate consumption and trade balance ratio to a shock in the foreign interest rate or trend productivity. Same intuition provided in Subsection 4.1 applies. However, in the case of stationary productivity shocks, an increase in credit market participation will have a dampening effect on the response of consumption. While unconstrained households have incentives to increase savings in order to smooth consumption after a temporary increase in income, rule of thumb consumers cannot save and will be adjusting their consumption proportional to their increased labor income. The lower is the fraction of rule of thumb consumers, lower is the rise in aggregate consumption after a positive stationary productivity shock.

Figure 4 illustrates that the presence of working capital requirements would mainly introduce hump-shaped impulse responses of consumption and output to an exogenous shock in the real interest rate. After a negative shock in the foreign risky rate ($\epsilon_t^{R^*}$), aggregate consumption will rise on impact and proportionally to households' intertemporal elasticity of substitution. Given that the working capital requirement links current labor demand with the predetermined interest rate, output doesn't change on impact. However, output and labor demand increases in the subsequent period, leading to a further increase of aggregate consumption.

Unlike working capital requirements, the introduction of a financial friction in the form of an endogenous spread will counteract and may even reverse the dampening effect that an increase in credit market participation has on aggregate consumption after a stationary productivity shock. Since real interest rates decline as foreign lenders perceive a lower probability of default, a positive shock in stationary productivity provides unconstrained households strong incentives to consume that may exceed their incentives to save and aggregate consumption may even rise more than output. This could translate in a trade deficit. Indeed, endogenous spreads are key to deliver a countercyclical trade balance in the case of stationary productivity shocks. In the case of shocks to the trend (ϵ_t^g), introducing endogenous spreads would tend to enhance the amplifying effect of a rise in credit market participation on the responses of aggregate consumption and the trade balance ratio. This is because in addition to observing an increasing profile of income, unconstrained households also observe a decrease in real interest rates that gives them further incentives to incur in debt. This in turn translates in a greater trade deficit. See Figure 5 for implications related with the introduction of endogenous spreads in an otherwise frictionless economy.

Figure 3: Impulse response functions: limited credit market participation in an otherwise frictionless economy model

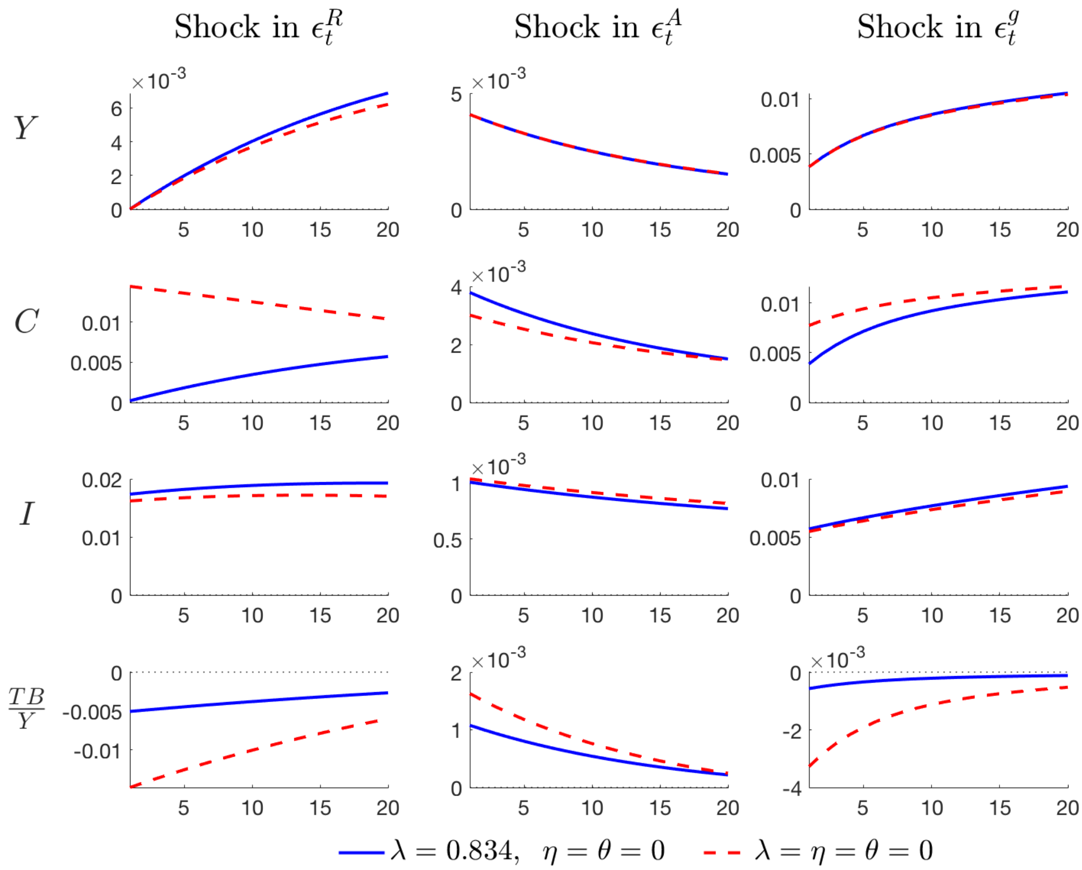


Figure 4: Impulse response functions: working capital requirement in an otherwise frictionless economy model

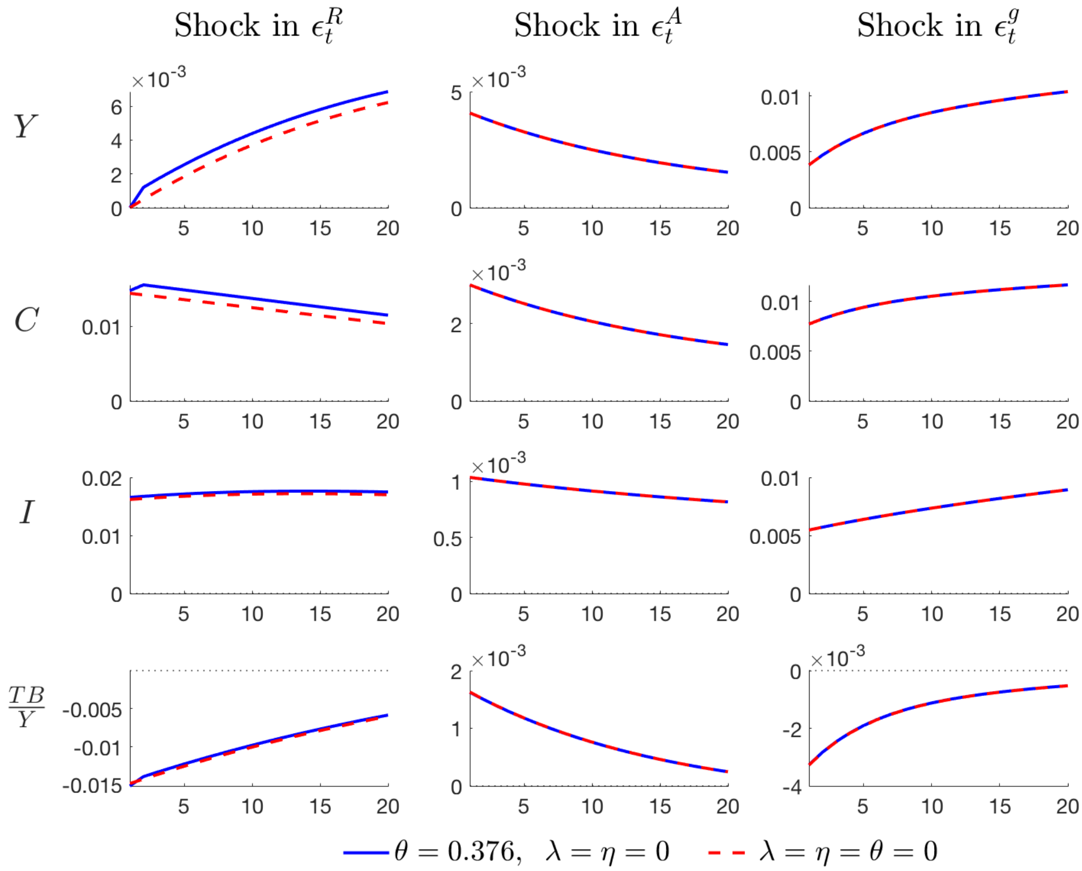
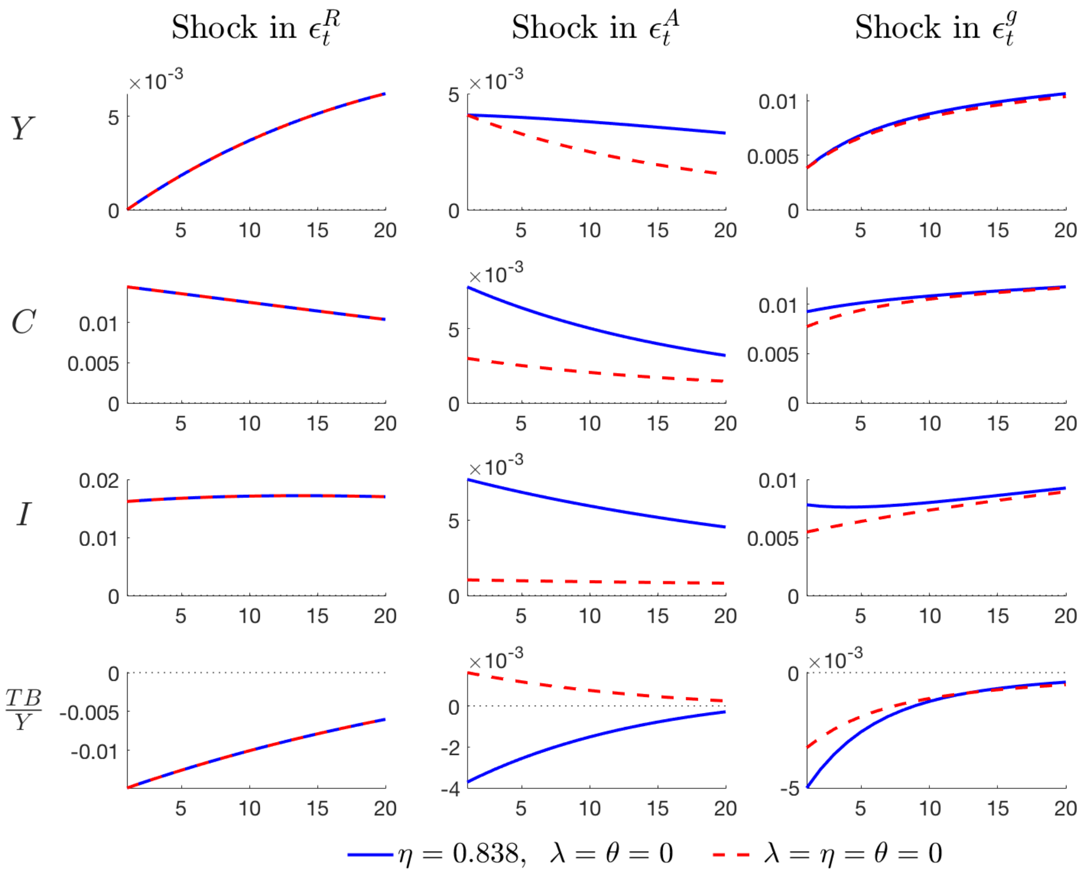


Figure 5: Impulse response functions: endogenous spread in an otherwise frictionless economy model



To conclude this section, we analyze the role of financial frictions on the sensitivity of selected moments to different values of λ. Figures in Appendix C illustrate that weakening financial frictions measured by η and θ will dampen the increase in unconditional volatilities of consumption and the trade balance implied by a rise in credit market participation. In addition, a decrease in η will mitigate the greater countercyclicality of the trade balance ratio driven by higher financial inclusion. The reason is that the smaller is η the less sensitive is the interest rate to domestic conditions. Therefore, when there is an improvement in productivity, there are less incentives for households to borrow.

4.3 Welfare implications

To assess welfare implications of rising credit market participation in an emerging economy, a compensating variation welfare metric is calculated for two regimes: low and high credit market participation regimes. In particular, let κ^j be the fraction of consumption that household type j would need each period in the high credit market participation regime to yield the same welfare as would be achieved in the low credit market participation regime. A negative value for κ^j means that the household prefers the high credit market participation regime - it would need to reduce consumption when credit market participation is high to be indifferent between the two regimes. In contrast, a positive value of κ^j means that the household prefers the low credit market participation regime. To find κ^j we solve the following expression:

$$V^j_{i=l,t} \equiv E_t \sum_{k=0}^{\infty} \beta^t U((1+\kappa^j)C^j_{i=h,t+k}, h^j_{i=h,t+k}) \tag{19}$$

With GHH preferences, κ^j the solution to the following equality:

$$V^j_{i=l,t} = E_t \sum_{k=0}^{\infty} \beta^t \frac{\left((1+\kappa^j)C^j_{i=h,t+k} - \tau\Gamma_{t+k-1}(h^j_{i=h,t})^{\omega}\right)^{1-\sigma}}{1-\sigma} \tag{20}$$

where

$$V^j_{i=l,t} = E_t \sum_{k=0}^{\infty} \beta^t \frac{\left(C^j_{i=l,t+k} - \tau\Gamma_{t+k-1}(h^j_{i=l,t})^{\omega}\right)^{1-\sigma}}{1-\sigma}$$

There does not exist a closed form expression for the κ^j that makes this expression hold with equality. Following the general method explained in Schmitt-Grohé and Uribe (2004) and the description of its application to calculate welfare costs in Schmitt-Grohe and Uribe (2005), I take a second order approximation of the equilibrium conditions (including the recursive representation of the value function for each type of household) around the model's non-stochastic steady state[22]. The parameter κ^j is the welfare cost of household type j of switching from a low credit market participation regime to a high credit market participation regime. The "low credit market participation regime" or "benchmark regime" is that corresponding to the model economy where all parameters are fixed at either calibrated values or median estimates of the unrestricted model for the full sample period.

Table 9 calculates κ^j for rule of thumb consumers ($j = r$) and unconstrained consumers ($j = u$) at different values of λ.

Table 9: Welfare analysis results

	Unconstrained κ^u %	Rule of thumb κ^r %
$\lambda = 0.734$	-10.6505	0.0018
$\lambda = 0.634$	-14.7702	0.0030
$\lambda = 0.534$	-16.9561	0.0038
$\lambda = 0.434$	-18.3108	0.0042
$\lambda = 0.334$	-19.2327	0.0045
$\lambda = 0.234$	-19.9007	0.0046
$\lambda = 0.134$	-20.4069	0.0047

Results indicate that higher credit market participation (or equivalently a lower

[22] See Supplementary Material for further details.

fraction of rule of thumb consumers, $\Downarrow \lambda$), increases welfare of unconstrained and decreases (but only minimally) welfare of rule of thumb consumers. A reduction in the fraction of rule of thumb consumers in 20 percentage points (from $\lambda = 0.834$ to $\lambda = 0.634$), imply that in order to attain the same welfare level as the benchmark regime, unconstrained households would have to reduce their consumption in this higher credit market participation regime by approximately 14.8%. In the case of rule of thumb households, in order to attain the same welfare level as the benchmark regime, they would have to increase their consumption in this higher credit market participation regime by 0.0030%.

The intuition behind this result is that even though both households are risk averse and prefer smoother streams of consumption, the higher credit market participation regime is endowing each unconstrained household not only lower capital and debt stocks than what they would hold in the lower credit market participation regime, but also a government collecting lower taxes. The mix of lower taxes, lower investment spending, lower debt holding and unaltered wage income in steady state affect the deterministic steady-state level of welfare of unconstrained households and compensate the negative higher order costs. In the case of rule of thumb households, since rising credit market participation doesn't affect aggregate steady states of the state vector, the deterministic steady-state level of welfare is unaltered when λ changes and they perceive only the negative higher order costs of higher consumption volatility.

Table 10 suggests that welfare costs will be slightly lower for both type of households as other measures of financial frictions in the aggregate economy are less severe.

Table 10: Welfare analysis results when changing other financial frictions

	Benchmark values	Lower financial frictions ($\Downarrow \eta$)		Lower financial frictions ($\Downarrow \theta$)	
	$\theta = 0.376$	$\theta = 0.376$		$\eta = 0.838$	
	$\eta = 0.838$	$\eta = 0.538$	$\eta = 0.238$	$\theta = 0.276$	$\theta = 0.176$
Unconstrained (κ^u %)					
$\lambda = 0.634$	-14.7702	-14.7698	-14.7694	-14.7701	-14.7700
$\lambda = 0.434$	-18.3108	-18.3106	-18.3105	-18.3107	-18.3106
$\lambda = 0.234$	-19.9007	-19.9006	-19.9006	-19.9006	-19.9006
Rule of thumb (κ^r %)					
$\lambda = 0.634$	0.0030	0.0021	0.0014	0.0029	0.0028
$\lambda = 0.434$	0.0042	0.0032	0.0025	0.0041	0.0040
$\lambda = 0.234$	0.0046	0.0036	0.0028	0.0045	0.0044

5 Rising credit market participation in Mexico and its effect on aggregate fluctuations

To provide further empirical evidence on the macroeconomic effect of a rise in credit market participation in an emerging economy, the model is re-estimated on Mexican data over two decades. First, this section verifies that, consistent with results from Mexico's first National Financial Inclusion Report (CNBV, 2009), credit market participation increased. Finally, I check whether this increase was behind a rise in relative volatility of consumption observed during the decade 2005-2014.

5.1 Splitting the full sample in two subperiods

I first proceed by splitting the sample in two subperiods: 1995:II - 2004:IV (39 quarters) and 2005:I- 2014:4 (40 quarters). The year 2005 is chosen as the beginning of the second subperiod since financial depth measured by domestic credit to private sector (as % of GDP) started to rise significantly around 2005[23]. The choice for splitting the sample is also aligned with the findings by Hansen and Sulla (2013) who find that domestic credit to private sector increased significantly from 2004 to 2011 in most latin american countries. In Mexico, most of the rise was driven by consumption credit growth[24].

5.2 Calibration and priors

The calibration of all parameters except that used to match the standard deviation of the foreign interest rate process (σ_{R^*}) are kept stable. The value used as σ_{R^*} for the first and second subperiod matches a foreign interest rate with a standard deviation of 1.89% and 1.38% respectively.

Since splitting the sample reduces significantly the sample size, the AR(1) coefficients in the transitory and the permanent technology processes, financial frictions parameters (θ and η) and the long run yearly growth rate ζ are calibrated at the median of the correspondent posterior distribution from the full sample estimation. Later, in robustness section we estimate them. The list of estimated parameters is therefore restricted to: λ, σ_a, σ_g, ϕ, σ_S and standard deviations of all five measurement errors. The assumed prior distributions are the same as those assumed earlier when estimating the full sample.

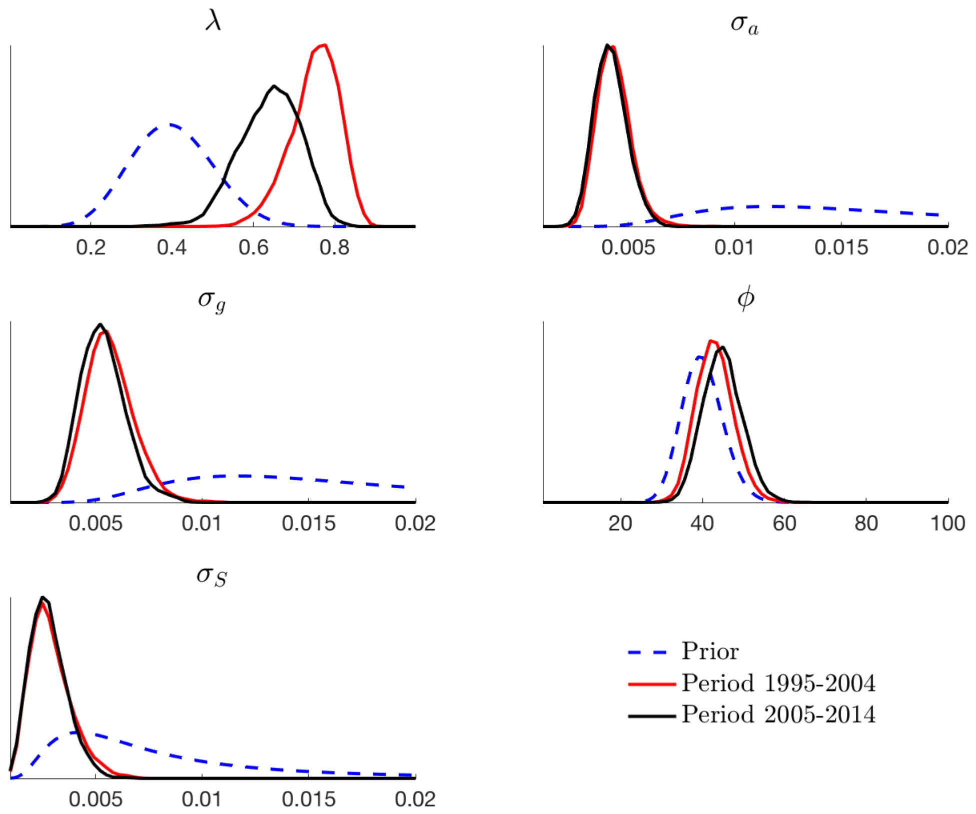
[23]See Figure 17a in Appendix
[24]See Figure 17b in Appendix

5.3 Posterior estimates

The posterior distributions of key parameters and for each subperiod are illustrated in Figure 6. See estimation results in Table 20 presented in the Appendix.

Whereas in the first subperiod of 1995-2004, median estimates suggest that around 76.4% of total households had a behavior consistent with rule of thumb consumers, during the most recent decade 2005-2014, that fraction fell to around 65.3%. The significant rise in the number of households smoothing income fluctuations, is aligned with the observed trend of financial sector outreach measures derived for Mexico[25]. The other main conclusion that emerges from the estimation results is that no other parameter changed significantly across subperiods.

Figure 6: Posterior estimates by subperiod



Regarding the variance decomposition analysis, productivity shocks (distributed somewhat equally across its stationary and non stationary components) were the main driver of fluctuations in real gdp and consumption growth, explaining around 90% of their

[25]The first National Financial Inclusion Report (CNBV, 2009), finds that the number of bank branches per 1,000 km2 increased from 3.61 in 2001 to 5.06 in 2009 and the number of bank branches per 100 people increased from 73 in 2001 to 93 in 2009. In addition to their upward trend, both measures experienced a significant increase on their annual compounded growth rate at the beginning of 2006. There are no other financial inclusion indicators for Mexico that date back to 2005 or earlier.

variance in both periods[26]. In the case of investment growth and the trade balance ratio, regardless the period considered, world interest rate was the main driver of their variance. However, in the recent decade from 2005 to 2014, its relative contribution fell for both series.

5.4 Isolating the role of a rise in credit market participation on busines cycles for the recent decade.

During the recent decade 2005-2014, the Mexican economy faced a less volatile foreign risky interest rate and less volatile spreads. Table 11 shows standard deviations for key macroeconomic series across subperiods.

Relative to the previous decade, the recent subperiod 2005-2014 is also associated with:

1. A **decrease** of 0.075 percentage points in GDP growth (γ_Y) volatility.
2. An **increase** of 0.318 in the ratio of standard deviation in consumption growth to standard deviation in gdp growth (γ_C/γ_Y).
3. A **decrease** of 0.720 in the ratio of standard deviation in investment growth to standard deviation in gdp growth (γ_I/γ_Y).
4. A **decrease** of 0.2 percentage points in trade balance ratio ($dTby$) volatility.

Recall that the calibration and estimates presented in the previous subsection reflect two key differences emerging across subperiods: a rise in credit market participation and a decrease in the volatility of the foreign risky interest rate process.

To illustrate the role of a rise in credit market participation on aggregate fluctuations the following experiment is conducted.

First, I illustrate the effect of an increase in credit market participation by 11.1 percentage points- as implied by second subperiod estimates of λ- by keeping all other parameters of baseline scenario fixed. The baseline scenario uses the calibration and implied median estimates of the first subperiod (1995-2004). The estimated increase in credit market participation would per se increase the ratio γ_C/γ_Y by 0.157 and $dTby$ by 0.245 percentage points.

Second, the volatility of the foreign interest rate is reduced by keeping all other parameters of baseline scenario fixed (including λ). The estimated reduction in the volatility of the foreign interest rate would per se decrease the volatility of all aggregate series and the relative volatilities γ_I/γ_Y (reduced by 0.435) and $dTby$ (reduced by 0.258).

[26] See Table 21 in Appendix.

Note the increase in the relative volatility of consumption reflects the greater sensitivity of ouput than consumption growth to a decrease in the standard deviation of the foreign interest rate.

The key message of this exercise is that a rise in credit market participation is crucial to approach the observed higher ratio of volatility of consumption growth relative to volatility of GDP growth in the more recent decade. Reestimating the model is able to generate volatility in all aggregates that is closer to what is observed in the data.

Table 11: Implied standard deviations at median estimates by subperiod

	γ_Y	γ_C/γ_Y	γ_I/γ_Y	$dTby$	S
Period 1995:II-2004:IV					
Data	1.319	0.747	2.808	0.971	0.685
Model	1.274	1.205	3.112	1.141	1.241
Period 2005:I-2014:4					
Data	1.244	1.065	2.088	0.770	0.168
Model	1.198	1.350	2.628	1.039	1.200

Table 12: Rising credit market participation in Mexico and implied standard deviations

	γ_Y	Δ^{**}	γ_C/γ_Y	Δ^{**}	γ_I/γ_Y	Δ^{**}	$dTby$	Δ^{**}
Data subperiod 1995-2004	1.319		0.747		2.808		0.971	
Data subperiod 2005-2014	1.244	-0.075	1.065	0.318	2.088	-0.720	0.770	-0.201
Baseline model*	1.274		1.205		3.112		1.141	
Baseline + new λ	1.273	-0.002	1.362	0.157	3.095	-0.017	1.386	0.245
Baseline + new $\sigma(R^f)$	1.249	-0.025	1.207	0.002	2.677	-0.435	0.883	-0.258
Baseline + new λ + new $\sigma(R^f)$	1.248	-0.026	1.345	0.140	2.664	-0.449	1.077	-0.064
Reestimated model	1.198	-0.076	1.350	0.145	2.628	-0.484	1.039	-0.102

Notes:

* Baseline model uses median estimates from the first subperiod estimation. New λ is baseline but setting λ to the median estimate for second subperiod (0.653). New σ_{R^*} is baseline but setting the calibration of foreign interest rate standard deviation to value observed for second subperiod (0.274). Reestimated model uses median estimates from the second subperiod estimation.

** Change (Δ) implied by data is relative to first subperiod. Change implied at different parameterizations is relative to baseline.

6 Robustness checks

6.1 Sensitivity to alternative values of dy_{ss}

The graph below illustrates that posteriors are insensitive to different calibrated values of steady state debt to GDP (dy_{ss}). I select two alternative values, the first sets $dy_{ss} = 0.05$ as in García-Cicco et al. (2010) for their Mexican sample and the second sets $dy_{ss} = 0.28$ reflecting average external debt stock as percentage of GDP for Mexico during the period 1995-2018 (World Bank data). Their corresponding posterior distributions are compared to those from the baseline model which sets $dy_{ss} = 0.1$ as in AG and CF. I present both restricted and unrestricted models.

Figure 7: Posterior estimates of the restricted model at different values of dy_{ss}

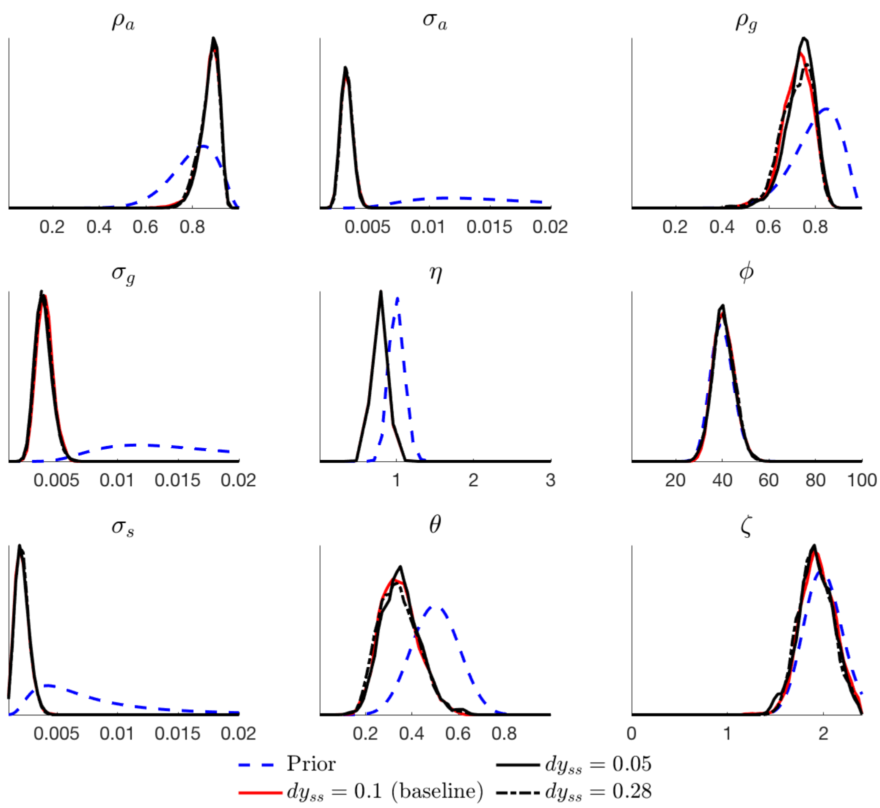
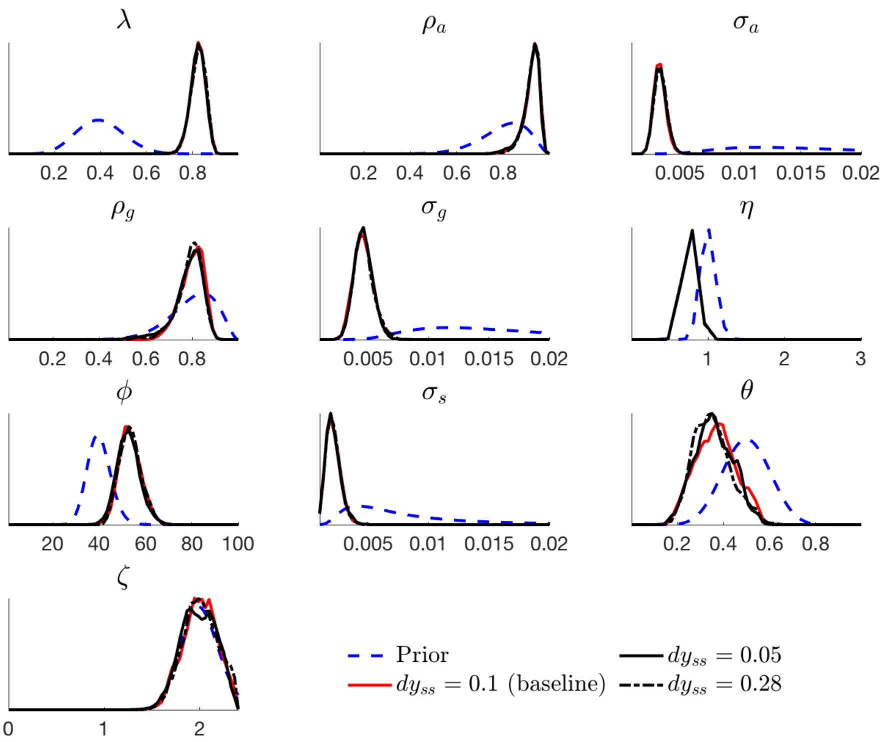


Figure 8: Posterior estimates of the unrestricted model at different values of dy_{ss}



6.2 Asymmetric risk aversion and labor supply elasticity

Let $U(C_t^j, L_t^j)$ denote period utility of household type $j = \{r, u\}$, where r refers to rule of thumb consumers and u to unconstrained consumers. This extension assumes preferences are asymmetric in the coefficient of risk aversion σ_j and the preference parameter ω_j that governs labor supply elasticity $(1/(\omega_j\text{-}1))$:

$$U(C_t^j, h_t^j, \Gamma_{t-1}) = \frac{\left(C_t^j - \tau_j \Gamma_{t-1} (h_t^j)^{\omega_j}\right)^{1-\sigma_j}}{1 - \sigma_j}$$

In addition to all other parameters calibrated in Section 3, long run productivity quarterly growth μ is set such that long run yearly growth rate ζ is 2.5%. In this extension, the new parameters σ_u, ω_r and ω_u are considered in the list of estimated parameters. Since σ_{R^*} doesn't appear in any equilibrium condition we can ignore it. Note that the parameters τ_u and τ_r will be linked with the posterior distribution of ω_u and ω_r, respectively. In particular, these will be such that $h_{ss}^r = h_{ss}^u = 1/3$.

As additional parameters are estimated, the list of observables also includes the first difference of Household Debt to GDP ratio (ΔDy_t) using the BIS database described in Section 1. As before, it is assumed a flat prior for measurement error shocks in ΔDy_t

with a standard deviation not larger than 25% of its total standard deviation.

Results reported in Supplementary Material suggest that data is very informative regarding the key parameter of interest λ and that its posterior median is above 0.80. Key findings related to other financial frictions parameters, the greater relevance of trend shocks in the unrestricted model, model evaluation results suggesting the unrestricted model performs better than its restricted version also remain robust.

Two other findings that are worth mentioning are those related with the coefficient of risk aversion of unconstrained households σ_u and the preference parameters ω_u and ω_r. First, estimates from the unrestricted model suggest a σ_u lower than that implied by restricted model estimates. The second interesting result emerges in the unrestricted model estimation. While the posterior distribution of the preference parameter ω_u shifts left relative to its prior, the posterior distribution of ω_r shifts right relative to its prior. In other words, aggregate data suggests that labor supply of unconstrained households tends to be more elastic to real wage fluctuations than that of rule of thumb households.

6.3 Estimating financial frictions parameters

This section checks whether main results change when instead of calibrating parameters reflecting financial frictions (θ and η), these are estimated. As before, the calibration includes the AR(1) coefficients in both the transitory technology process and the permanent technology process and the long run yearly growth rate ζ. In addition, the standard deviations in both the transitory technology process (σ_a) and the permanent technology process (σ_g) are calibrated at the median of the correspondent posterior distribution from the full sample estimation. Prior distributions assumed are the same as those described earlier when estimating the full sample.

Estimation results reported in Supplementary Material once more suggest that 75.2% of total households had a behavior consistent with rule of thumb consumers in the first subperiod of 1995-2004 and that the fraction fell to around 63.9% during the most recent decade 2005-2014. As before, no other parameter - i.e financial frictions (θ and η) spread shocks, capital adjustment cost parameter ϕ - seemed that changed significantly across subperiods.

6.4 Lower social transfers during first subperiod

According to annual data from the OECD, while the ratio net transfers over GDP (γ_t) remained stable and relatively close to 6.5% during the second subperiod 2005-2014, it was significantly lower during the first subperiod 1995-2004. This section checks whether a lower ratio affects main results. As shown in Supplementary Material, even after calibrating γ_t at the observed average of 4.6%, around 75.8% of total households had a behavior consistent with rule of thumb consumers in the first subperiod of 1995-2004.

7 Concluding Remarks and Suggestions for Further Research

Aligned with previous literature, this paper finds evidence that an increase in indicators of the degree to which the public can access financial services would tend to increase aggregate volatility in emerging countries. In particular, estimation results of an interacted panel VAR model, suggest that an increase in financial access measures tend to amplify the responses of macroeconomic aggregates to a country interest rate shock in an emerging economy.

In order to illustrate the role of financial frictions - acting through the interest rate channel- in the relationship between household usage of financial services and business cycle dynamics, a household financial constraint is embedded in an otherwise standard small open economy model. The estimation of the extended model with limited credit market participation by households contribute to a growing body of research that studies business cycles in emerging economies. In the extended model, while financial frictions remain quite significant, trend shocks become a more relevant source of business cycles. Furthermore, standard measures of predictive accuracy suggest the extended model that includes rule of thumb consumers outperforms a baseline model that excludes them. While these findings arise as by-product of the main research, results suggest that including rule of thumb consumers may have important implications in models assessing the role of particular shocks in emerging market business cycles.

From impulse response analyses, two key model implications emerge. First, a rise in household credit market participation in an emerging economy yields an increase in aggregate consumption and trade balance volatility, regardless the shock hitting the economy. Second, the lesser financial frictions are, the lower is the increase in consumption growth and trade balance volatility driven by a rise in household credit market participation. To provide further empirical evidence on these macroeconomic effects, the model is re-estimated on Mexican data over two subperiods. The estimation results suggest that the structural increase in credit market participation lead to an increase in the volatility of consumption growth relative to output and during the recent decade 2005-2014.

Although this paper finds that rising credit market participation would increase welfare of unconstrained households, it would also have an effect on the transmission of exogenous disturbances to emerging economies and unambiguously increase fluctuations in terms of aggregate consumption and trade balance ratio at business cycle frequencies. The presence of financial frictions is the main mechanism. As more households participate in consumption credit markets, a greater need of improving broad financial development measures arise. For example, domestic policies that improve access to international financial markets and lead towards more stable real interest rates in foreign borrowing would dampen the volatility effect of higher credit market participation and their effect on aggregate responses of consumption and the trade balance ratio after exogenous disturbances. Similarly, reducing working capital constraints within firms would reduce labor demand sensitivity to credit conditions and decrease aggregate volatility driven by the rise in households that are able to borrow.

An interesting venue for future research is the exciting task of endogenizing the fraction of households with rule of thumb behavior using a richer model with occasionally binding borrowing constraints. A much richer model may not only assess more adequately welfare implications but also answer other interesting questions such as the effect of monetary or fiscal policy on income and wealth distribution in emerging economies with limited credit market participation.

References

Aguiar, M. and Gopinath, G. (2007). Emerging market business cycles: The cycle is the trend. *Journal of Political Economy*, 115(1):pp. 69–102.

Akinci, O. (2013). Global financial conditions, country spreads and macroeconomic fluctuations in emerging countries. *Journal of International Economics*, 91:358–371.

Akinci, O. (2014). Financial frictions and macroeconomic fluctuations in emerging economies. International Finance Discussion Papers 1120, Board of Governors of the Federal Reserve System (U.S.).

An, S. and Schorfheide, F. (2007). Bayesian analysis of dsge models. *Econometric Reviews*, 26(2-4):113–172.

Arellano, C. (2008). Default risk and income fluctuations in emerging economies. *The American Economic Review*, pages 690–712.

Basu, S. and Macchiavelli, M. (2015). Consumption volatility and borrowing constraints in small open economies. Mimeo.

Beck, T., Demirguc-Kunt, A., and Martinez Peria, M. S. (2005). *Reaching Out : Access To And Use Of Banking Services Across Countries.* The World Bank.

Benhabib, J., Rogerson, R., and Wright, R. (1991). Homework in macroeconomics: Household production and aggregate fluctuations. *Journal of Political economy*, pages 1166–1187.

Bhattacharya, R. and Paitnaik, I. (2015). Financial inclusion, productivity shocks, and consumption volatility in emerging economies. *Policy Research working paper*, (WPS 7288).

Bilbiie, F. O. (2008). Limited asset markets participation, monetary policy and (inverted) aggregate demand logic. *Journal of Economic Theory*, 140(1):162 – 196.

Bilbiie, F. O. and Straub, R. (2013). Asset market participation, monetary policy rules, and the great inflation. *Review of Economics and Statistics*, 95(2):377–392.

Broer, T., Harbo Hansen, N.-J., Krusell, P., and Öberg, E. (2019). The New Keynesian Transmission Mechanism: A Heterogeneous-Agent Perspective. *The Review of Economic Studies*. rdy060.

Chang, R. and Fernández, A. (2013). On the sources of aggregate fluctuations in emerging economies. *International Economic Review*, 54(4):1265–1293.

Cihak, M., Demirgüç-Kunt, A., Feyen, E., and Levine, R. (2012). Benchmarking financial systems around the world. *World Bank Policy Research Working Paper*, (6175).

CNBV (2009). Reporte nacional de inclusión financiera (national financial report) 1. Technical report, Comisión Nacional Bancaria y de Valores.

CONAIF (2016). Reporte nacional de inclusión financiera (national financial report) 7. Technical report, Consejo Nacional de Inclusión Financiera, Mexico.

Debortoli, D. and Galí, J. (2017). Monetary policy with heterogeneous agents: Insights from tank models. Technical report, CREI and University of PompeuFabra.

Drechsel, T. and Tenreyro, S. (2018). Commodity booms and busts in emerging economies. *Journal of International Economics*, 112(C):200–2018.

Eaton, J. and Gersovitz, M. (1981). Debt with potential repudiation: Theoretical and empirical analysis. *The Review of Economic Studies*, pages 289–309.

Fernandez, A., Gonzalez, A., and Rodriguez, D. (2018). Sharing a ride on the commodities roller coaster: Common factors in business cycles of emerging economies. *Journal of International Economics*, 111:99–121.

Fernández, A., Schmitt-Grohé, S., and Uribe, M. (2017). World shocks, world prices, and business cycles: An empirical investigation. *Journal of International Economics*, 108(S2-S14).

Fernández-Villaverde, J., Guerrón-Quintana, P., Rubio-Ramírez, J. F., and Uribe, M. (2011). Risk matters: The real effects of volatility shocks. *American Economic Review*, 101(6):2530–61.

Ferreira, F. H., Messina, J., Rigolini, J., Lopez-Calva, L.-F., Lugo, M. A., and Vakis, R. (2013). *Economic Mobility and the Rise of the Latin American Middle Class*. Number 11858 in World Bank Publications. The World Bank.

Fulford, S. L. (2013). The effects of financial development in the short and long run: Theory and evidence from india. *Journal of Development Economics*, 104:56 – 72.

Galí, J., López-Salido, J. D., and Vallés, J. (2004). Rule-of-thumb consumers and the design of interest rate rules. *Journal of Money, Credit and Banking*, pages 739–763.

Galí, J., López-Salido, J. D., and Vallés, J. (2007). Understanding the effects of government spending on consumption. *Journal of the European Economic Association*, 5(1):227–270.

García-Cicco, J., Pancrazi, R., and Uribe, M. (2010). Real business cycles in emerging countries? *American Economic Review*, 100(5):2510–31.

Geweke, J. (1999). Using simulation methods for bayesian econometric models: inference, development,and communication. *Econometric Reviews*, 18(1):1–73.

Hansen, N.-J. and Sulla, O. (2013). El crecimiento del credito en america latina: desarrollo financiero o boom crediticio? *Revista Estudios Economicos*, 25(1).

Lopez-Salido, J. D. and Rabanal, P. (2006). Government spending and consumption - hours preferences. *Working Paper, Federal Reserve Board.*

Lubik, T. A. and Teo, W. L. (2005). Do world shocks drive domestic business cycles? evidence from structural estimation. Mimeo.

Mendoza, E. (2005). Suddens Stops in an Equilibrium Business Cycle Model with Credit Constraints: A Fisherian Deflation of Tobin's Q. 2005 Meeting Papers 307, Society for Economic Dynamics.

Mendoza, E. and Yue, V. (2012). A general equilibrium model of sovereign default and business cycles. *Quarterly Journal of Economics*, 127(2):889–946.

Montero, J. P. and Tarzijan, J. (2010). El éxito de las casas comerciales en chile : Regulación o buena gestión. Working Papers Central Bank of Chile 565, Central Bank of Chile.

Neumeyer, P. A. and Perri, F. (2005). Business cycles in emerging economies: the role of interest rates. *Journal of monetary Economics*, 52(2):345–380.

Obermann, T. (2006). A revolution in consumer banking: Developments in consumer banking in latin america.

OECD (2014). *OECD Factbook 2014: Economic, Environmental and Social Statistics*. OECD Publishing.

Oviedo, M. (2005). World interest rate, business cyles and financial intermediation in small open economies. Mimeo.

Ponce, R. A. (2003). Restricciones de liquidez, canal de crédito y consumo en méxico. *economía mexicana. NUEVA ÉPOCA*, 12(1).

Schmitt-Grohé, S. and Uribe, M. (2003). Closing small open economy models. *Journal of international Economics*, 61(1):163–185.

Schmitt-Grohé, S. and Uribe, M. (2004). Solving dynamic general equilibrium models using a second-order approximation to the policy function. *Journal of Economic Dynamics and Control*, 28(4):755 – 775.

Schmitt-Grohe, S. and Uribe, M. (2005). Optimal fiscal and monetary policy in a medium-scale macroeconomic model: Expanded version. Working Paper 11417, National Bureau of Economic Research.

Shousha, S. (2016). Macroeconomics effects of commodity booms and busts: the role of financial frictions. Mimeo.

Towbin, P. and Weber, S. (2013). Limits of floating exchange rates: The role of foreign currency debt and import structure. *Journal of Development Economics*, 101:179 – 194.

Uribe, M. and Yue, V. (2006). Country spreads and emerging countries: Who drives whom? *Journal of International Economics*, 69(1):6–36.

Uribe, M. and Yue, V. Z. (2003). Country spreads and emerging countries: Who drives whom? Working Paper 10018, National Bureau of Economic Research.

Vaidyanathan, G. (1993). Consumption, liquidity constraints and economic development. *Journal of Macroeconomics*, 15(3):591 – 610.

Appendix

A Sample and Variable description for IPVAR

Table 13: Country sample

n	Country	Maximum sample[1]	Source National Accounts
1	Argentina[a]	1996q1 - 2017q1	IFS
2	Brazil	1996q1 - 2017q4	OECD
3	Chile	1999q3 - 2017q4	OECD
4	Colombia	2000q1 - 2017q4	OECD
5	Ecuador[a]	1996q1 - 2017q3	IFS
6	Egypt[a]	2002q1 - 2013q4	IFS
7	India	2013q1 - 2017q4	OECD
8	Indonesia[a]	2004q3 - 2017q1	IFS
9	Malaysia[a]	1997q1 - 2017q1	IFS
10	Mexico[b]	1996q1 - 2017q2	IFS
11	Peru[a]	1997q2 - 2017q1	IFS
12	Philippines[c]	1998q1 - 2017q4	PSA
13	Southafrica[b]	1996q1 - 2016q4	IFS
14	Thailand[b]	1998q1 - 2017q3	IFS
15	Turkey[a]	1996q3 - 2017q4	IFS
16	Uruguay[c]	2005q1 - 2017q4	BCU

IADB: Inter-American Development Bank, PSA: Philippine Statistics Authority, BCU: Central Bank of Uruguay, ECLAC: Economic Commission for Latin America and the Caribbean.
[1] Maximum sample given by national accounts and real interest rate data availability.
[a] National Accounts data had to be seasonally adjusted and divided by GDP deflator.
[b] National Accounts data had to be divided by GDP deflator.
[c] National Accounts data had to be seasonally adjusted. No superscript implies data was already in constant values and seasonally adjusted.

Proxies for Household access and use of financial services:

- *Financial system deposits to GDP*: A common measure of financial depth which refers to the size of financial institutions and markets and reflects the overall extent of services provided by the financial system (Cihak et al., 2012). Data is annual and extracted from the World Bank's Global Financial Development database.
- *Credit to Households as % GDP*: Credit to Households and Non-profit institutions serving households (NPISHs) from All sectors at Market value expressed as percentage of GDP and adjusted for breaks. It has quarterly frequency and was extracted from Bank for International Settlements (BIS) "Long series on credit to the private non-financial sector" database.
- **Alternative financial access measures:** Financial access refers to the degree to which individuals and firms can and do use financial institutions

and markets. Three commonly used indicators are used: *Bank accounts per 10 adults*, *Bank branches per 1000 adults* and *ATMs per 1000 adults*. Data is annual and extracted from the World Bank's Global Financial Development database.

Domestic real interest rate

The real gross interest rate for each emerging country is constructed as the product of gross real interest rate for the US and gross country spreads. The former is measured by the 3-month Treasury Bill Secondary market rate (%) minus a measure of expected annual inflation. This measure is the average of annual inflation of 4 previous quarters. The price index used to calculate inflation is the GDP Implicit Price Deflator. All inputs for constructing US real interest rate are extracted from FRED. Gross country spreads are based on JP Morgan's Emerging Markets Bond Index Global (EMBIG) which tracks total returns for traded external debt instruments (i.e. foreign currency denominated fixed income) in emerging markets.

Table 14: Descriptive statistics of National Accounts and interest rate data

Variable		Mean	Std. Dev.	Min	Max	Observations
Output	overall	-0.002	0.069	-0.260	0.284	N = 1153
	between		0.006	-0.011	0.011	n = 16
	within		0.069	-0.252	0.291	T-bar = 72.063
Consumption	overall	-0.004	0.065	-0.354	0.335	N = 1153
	between		0.007	-0.018	0.010	n = 16
	within		0.065	-0.350	0.349	T-bar = 72.063
Investment	overall	-0.015	0.157	-0.676	0.714	N = 1153
	between		0.021	-0.070	0.009	n = 16
	within		0.156	-0.681	0.711	T-bar = 72.063
Trade Balance	overall	0.011	0.068	-0.137	0.287	N = 1153
to Output ratio	between		0.055	-0.059	0.160	n = 16
	within		0.041	-0.196	0.153	T-bar = 72.063
Real interest rate	overall	0.055	0.061	-0.001	0.551	N = 1153
	between		0.035	0.017	0.145	n = 16
	within		0.050	-0.047	0.461	T-bar = 72.063

Output, consumption, investment and the trade balance are in constant local currency units, seasonally adjusted and expressed as log deviations from their corresponding log-linear trend. The trade balance ratio and real interest rate are detrended in levels.

Table 15: Descriptive statistics of Financial Access measures

Variable		Mean	Std. Dev.	Min	Max	Observations
ACCESS I	overall	48.357	28.290	12.999	126.365	N = 1049
Financial system deposits	between		28.702	18.180	114.531	n = 16
to GDP (%)	within		5.259	30.276	63.440	T = 65.563
ACCESS II	overall	22.925	18.283	1.000	70.900	N = 709
Credit to Households	between		18.847	4.900	60.878	n = 11
to GDP (%)	within		5.866	9.849	41.749	T-bar = 64.455
ACCESS III	overall	0.197	0.307	0.038	2.577	N = 698
Bank branches	between		0.204	0.043	0.884	n = 16
per 1000 adults	within		0.234	-0.578	1.889	T = 43.625
ACCESS IV	overall	0.433	0.281	0.026	1.180	N = 674
ATMs	between		0.259	0.069	1.119	n = 16
per 1000 adults	within		0.120	-0.046	0.795	T = 42.125
ACCESS V	overall	7.053	4.502	0.534	21.332	N = 356
Bank accounts	between		4.829	1.337	17.756	n = 10
per 10 adults	within		1.174	3.663	10.629	T = 35.6

Table 16: Impulse response to a one standard deviation shock to the domestic real interest rate conditional to financial access size (alternative proxies)

	Low Fin. Access	High Fin. Access	Diff.
1 std. shock in R Access: bank branches per 1000 adults			
Output			
1st year	-0.26***	-0.26***	-0.01
2nd year	-0.3***	-0.3***	-0.01
3rd year	-0.25***	-0.24***	-0.01
Investment			
1st year	-0.86***	-0.69***	-0.18**
2nd year	-0.91***	-0.73***	-0.19*
3rd year	-0.67***	-0.54***	-0.14*
Trade Balance Ratio			
1st year	0.05	0.13**	-0.08***
2nd year	0.09	0.14***	-0.06***
3rd year	0.08**	0.11***	-0.03*
1 std. shock in R Access: ATMS per 1000 adults			
Output			
1st year	-0.24***	-0.35***	0.12
2nd year	-0.27***	-0.39***	0.13
3rd year	-0.22***	-0.31***	0.1
Investment			
1st year	-0.61***	-1.29***	0.69***
2nd year	-0.62**	-1.35***	0.73***
3rd year	-0.45**	-0.97***	0.53***
Trade Balance Ratio			
1st year	0.05	0.31***	-0.27***
2nd year	0.06	0.27***	-0.22***
3rd year	0.05	0.17***	-0.13***
1 std. shock in R Access: Bank accounts per 10 adults			
Output			
1st year	-0.42***	-0.29***	-0.13
2nd year	-0.39***	-0.25***	-0.14
3rd year	-0.27***	-0.16***	-0.12*
Investment			
1st year	-0.8***	-0.27	-0.53*
2nd year	-0.87***	-0.38	-0.49*
3rd year	-0.69***	-0.31	-0.38
Trade Balance Ratio			
1st year	-0.02	0.26***	-0.28***
2nd year	0.05	0.15***	-0.1*
3rd year	0.06	0.08***	-0.03

*,**,*** indicate that zero lies outside the 80,90,95 % confidence bands.

B Appendix Section 3

B.1 Posterior estimates

Figure 9: Posterior estimates of the restricted model ($\lambda = 0$)

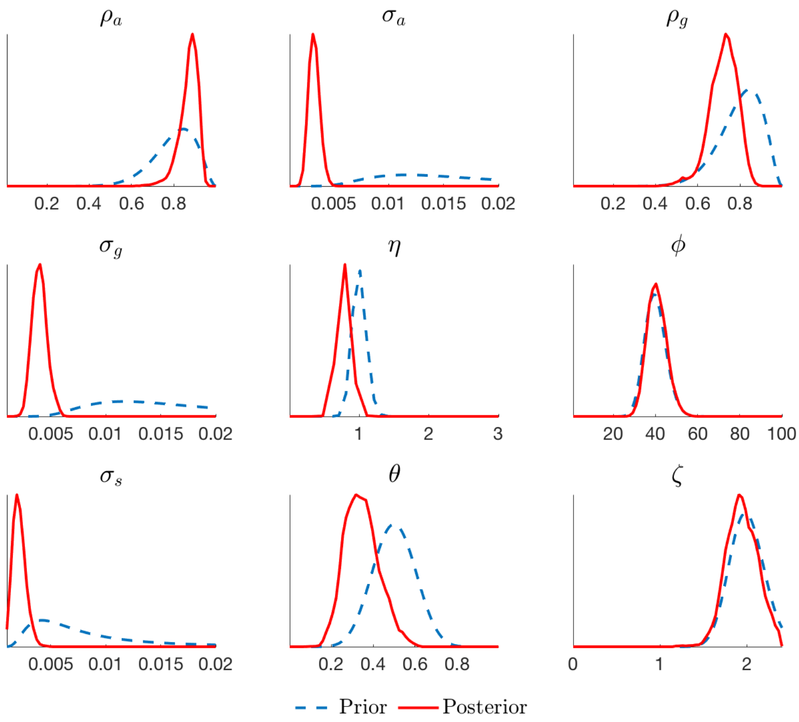
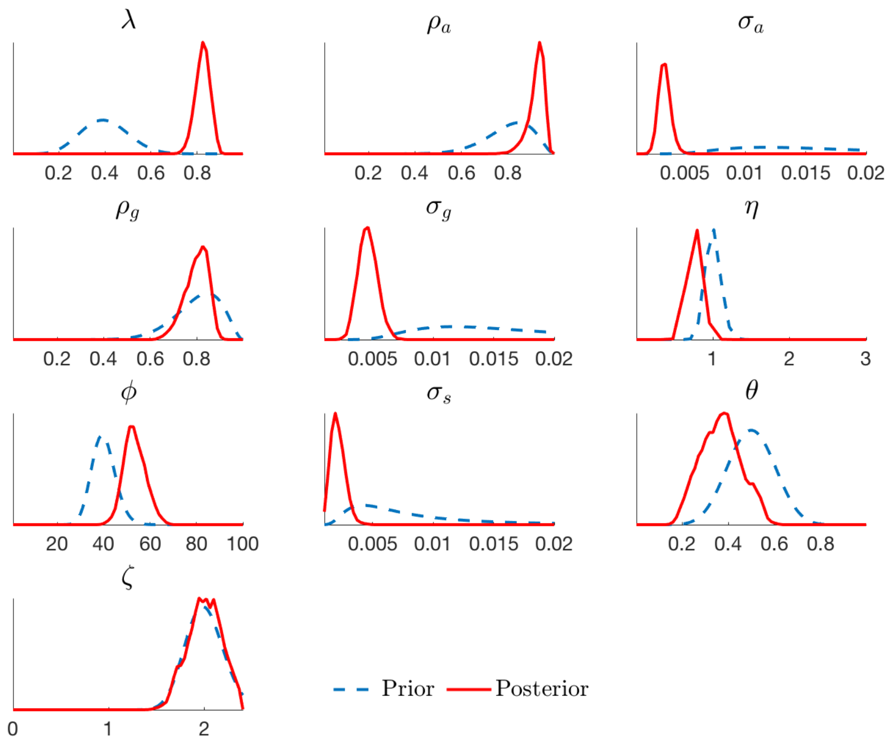


Figure 10: Posterior estimates of the unrestricted model ($\lambda \geq 0$)



B.2 Model Evaluation

Table 17: Variance decomposition of restricted model and counterfactual exercises.

	γ_Y	γ_C	γ_I	$dTby$	S
Restricted model ($\lambda = 0$)					
Stationary technology (ϵ_t^A)	49.30	12.00	7.10	0.60	69.10
Nonstationary technology (ϵ_t^g)	35.10	13.80	6.20	2.00	22.20
World Interest rate ($\epsilon_t^{R^*}$)	14.80	74.00	86.70	97.40	0.00
Exogenous spread (ϵ_t^S)	0.70	0.20	0.00	0.10	8.70
Counterfactual, higher working capital ($\theta = 0.69$)					
Stationary technology (ϵ_t^A)	48.13	13.69	7.07	0.27	69.14
Nonstationary technology (ϵ_t^g)	33.43	14.84	6.08	1.41	22.18
World Interest rate ($\epsilon_t^{R^*}$)	16.20	70.85	86.85	98.03	0.00
Exogenous spread (ϵ_t^S)	2.24	0.62	0.00	0.29	8.67
Counterfactual, lower volatility of g_t ($\sigma_g = 0.052\%$)					
Stationary technology (ϵ_t^A)	75.38	13.88	7.55	0.57	88.46
Nonstationary technology (ϵ_t^g)	0.85	0.25	0.10	0.03	0.45
World Interest rate ($\epsilon_t^{R^*}$)	22.67	85.67	92.35	99.32	0.00
Exogenous spread (ϵ_t^S)	1.11	0.20	0.00	0.08	11.09
Counterfactual, lower volatility of R^* ($\sigma_{R^*} = 0.26\%$)					
Stationary technology (ϵ_t^A)	53.94	20.88	14.12	1.26	69.14
Nonstationary technology (ϵ_t^g)	38.37	24.02	12.41	4.57	22.18
World Interest rate ($\epsilon_t^{R^*}$)	6.90	54.79	73.47	93.99	0.00
Exogenous spread (ϵ_t^S)	0.79	0.31	0.00	0.18	8.67

Notes: The estimated contribution of measurement errors (not shown) is negligible for all five variables. Third counterfactual experiment use σ_g such that the implied ratio of unconditional volatilities of trend to stationary shocks is that implied by CF estimates and assuming ρ_g, ρ_a and σ_a are fixed at median estimates from the restricted model in Section 3. Fourth counterfactual experiment use σ_{R^*} such that the implied unconditional volatility of the foreign interest rate shock is that implied by CF estimates and assuming ρ_{R^*} is fixed at its calibrated value in Section 3.

Table 18: Variance decomposition of unrestricted model and counterfactual exercises.

	γ_Y	γ_C	γ_I	$dTby$	S
Benchmark, Unrestricted model ($\lambda \geq 0$)					
Unrestricted model ($\lambda \geq 0$)					
Stationary technology ϵ_t^A	43.70	42.70	13.10	2.30	72.50
Nonstationary technology ϵ_t^g	44.20	44.40	13.20	3.90	22.40
World Interest rate $\epsilon_t^{R^*}$	11.40	10.50	73.70	93.60	0.00
Exogenous spread ϵ_t^S	0.70	2.40	0.00	0.20	5.10
Counterfactual, no limited credit market participation ($\lambda = 0$)					
Stationary technology σ_z	44.62	18.03	14.15	3.80	72.53
Nonstationary technology σ_g	44.87	22.91	13.90	7.20	22.39
World Interest rate σ_{R^*}	9.80	58.90	71.95	88.91	0.00
Exogenous spread σ_S	0.72	0.16	0.00	0.09	5.08
Counterfactual, no endogenous spread ($\eta = 0$)					
Stationary technology σ_z	41.64	34.98	0.26	3.60	0.00
Nonstationary technology σ_g	43.80	45.39	8.31	0.99	0.00
World Interest rate σ_{R^*}	13.71	15.97	91.44	95.23	0.00
Exogenous spread σ_S	0.85	3.66	0.00	0.18	100.00
Counterfactual, no working capital requirement ($\theta = 0$)					
Stationary technology σ_z	42.70	41.69	13.12	3.42	72.53
Nonstationary technology σ_g	46.58	50.98	13.52	5.58	22.39
World Interest rate σ_{R^*}	10.72	7.33	73.37	91.00	0.00
Exogenous spread σ_S	0.00	0.00	0.00	0.00	5.08
Counterfactual, $\lambda = \eta = \theta = 0$					
Stationary technology σ_z	44.59	2.97	0.32	1.00	0.00
Nonstationary technology σ_g	46.59	19.33	9.08	4.03	0.00
World Interest rate σ_{R^*}	8.82	77.71	90.60	94.96	0.00
Exogenous spread σ_S	0.00	0.00	0.00	0.00	100.00

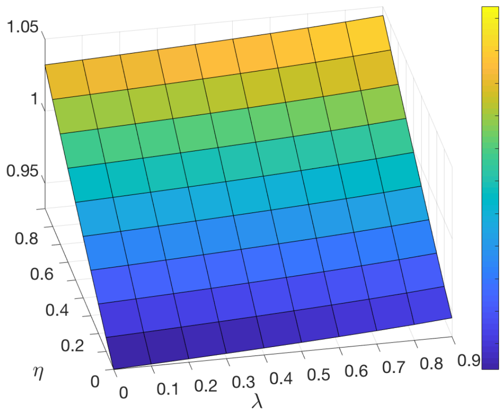
Notes: The estimated contribution of measurement errors (not shown) is negligible for all five variables

Table 19: Implied moments by model

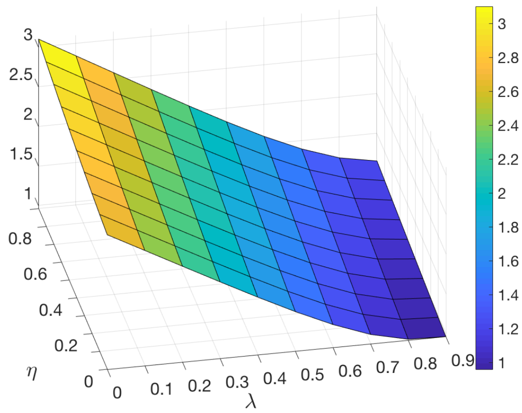
	γ_Y	γ_C	γ_I	$dTby$	S
Data					
Standard deviation (%)	1.184	1.128	3.031	0.836	0.556
Serial correlation	0.267	0.341	0.249	-0.176	0.767
Correlation with γ_Y	1.000	0.760	0.794	-0.379	-0.167
Unrestricted model $\lambda = 0.834,\ \eta = 0.838,\ \theta = 0.376$					
Standard deviation (%)	1.035	1.180	3.271	0.862	0.977
Serial correlation	0.221	0.156	0.015	-0.066	0.862
Correlation with γ_Y	1.000	0.990	0.481	-0.159	-0.436
Model $\lambda = 0.834,\ \eta = \theta = 0$					
Standard deviation (%)	0.922	0.892	2.884	0.831	0.220
Serial correlation	0.257	0.276	0.028	-0.012	0.000
Correlation with γ_Y	1.000	0.996	0.241	0.107	0.000
Model $\eta = 0.838,\ \lambda = \theta = 0$					
Standard deviation (%)	0.911	2.905	3.035	2.566	0.977
Serial correlation	0.267	0.002	0.011	-0.020	0.862
Correlation with γ_Y	1.000	0.549	0.494	-0.256	-0.448
Model $\theta = 0.376,\ \lambda = \eta = 0$					
Standard deviation (%)	0.931	2.654	2.752	2.501	0.220
Serial correlation	0.233	0.064	0.025	-0.055	0.000
Correlation with γ_Y	1.000	0.387	0.238	0.014	-0.066
Model $\lambda = \eta = \theta = 0$					
Standard deviation (%)	0.911	2.597	2.698	2.448	0.220
Serial correlation	0.238	0.014	0.025	-0.016	0.000
Correlation with γ_Y	1.000	0.389	0.246	0.000	0.000

C Appendix Section 4

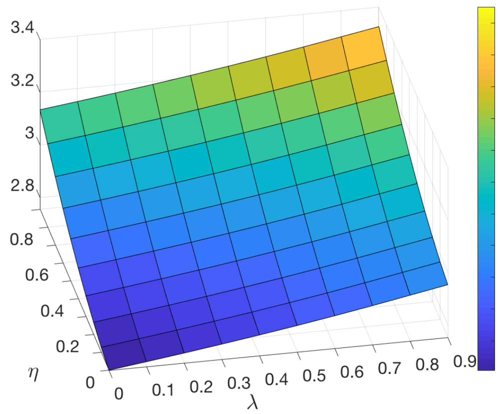
Figure 11: Unconditional standard deviation of key macroeconomic aggregates at different λ and η combinations



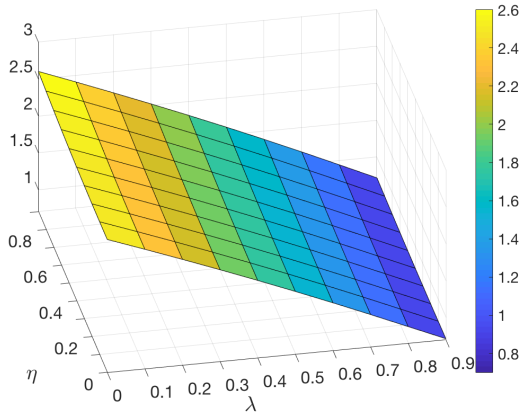
(a) Output growth



(b) Consumption growth



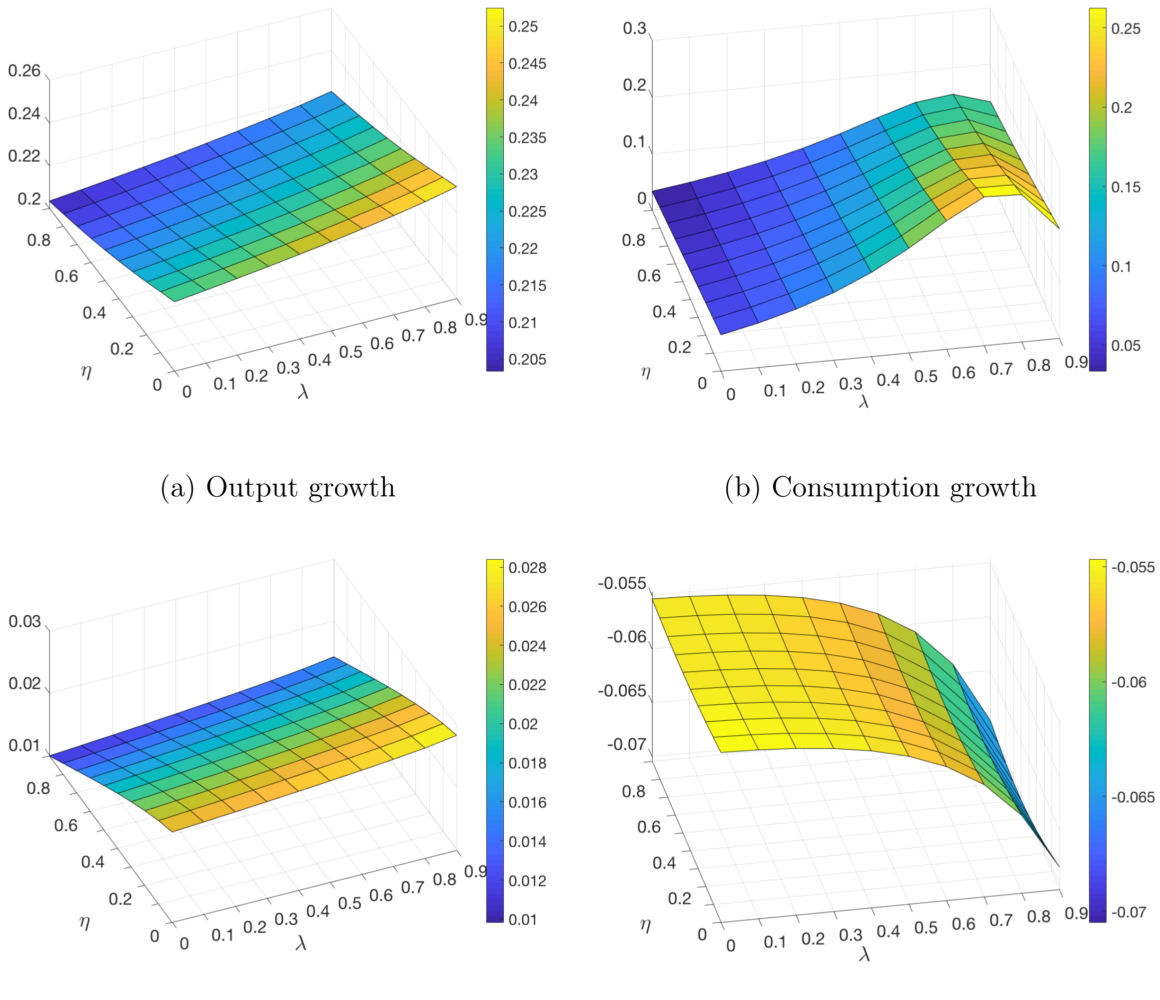
(c) Investment growth



(d) Trade balance ratio (first difference)

Notes: Remaining parameters are fixed at median estimates of unrestricted model

Figure 12: Implied Autocorrelation (order 1) of key macroeconomic aggregates at different λ and η combinations



(a) Output growth

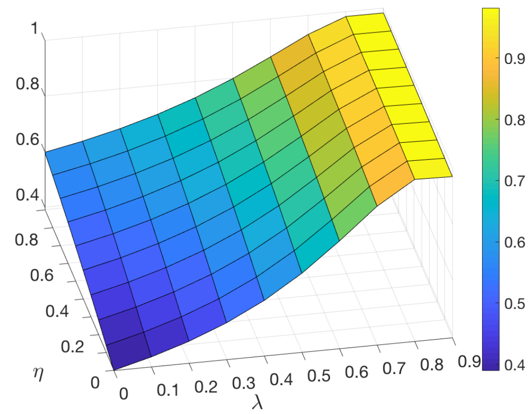
(b) Consumption growth

(c) Investment growth

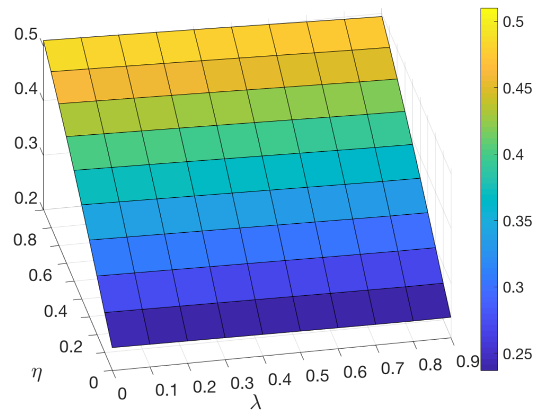
(d) Trade balance ratio (first difference)

Notes: Remaining parameters are fixed at median estimates of unrestricted model

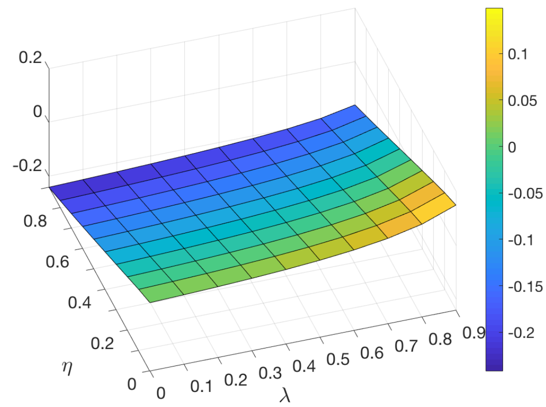
Figure 13: Implied Correlation with Output Growth of key macroeconomic aggregates at different λ and η combinations



(a) Consumption growth



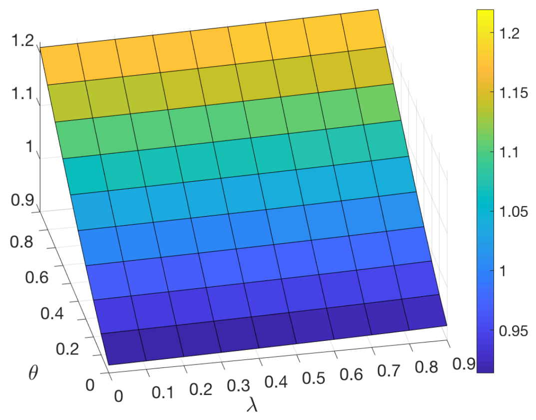
(b) Investment growth



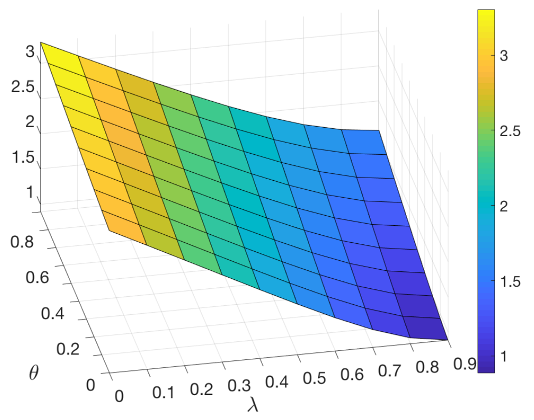
(c) Trade balance ratio (first difference)

Notes: Remaining parameters are fixed at median estimates of unrestricted model

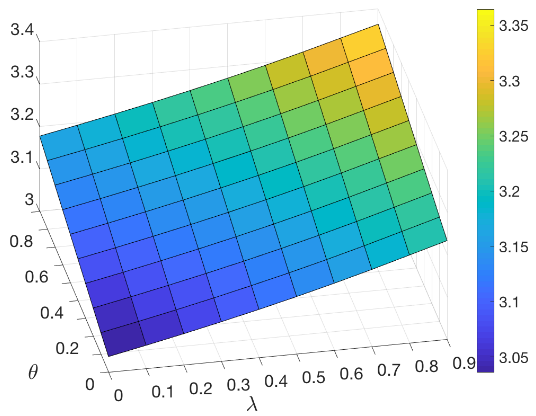
Figure 14: Unconditional standard deviation of key macroeconomic aggregates at different λ and θ combinations



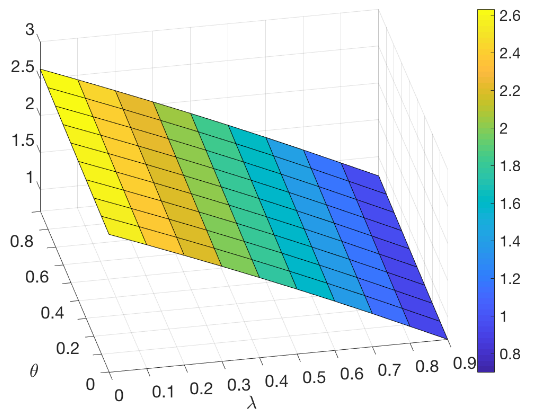
(a) Output growth



(b) Consumption growth



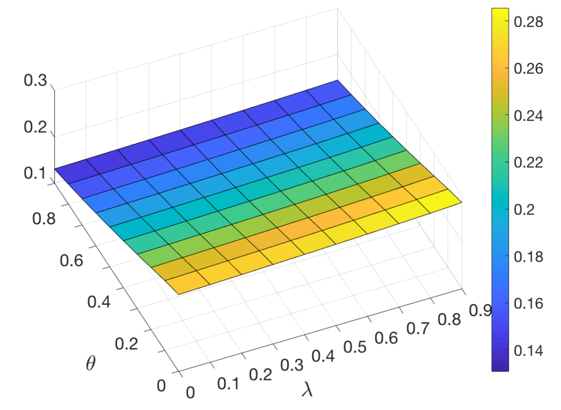
(c) Investment growth



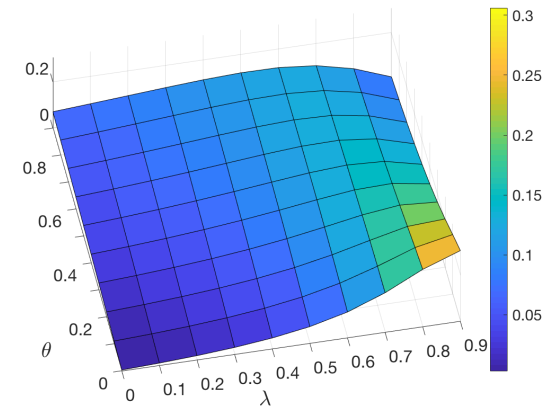
(d) Trade balance ratio (first difference)

Notes: Remaining parameters are fixed at median estimates of unrestricted model

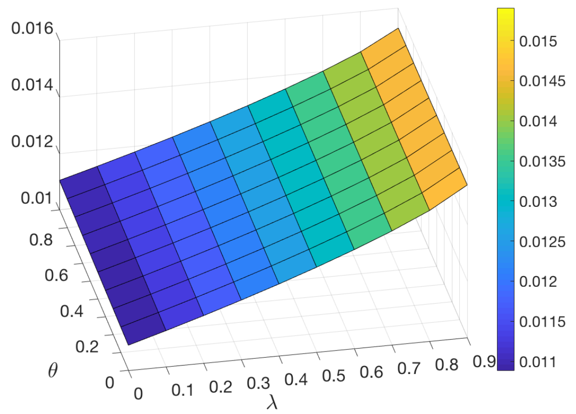
Figure 15: Implied Autocorrelation (order 1) of key macroeconomic aggregates at different λ and θ combinations



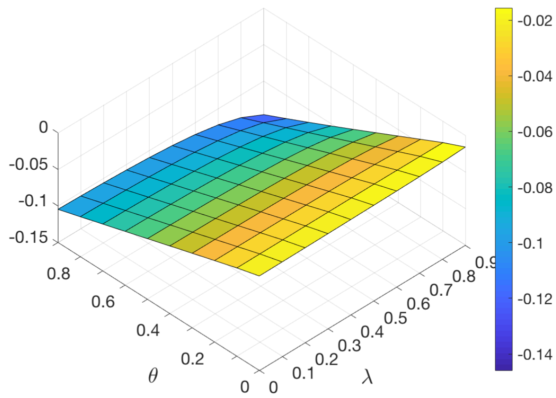
(a) Output growth



(b) Consumption growth



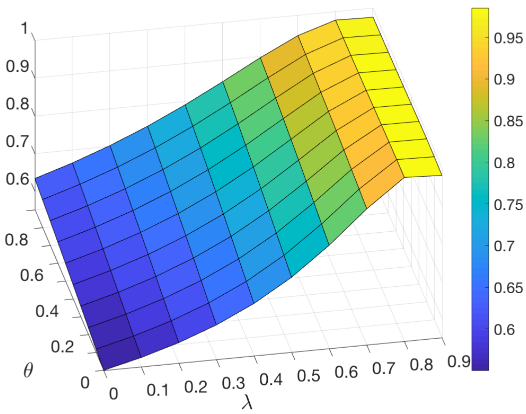
(c) Investment growth



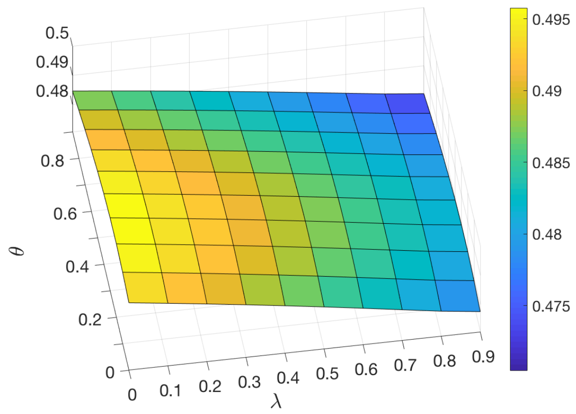
(d) Trade balance ratio (first difference)

Notes: Remaining parameters are fixed at median estimates of unrestricted model

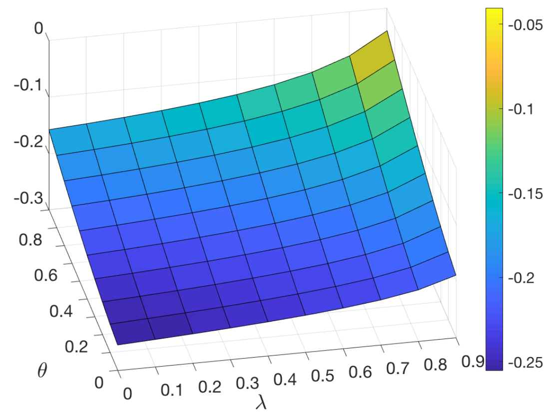
Figure 16: Implied Correlation with Output Growth of key macroeconomic aggregates at different λ and θ combinations



(a) Consumption growth



(b) Investment growth

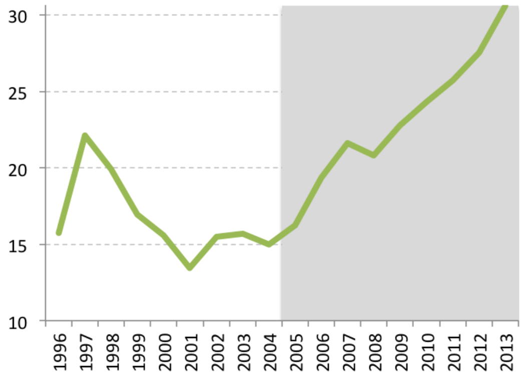


(c) Trade balance ratio (first difference)

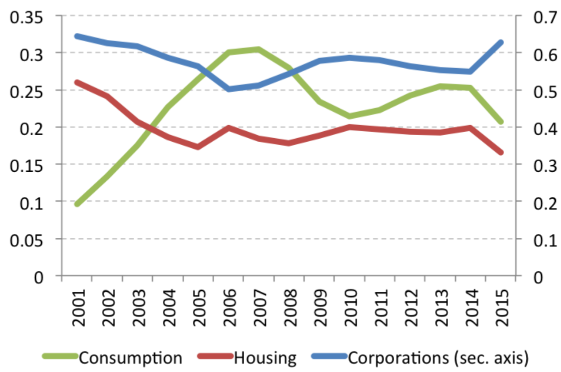
Notes: Remaining parameters are fixed at median estimates of unrestricted model

D Appendix Section 5

Figure 17: Evolution of private credit in Mexico



(a) Domestic credit to private sector as % GDP



(b) Credit by type as % of domestic credit to private sector

Sources: World Bank Global Financial database. Comision Nacional Bancaria y de Valores de Mexico.

Table 20: Estimation results by subperiod

		Period 1995:II-2004:IV					Period 2005:I-2014:IV				
		Mode	Mean	Median	90% credible set		Mode	Mean	Median	90% credible set	
λ	Fraction of rule of thumb households	0.798	0.758	0.764	0.677	0.830	0.686	0.648	0.653	0.548	0.742
σ_a	S.D transitory tech. shock (%)	0.730	0.448	0.442	0.353	0.548	0.529	0.433	0.429	0.339	0.534
σ_g	S.D permanent tech. shock (%)	0.669	0.582	0.572	0.445	0.730	0.745	0.551	0.543	0.422	0.688
ϕ	Capital adjustment cost parameter	45.010	43.766	43.595	38.097	49.640	43.221	45.664	45.524	39.622	51.888
σ_s	S.D spread shock (%)	0.256	0.306	0.291	0.192	0.439	0.243	0.295	0.286	0.191	0.411
σ^{γ_Y}	S.D m.e. output growth (%)	0.010	0.012	0.011	0.010	0.014	0.010	0.011	0.011	0.010	0.013
σ^{γ_C}	S.D m.e. C growth (%)	0.012	0.012	0.011	0.010	0.014	0.010	0.012	0.011	0.010	0.014
σ^{γ_I}	S.D m.e. investment growth (%)	0.010	0.039	0.035	0.015	0.068	0.029	0.024	0.022	0.012	0.038
σ^{dTby}	S.D m.e. dTBy (%)	0.015	0.012	0.012	0.010	0.016	0.010	0.011	0.011	0.010	0.013
σ^S	S.D m.e. spread (%)	0.010	0.011	0.011	0.010	0.012	0.010	0.011	0.011	0.010	0.012
RWC	Random walk component	5.118	6.716	6.703	6.597	6.819	7.040	6.630	6.612	6.536	6.684

Table 21: Variance decomposition predicted by subperiod estimates.

	γ_Y	γ_C	γ_I	$dTby$	S
Subperiod 1995:II - 2004:IV					
Stationary technology (ϵ_t^A)	47.32	46.03	21.17	6.70	74.15
Nonstationary technology (ϵ_t^g)	43.49	43.80	17.19	7.65	20.37
World Interest rate ($\epsilon_t^{R^*}$)	8.38	7.84	61.64	85.44	0.00
Exogenous spread (ϵ_t^S)	0.82	2.34	0.00	0.21	5.48
Subperiod 2005:I - 2014:IV					
Stationary technology (ϵ_t^A)	50.31	46.37	29.20	10.25	74.69
Nonstationary technology (ϵ_t^g)	44.11	43.72	23.00	12.87	19.64
World Interest rate ($\epsilon_t^{R^*}$)	4.69	8.06	47.80	76.56	0.00
Exogenous spread (ϵ_t^S)	0.89	1.86	0.00	0.32	5.67

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

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