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FINANCIAL FRICTIONS AND MONETARY POLICY UNDER INVERTED AGGREGATE DEMAND LOGIC

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Abstract

This thesis investigates the macroeconomic implications of financial frictions using a New Keynesian DSGE framework that incorporates a financial accelerator mechanism following Bernanke *et al.*, (1999), combined with limited asset market participation following Bilbiie (2008). The model is calibrated to match features of the Mexican economy and used to study the transmission of four structural shocks: monetary policy, entrepreneur riskiness, net worth, and productivity shocks. Special attention is given to how macroeconomic dynamics are shaped by (i) the sensitivity of the external finance premium to leverage and (ii) the central bank's response to the external finance premium. The results show that under Inverted Aggregate Demand Logic, financial frictions may either amplify or dampen macroeconomic fluctuations, depending on the nature of the shock and the design of monetary policy. Notably, the interaction between the financial accelerator and Inverted Aggregate Demand Logic produces nonstandard effects, such as expansionary monetary contractions or inflationary financial shocks, highlighting the importance of financial variables in the transmission of monetary policy.

Contents

1 Introduction

The dominant analytical framework in modern macroeconomics is the New Keynesian model, which has become the standard for policy analysis in both academic and institutional settings. In its most basic form, the model consists of three core equations: an intertemporal Euler equation (IS curve), a New Keynesian Phillips curve, and a monetary policy rule such as the Taylor rule, as presented in Gali (2015). These minimal models have been extended into fully specified dynamic stochastic general equilibrium (DSGE) frameworks, which are widely used by central banks and international organizations. However, both versions typically abstract from financial frictions, assuming complete markets and frictionless financial intermediation. This omission is particularly problematic in the context of emerging market economies such as Mexico, where financial imperfections are empirically significant.

According to the *Encuesta Nacional de Inclusión Financiera*, ENIF (2024), a large part of Mexico's adult population (aged 18 years and older) continues to lack access to formal credit. The percentage of adults without any formal credit product, such as a bank loan, credit card, or payroll loan, was 29.1% in 2018, 31.1% in 2020, 32.7% in 2022, and increased further to 37.3% in the most recent 2024 ENIF report. This persistent exclusion underscores the structural nature of credit market frictions in Mexico. These frictions are also evident in the business sector. According to Banco de México (2024), there are significant differences in the cost of credit across firms of different sizes. The interest rate spread on new loans was 120 basis points for large issuing firms, 239 basis points for large non-issuers, and 511 basis points for smaller firms.[1] These elevated spreads reflect substantial financial frictions and borrowing constraints, particularly affecting small and medium-sized enterprises (SMEs), and forcing many to rely heavily on internal funds. This is especially relevant in the Mexican context, where SMEs account for 68.4% of formal employment, according to Economía (2024). Such widespread frictions across both households and firms not only constrain economic activity, but also distort investment dynamics and amplify macroeconomic fluctuations.

These dynamics are best understood through the lens of balance sheet effects, which play a central role in the propagation and amplification of macroeconomic shocks. When financial frictions make borrowing costs dependent on the net worth agents or collateral, fluctuations in balance sheets can trigger disproportionately large movements in investment and output.

[1] The differentials in interest rates are calculated by taking the yield on an interest rate swap referencing the 28-day TIIE with a payment structure equivalent to the loan being analyzed, and subtracting this benchmark from the actual interest rate charged on new loans to firms.

This mechanism, formalized in the financial accelerator model of Bernanke *et al.*, (1999) and the collateral models based on Kiyotaki and Moore (1997), has been widely used to explain how small initial shocks can generate deep recessions or prolonged booms, particularly in financially vulnerable economies. In the Mexican context, where firms and households face persistent credit constraints, balance sheet channels are likely to be a key driver of business cycle dynamics.

In light of these considerations, this thesis develops a New Keynesian DSGE model that incorporates two empirically grounded financial frictions. The first is limited asset market participation (LAMP), which captures household heterogeneity by distinguishing between financially constrained (hand-to-mouth) and unconstrained consumers, as proposed by Bilbiie (2008). The second is a financial accelerator mechanism, in which credit market frictions make borrowing costs for firms depend on their leverage, giving rise to an external finance premium that amplifies macroeconomic fluctuations,[2] following Bernanke *et al.*, (1999) and extended by L. J. Christiano *et al.*, (2014) and Brzoza-Brzezina *et al.*, (2010). The model is calibrated to reflect key features of the Mexican economy and is used to examine the transmission of four structural shocks: monetary policy, entrepreneurial risk, net worth, and productivity shocks.

The contribution of this thesis is primarily quantitative and focuses on how the interaction between financial frictions and inverted aggregate demand logic (IADL) shapes macroeconomic dynamics. IADL refers to an environment in which monetary policy can produce non-standard expansionary effects when a large share of households are financially constrained[3]. Within this framework, particular attention is paid to the external finance premium (EFP), specifically its sensitivity to firm leverage and the monetary authority's policy response to changes in financial conditions. These features allow the model to capture a richer range of transmission mechanisms than standard frameworks, making it particularly suitable for studying financially vulnerable economies such as Mexico.

The main findings are as follows. First, financial frictions significantly attenuate the expansionary effects typically predicted by the IADL, particularly through the amplification

[2]The financial accelerator amplifies shocks by increasing borrowing costs when net worth of firms declines, thereby reducing investment and output, and reinforcing the initial disturbance. See Bernanke and Gertler (1995).

[3]When a large share of consumers are hand-to-mouth, tighter monetary policy can have expansionary effects by raising real wages and boosting consumption, output, and labor supply, a dynamic known as Inverted Aggregate Demand Logic (IADL) (Bilbiie, 2008).

role of the EFP. Second, under an entrepreneurial riskiness shock, the model yields a nonstandard combination of falling output and rising inflation, driven by household heterogeneity in consumption behavior and wage dynamics. Third, increases in entrepreneurs' net worth generate persistent expansions, which are amplified when the EFP is more sensitive to leverage. Fourth, productivity shocks produce standard expansionary effects across specifications, although the strength of the response depends on the EFP's elasticity. Sensitivity analysis confirms that macroeconomic outcomes are highly dependent on both the intensity of the financial accelerator and the reaction function of the monetary authority. Robustness checks show that the model's qualitative dynamics remain stable across a range of parameter values.

From a policy perspective, the results underscore that in financially constrained economies such as Mexico, monetary policy must account for the structure and responsiveness of financial frictions. Depending on the nature of the shock, procyclical or countercyclical responses can stabilize or exacerbate macroeconomic volatility, highlighting the need for optimal policy to be carefully calibrated to prevailing financial conditions.

Our work is related to a broader literature that models financial frictions through various mechanisms. One strand emphasizes the role of agency costs and informational asymmetries, introducing financial frictions via an external finance premium. For example, Bernanke and Gertler (1989) links the financial position of firms to the investment dynamics through agency problems, demonstrating how shocks to net worth propagate in the real economy. This approach is extended by Carlstrom and Fuerst (1997) and applied to open economy settings by Mendoza (2010), highlighting the macroeconomic implications of imperfect credit markets.

Alternatively, financial frictions can be modeled through collateral constraints. Kiyotaki and Moore (1997) propose a framework in which durable assets serve both as a productive input and as collateral for loans, and access to credit borrowers is limited by the value of their collateral. Although influential, this approach presents some notable limitations. As Brzoza-Brzezina *et al.*, (2010) argues, models with sharply binding collateral constraints often fail to produce hump-shaped impulse responses and tend to generate excessive volatility in asset prices and returns, patterns that diverge substantially from empirical observations. Despite their relevance, such models may overstate the amplification effects of financial frictions.

This thesis adopts a Two-Agent New Keynesian (TANK) model to capture household heterogeneity, following the approach of Bilbiie (2008). TANK models provide a tractable alternative to fully specified Heterogeneous Agent New Keynesian (HANK) frameworks while still capturing key distributional dynamics. As shown by Debortoli and Galí (2018), the TANK models approximate reasonably well the aggregate responses of the baseline HANK models to macroeconomic shocks. This modeling choice is also consistent with the argument of Blanchard (2025), who emphasizes that relatively simple models that incorporate realistic frictions can provide valuable insights for policy analysis, particularly in emerging market contexts, where data limitations often preclude the use of more complex structures.

The thesis is organized as follows. Chapter 2 presents the theoretical framework, developing a general equilibrium model that incorporates both a financial accelerator and limited asset market participation (LAMP). Details the behavior of households, firms, and financial intermediaries, as well as the role of the central bank and market, clearing conditions. Chapter 3 outlines the log-linearized equilibrium conditions and describes the calibration strategy used to match key characteristics of the Mexican economy. Chapter 4 conducts the quantitative analysis, evaluating the role of the external finance premium and LAMP in the transmission of four structural shocks: a monetary policy shock, an entrepreneur riskiness shock, a net worth shock, and a productivity shock. This chapter also includes sensitivity analyzes regarding (i) the elasticity of the external finance premium with respect to leverage, and (ii) the central bank response to financial conditions, captured by the parameter γ_χ in the Taylor rule. Finally, Chapter 5 summarizes the main conclusions and policy implications, and Chapter 6 provides technical appendices, including the full set of model equations and derivations.

2 The Model

In this section, we outline the structure of our cashless economy model and present the optimization problems faced by constrained and unconstrained households, intermediate goods producers, capital goods producers, the final goods producer, banks, and entrepreneurs.

2.1 Households

This model follows the Two-Agent New Keynesian (TANK) framework developed by Bilbiie (2008) to capture household heterogeneity. There is a continuum of infinitely lived households indexed by the unit interval $[0, 1]$. All households share the same preferences and maximize expected discounted utility over consumption (C_t) and labor supply (N_t), but differ in their access to financial markets.

We assume the existence of complete asset markets; that is, a full set of state-contingent claims allows for perfect insurance against all types of risk. In this economy, a fraction λ of households consists of agents who do not have access to financial markets, referred to as "constrained households"[4]. These households cannot smooth consumption intertemporally and instead consume their entire labor income each period. The remaining fraction $(1 - \lambda)$ represents'unconstrained households," who do have access to financial markets and, therefore, are able to smooth consumption over time through savings and borrowing.

2.1.1 Constrained households

There is a representative agent denoted by a subscript H. As was mentioned before, this agent type does not have access to the financial markets; therefore, this agent consumes all their income in every period and their budget constraint is given by:

$$C_{H,t} = \frac{W_t}{P_t} N_{H,t} \tag{1}$$

where $C_{H,t}$ is consumption in period t, $\frac{W_t}{P_t}$ is the real wage rate, P_t is the aggregate price level, and $N_{H,t}$ is the hours worked in period t of the representative "constrained household".

The constrained households solve the following optimization problem:

$$\max_{C_{H,t}, N_{H,t}} U(C_{H,t}, N_{H,t})$$

[4]Sometimes called Hand-to-Mouth (HtM) households in the literature.

$$\text{s.t.} \quad C_{H,t} = \frac{W_t}{P_t} N_{H,t}.$$

For household preferences, we assume a constant relative risk aversion (CRRA) utility function.[5]. Therefore, the problem to solve is now:

$$\max_{C_{H,t}, N_{H,t}} U(C_{H,t}, N_{H,t}) = \frac{C_{H,t}^{1-\sigma} - 1}{1-\sigma} - \omega \frac{N_{H,t}^{1+\varphi}}{1+\varphi}$$

$$\text{s.t.} \quad C_{H,t} = \frac{W_t}{P_t} N_{H,t}$$

where $\omega > 0$ represents how leisure is valued relative to the consumption, $\sigma > 0$ is the inverse of the intertemporal elasticity of substitution in consumption and $\varphi > 0$ is the inverse of the labor supply elasticity.

Substituting $C_{H,t}$ from the budget constraint into the utility function yields:

$$\max_{N_{H,t}} U(C_{H,t}, N_{H,t}) = \frac{\left(\frac{W_t}{P_t} N_{H,t}\right)^{1-\sigma} - 1}{1-\sigma} - \omega \frac{N_{H,t}^{1+\varphi}}{1+\varphi}.$$

The first-order conditions yield the optimal labor supply of constrained households:

$$N_{H,t} = \left(\frac{W_t}{P_t}\right)^{\frac{1-\sigma}{\varphi+\sigma}} \left(\frac{1}{\omega}\right)^{\frac{1}{\varphi+\sigma}}. \tag{2}$$

Substituting equation (2) into the budget constraint yields the optimal consumption of constrained households:

$$C_{H,t} = \left(\frac{1}{\omega}\right)^{\frac{1}{\varphi+\sigma}} \left(\frac{W_t}{P_t}\right)^{\frac{1+\varphi}{\varphi+\sigma}}. \tag{3}$$

[5]Notice that the disutility of labor increases convexly, indicating that working more hours leads to a more-than-proportional loss of utility.

2.1.2 Unconstrained households

Similarly to the constrained household, there is a representative agent denoted by a subscript S. This household has access to financial markets and, therefore, is able to smooth consumption over time.

This representative agent solves the following intertemporal optimization problem:

$$\max_{C_{S,t},N_{S,t}} \sum_{j=0}^{\infty} \beta^j \mathbb{E}_t \left[U(C_{S,t}, N_{S,t}) \right]$$

s.t.

$$B_{S,t} + V_t(\Omega_{S,t+1} - \Omega_{S.t}) + P_t C_{S,t} \leqslant Z_{S,t} + W_t N_{S,t} + \Omega_{S,t} P_t D_t + T_{E,t} \tag{4}$$

where $\beta \in [0,1]$ denotes the discount factor, P_t denotes the price of a consumption good, $B_{S,t}$ represents the nominal value of a portfolio of all state-contingent assets held at the end of period t, excluding shares in firms. $T_{E,t}$ denotes the wealth received from existing entrepreneurs (net of transfers to surviving and entering entrepreneurs) during the period t. $Z_{S,t}$ represents the beginning-of-period wealth net, including the payoff of shares. V_t is the average market value of shares in intermediate good firms at time t, D_t denotes the real dividend payoffs from these shares, and $\Omega_{S,t}$ represents share holdings. The left-hand side is the total spending of the representative unconstrained household and the right-hand side represents the beginning of period wealth.

Therefore, the first-order conditions of the unconstrained household optimization problem, subject to the intertemporal budget constraint in equation (4), are given by the following expressions with respect to consumption and labor:

$$\beta \left(\frac{C_{S,t}}{C_{S,t+1}} \right)^{\sigma} = \Lambda_{t,t+1} \frac{P_{t+1}}{P_t} \tag{5}$$

$$\omega N_{S,t}^{\varphi} = \frac{1}{C_{S,t}^{\sigma}} \frac{W_t}{P_t}. \tag{6}$$

The expected gross return $\mathbb{E}_t[\Lambda_{t,t+1}^{-1}]$ corresponds to the risk-free rate of interest R_t. Consequently, it follows from equation (5) that the short-term nominal interest rate is:

$$\frac{1}{R_t} = \beta \mathbb{E}_t \left[\frac{C_{S,t+1}^{-\sigma}}{C_{S,t}^{-\sigma}} \frac{P_t}{P_{t+1}} \right]. \tag{7}$$

Additionally, the transversality conditions for the financial state variables for optimal behavior are:

$$\lim_{j\to\infty} \mathbb{E}_t \left[\Lambda_{t,t+j} V_{t+j}\right] = 0 \tag{8}$$

$$\lim_{j\to\infty} \mathbb{E}_t \left[\Lambda_{t,t+j} Z_{t+j}\right] = 0. \tag{9}$$

2.2 Firms

This section is mainly based on the framework developed in the seminal paper of Bernanke *et al.*, (1999). In this framework, there are three types of firms in the economy: intermediate goods firms that produce differentiated goods, which they sell to the competitive final good producer. The final good producer aggregates these differentiated goods into a homogeneous final good. This final good can then be used for consumption or as an input for the production of capital goods.

2.2.1 Capital Good Producers

A representative capital good producer combines final goods i_t and undepreciated capital K_{t-1} to produce newly installed capital. We assume that the transformation of investments into new capital goods exhibits decreasing margin returns. Specifically, the gross capital production is given by $\Phi\left(\frac{i_t}{K_{t-1}}\right) K_{t-1}$, where $\Phi(\cdot)$ is an increasing and concave function satisfying $\Phi(0) = 0$. This formulation implies that the efficiency of investment depends on its scale relative to the existing capital stock. Following the mechanism outlined in Kiyotaki and Moore (1997), this structure allows asset price fluctuations to amplify movements in entrepreneurs' net worth. Consequently, the law of motion for capital is given by:

$$K_t = (1-\delta)K_{t-1} + \Phi\left(\frac{i_t}{K_{t-1}}\right) K_{t-1} \tag{10}$$

where $\delta \in (0, 1)$ is the depreciation rate. Capital good producers take as given the price of installed capital, Q_t. Their objective is to maximize the present discounted value of profits by choosing i_t. Therefore, the first-order condition with respect to i_t yields:

$$Q_t = \left[\Phi'\left(\frac{i_t}{K_{t-1}}\right)\right]^{-1} \tag{11}$$

which equates the marginal value of installed capital to the marginal cost of investment.

The newly produced capital is sold in a perfectly competitive market to the entrepreneurs, where it becomes available for use in the production process during the next period.

2.2.2 Final Good Producers

The final good producers buys differentiated products from intermediate goods producers $Y_t(j)$ [6] and aggregates them into a single final good, which is sold in a perfectly competitive market. The final good is produced using the usual aggregator of intermediate goods:

$$Y_t = \left[\int_0^1 Y_t(j)^{\frac{\varepsilon-1}{\varepsilon}} dj \right]^{\frac{\varepsilon}{\varepsilon-1}} \tag{12}$$

where $\varepsilon > 1$ is the constant elasticity substitution between individual goods. Furthermore, we denote the overall price index of the final good as P_t. The final good producer's optimization problem to solve is given by:

$$\max_{Y_t(j)} \quad P_t Y_t - \int_0^1 P_t(j) Y_t(j) dj.$$

The first-order condition yields the optimal demand function for each intermediate good j:

$$Y_t(j) = Y_t \left(\frac{P_t(j)}{P_t} \right)^{-\varepsilon}. \tag{13}$$

To obtain the consumer price index (CPI) P_t, we can define nominal production as follows:

$$P_t = \left(\int_0^1 P_t(j)^{1-\varepsilon} dj \right)^{\frac{1}{1-\varepsilon}}. \tag{14}$$

2.2.3 Intermediate Goods Producers

There is a continuum of intermediate goods producers indexed by $j \in [0, 1]$, each operating in a monopolistically competitive environment. These firms rent capital from entrepreneurs and hire labor from households, and utilize the following production technology:

[6] There is a continuum of intermediate good producers indexed by j.

$$Y_t(j) = A_t K_t(j)^{\alpha} N_t(j)^{1-\alpha} \tag{15}$$

where $Y_t(j)$ represents the output of the intermediate good producer, A_t is the total factor productivity [7], $K_t(j)$ is the amount of capital rented, $N_t(j)$ is the total labor hired, and $0 < \alpha < 1$ is the capital input share of production.

Letting, MC_t denotes the nominal marginal cost, which is identical across intermediate goods producers, it follows that:

$$MC_t = \frac{1}{\alpha}\left(\frac{Y_t}{L_t}\right) Q_t \tag{16}$$

The optimal conditions for labor and capital demand are given by:

$$W_t = (1-\alpha)\left(\frac{Y_t}{L_t}\right) MC_t \tag{17}$$

$$R_{k,t} = \alpha\left(\frac{Y_t}{K_t}\right) MC_t. \tag{18}$$

According to Calvo (1983), each firm can reset its price with probability $(1-\theta)$ in any given period to maximize its expected profits, subject to the demand of the final producer (13). Notice that since $\theta \in [0,1]$, meaning that a fraction θ of firms do not reset their prices. In light of the above, θ can be understood as a natural index of price stickiness.

If a firm is able to set its price at time t and is then unable to reset it until a later date i, its profits at time $t+i$ are affected by the price it set at t (the probability of this is θ^i). Hence, firm j must choose $P_t^*(j)$ to maximize its expected profits:

$$\max_{P_t^*(j)} \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \theta^i \Lambda_{t,t+i} \left[P_t^*(j) Y_{t+i}(j) - MC_{t+i} Y_{t+i} \right] \right\} \tag{19}$$

$$\text{s.t.} \quad Y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\varepsilon}$$

where $\Lambda_{t,t+i}$ is the discount factor, which is defined as follows:

$$\Lambda_{t,t+i} = \beta^i \left(\frac{U_C(C_{S,t+i}, N_{S,t+i})}{U_C(C_{S,t} N_{S,t})}\right)\left(\frac{P_t}{P_{t+i}}\right).$$

[7] The log of A_t follows an exogenous $AR(1)$ process where the autoregressive coefficient is ρ_A and the standard deviation is σ_A.

The optimal price P_t^* follows from the first-order condition:

$$P_t^* = \frac{\varepsilon}{\varepsilon - 1} \frac{\mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \theta^i \Lambda_{t,t+i} MC_{t+i} P_{t+i}^{\varepsilon} Y_{t+i} \right\}}{\mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \theta^i \Lambda_{t,t+i} P_{t+i}^{\varepsilon} Y_{t+i} \right\}}. \tag{20}$$

As a result of the optimal condition, the optimal price is set by adding a markup to the weighted average of current and future nominal marginal costs. It is worth mentioning that when prices are fully flexible ($\theta = 0$), we obtain: $P_t^* = \frac{\varepsilon}{\varepsilon-1} MC_t$.

Next, recall that the price index is given by:

$$P_t = \left(\int_0^1 P_t(j)^{1-\varepsilon} dj \right)^{\frac{1}{1-\varepsilon}}$$

$$\Rightarrow \quad P_t^{1-\varepsilon} = \int_0^1 P_t(j)^{1-\varepsilon} dj.$$

As we mentioned, the fraction $(1-\theta)$ of firms that are able to re-optimize their price in period t will choose the same price, P_t^*. Therefore, the aggregate price index can be rewritten as follows:

$$P_t^{1-\varepsilon} = \theta P_{t-1}^{1-\varepsilon} + (1-\theta)(P_t^*)^{1-\varepsilon}. \tag{21}$$

Dividing by $P_{t-1}^{1-\epsilon}$, we obtain the following equation for the dynamics of inflation:

$$\Pi_t^{1-\varepsilon} = \theta + (1-\theta) \left(\frac{P_t^*}{P_{t-1}} \right)^{1-\varepsilon}. \tag{22}$$

Note that Π_t is the gross inflation rate in period t.

2.3 Financial frictions

The financial frictions considered are LAMP and the External Finance Premium (EFP). The former has already been introduced in the household section; hence, in this section, we focus on the latter. The EFP originates from an asymmetric information problem, whereby the productivity of investment projects is not observable ex ante and only becomes known once realized. Following the seminal papers by Townsend (1979) and Bernanke *et al.*, (1999) and the related literature, we consider an optimal contract framework. This highlights a natural asymmetry between entrepreneurs and their creditors, as described by Christiano (2022).

2.3.1 Entrepreneurs

There is a continuum of entrepreneurs indexed by l and all of whom are risk-neutral. Each entrepreneur purchases installed capital $K_t(l)$ from capital producers at the end of period t. These purchases are financed using their financial wealth $VE_t(l)$ with the remainder covered by a bank loan $L_t(l)$:

$$L_t(l) = Q_t K_t(l) - VE_t(l) \geqslant 0. \tag{23}$$

The entrepreneur chooses the value of firm capital $Q_t K_t(l)$ and the corresponding level of bank loans $L_t(l)$ before the realization of the idiosyncratic productivity shock a_E. This shock transforms the capital of the entrepreneur into $a_E(l)K_{t+1}$, where a_E is a random variable that is i.i.d. over time and across entrepreneurs, with a continuous cumulative density function F_t and $\mathbb{E}[a_E] = 1$. Additionally, we assume that the distribution of a_E is log-normal. Denote the period t standard deviation of log a_E by $\bar{\sigma}_{a,t}$.[8]

Each entrepreneur rents out capital services at the given rental rate $R_{k,t+1}$. Since $\mathbb{E}[a_E] = 1$, the average rate of return on capital earned by entrepreneurs is:

$$R_{E,t+1} \equiv \frac{R_{k,t+1} + (1-\delta)Q_{t+1}}{Q_t} \tag{24}$$

The rate of return earned by an individual entrepreneur is $a_E(l)R_{E,t+1}$. Due to idiosyncratic productivity shocks being observable to entrepreneurs but not to banks, lending involves agency costs. Consequently, the optimal contract between the two parties is characterized by the gross non-default interest rate $R_{L,t+1}(l)$ and the loan size $L_t(l)$. Notably, there exists a threshold value for the idiosyncratic productivity shock, denoted as $\tilde{a}_{E,t+1}(l)$, such that the entrepreneur can repay the loan if the idiosyncratic productivity shock is greater than or equal to $\tilde{a}_{E,t+1}(l)$:

$$\tilde{a}_{E,t+1}(l) R_{E,t+1} Q_t K_t(l) = R_{L,t+1} L_t(l). \tag{25}$$

According to the optimal contract, when $a_{E,t+1} \geqslant \tilde{a}_{E_{t+1}}$, the entrepreneur repays the loan by the amount $R_{L,t+1}L_t(l)$ and retains the difference represented by $a_{E_{t+1}}(l)R_{E,t+1}Q_tK_t(l) - R_{L,t+1}L_t(l)$. Conversely, $a_{E,t+1} < \tilde{a}_{E_{t+1}}$, the entrepreneur is unable to repay the loan and thus declares default, leading to bankruptcy. In this case, the bank incurs a monitoring cost μ and seizes all the resources it can recover, represented by $(1-\mu)a_{E_{t+1}}(l)R_{E,t+1}Q_tK_t(l)$.

[8]The log of $\bar{\sigma}_{a,t}$ follows an AR(1) process, with autoregressive coefficient ρ_{σ_a}, and standard deviation of innovations σ_a.

Table I outlines the sequence of events in the life of entrepreneur.

2.3.2 Banks

The banking sector is assumed to be perfectly competitive. Banks obtain their funds from deposits made by unconstrained households and face an opportunity cost of funds equal to the risk-free interest rate R_t. Due to risk aversion of households and the risk neutrality of entrepreneurs, an optimal financial contract ensures that entrepreneurs absorb all aggregate risk, given the infinite number of entrepreneurs [9]. Consequently, the interest paid by entrepreneurs $R_{L,t+1}$ is state-contingent, ensuring that the banking sector satisfies a zero-profit condition in each period:

$$[1-F_{t+1}(\tilde{a}_{E,t+1})]R_{L,t+1}L_t \quad + \quad (1-\mu)\int_0^{\tilde{a}_{E,t+1}} a_{E,t+1}dF(a_{E,t+1})(R_{E,t+1}Q_tK_t) = R_tL_t. \quad (26)$$

The left-hand side of the equation (26) represents the gross return on the loan to the entrepreneur and the right-hand side is the opportunity cost of lending of the bank. Note that $F_{t+1}(\tilde{a}_{E,t+1})$ gives the probability of default.

Equation (26) can be rewritten using equation (25) as follows:

$$[1-F_{t+1}(\tilde{a}_{E,t+1})]\tilde{a}_{E,t+1}R_{E,t+1}Q_tK_t \quad + \quad (1-\mu)\int_0^{\tilde{a}_{E,t+1}} a_{E,t+1}dF(a_{E,t+1})(R_{E,t+1}Q_tK_t) = R_tL_t$$

$$\Rightarrow \quad [\Gamma_t(\tilde{a}_{E,t+1}) - \mu G_t(\tilde{a}_{E,t+1})]\, R_{E,t+1}\varrho_t = (\varrho_t - 1)R_t \quad (27)$$

where:

$$\Gamma_t(\tilde{a}_{E,t+1}) \equiv \tilde{a}_{E,t+1}[1 - F_{t+1}(\tilde{a}_{E,t+1}) + G_t(\tilde{a}_{E,t+1})] \quad (28)$$

$$G_t(\tilde{a}_{E,t+1}) \equiv \int_0^{\tilde{a}_{E,t+1}} a_E \quad dF(a_E) \quad (29)$$

$$\varrho_t \equiv \frac{Q_tK_t}{VE_t}. \quad (30)$$

Equation (27) expresses the expected return of the bank solely as a function of the cutoff

[9]The risk arising from idiosyncratic productivity shock is fully diversifiable.

value for the idiosyncratic productivity shock of the entrepreneur $a_{E,t+1}$. An increase in $a_{E,t+1}$ raises the non-default payoff while also increasing the probability of default. Consequently, the expected payoff decreases. As shown by Bernanke *et al.*, (1999), the expected return reaches its maximum at a unique interior value, $\tilde{a}^M_{E,t+1}$. When $\tilde{a}_{E,t+1}$ exceeds this threshold, the expected return decreases due to a higher likelihood of default. Conversely, for values of $\tilde{a}_{E,t+1}$ below the maximum, the function exhibits an increasing and concave behavior.

2.3.3 Evolution of net worth of entrepreneurs

Overall, the net worth at end the period is equal to the revenues from selling capital less interest paid to the banks. To refine the concept of interest paid, it is necessary to consider both non-bankrupt and bankrupt entrepreneurs. The former pay $R_{t-1}L_{t-1}(l)$, while the latter pay $\mu a_t R_{E,t} Q_{t-1} K_{t-1}(l)$[10]. Therefore, the net worth can be expressed as:

$$VE_t(l) = R_{E,t}Q_{t-1}K_{t-1}(l) - \left(R_{t-1} + \frac{\mu G_t R_{E,t} Q_{t-1} K_{t-1}(l)}{L_{t-1}(l)} \right) L_{t-1}(l).$$

We assume that in each period, a randomly selected and variable fraction $(1-\varepsilon_{s,t})$[11] of entrepreneurs exit the market. When this occurs, their entire financial wealth is redistributed to unconstrained households, reflecting the continuous entry and exit of firms and preventing entrepreneurs from accumulating enough wealth to become entirely self-financing. Simultaneously, an equal number of new entrepreneurs enter the market, ensuring that the total number of entrepreneurs remains constant. Both surviving and newly entered entrepreneurs receive a fixed transfer $T_{E,t}$ from unconstrained households, guaranteeing that entrants have a small but positive amount of wealth necessary to acquire capital.

By summing across all entrepreneurs and considering the zero-profit condition for banks (27) we derive the following equation describing the law of motion for net worth in the economy:

$$VE_t = \varepsilon_{s,t} \left[R_{E,t}Q_{t-1}K_{t-1} - \left(R_{t-1} + \frac{\mu G_t R_{E,t} Q_{t-1} K_{t-1}}{L_{t-1}} \right) L_{t-1} \right] + T_{E,t} \tag{31}$$

Where the first term in the square brackets represents the total revenue from selling capital at time t, reflecting the gross return on the capital invested by entrepreneurs and the second term captures the total interest payments made by entrepreneurs to banks. This includes

[10] As we mentioned earlier, if an entrepreneur satisfies $a_{E,t+1} < \tilde{a}_{E_t+1}$, this means that the entrepreneur is unable to repay the loan, and the bank recovers $(1-\mu)a_{E_t+1}(l)R_{E,t+1}Q_tK_t(l)$. Consequently, the entrepreneur loses or pays $\mu a_{E_t+1}(l)R_{E,t+1}Q_tK_t(l)$.

[11] The log of $\varepsilon_{s,t}$ follows an AR(1) process, with autoregressive coefficient ρ_s and standard deviation of innovations σ_s.

both the standard interest payments ($R_{t-1}L_{t-1}$) and the additional costs associated with monitoring frictions (μG_t). These payments are averaged across both bankrupt and non-bankrupt entrepreneurs.

2.3.4 Optimal contract

Following Brzoza-Brzezina *et al.*, (2010), the equilibrium debt contract is designed to maximize the welfare of each individual entrepreneur. It is characterized by the expected net worth at the end of the contract, relative to the risk-free alternative of holding a domestic bond:

$$\mathbb{E}_t \left\{ \frac{\int_{\tilde{a}_{E,t}}^{\infty} [R_{E,t+1} Q_t K_t(l) a_E(l) - R_{L,t+1} L_t(l)] \quad dF(a_E(l))}{R_t VE_t(l)} \right\} \tag{32}$$

where the expectations are evaluated over the distribution of the random variable $R_{E,t+1}$. The above equation can be reformulated using equation (25) as follows:

$$\mathbb{E}_t \left\{ \frac{\int_{\tilde{a}_{E,t}}^{\infty} [R_{E,t+1} Q_t K_t(l) a_E(l) - \tilde{a}_{E,t+1}(l) R_{E,t+1} Q_t K_t(l)] \quad dF(a_E(l))}{R_t VE_t(l)} \right\}$$

recalling (28), (29), and (30), we obtain:

$$\mathbb{E}_t \left\{ \frac{R_{E,t+1}}{VE_t(l)} \varrho_t \left(1 - \Gamma_t(\tilde{a}_{E,t+1}(l))\right) \right\}. \tag{33}$$

Therefore, the optimization problem involves choosing ϱ_t to maximize (33), subject to the zero-profit condition for banks (27). The problem can be expressed as follows:

$$\max_{\varrho_t} \quad \mathbb{E}_t \left\{ \frac{R_{E,t+1}}{VE_t(l)} \varrho_t \left(1 - \Gamma_t(\tilde{a}_{E,t+1}(l))\right) \right\}$$
$$\text{s.t.} \quad \left[\Gamma_t(\tilde{a}_{E,t+1}) - \mu G_t(\tilde{a}_{E,t+1})\right] R_{E,t+1} \varrho_t = (\varrho_t - 1) R_t$$

and the first-order condition can be written as:

$$\mathbb{E}_t \left\{ \frac{R_{E,t+1}}{R_t} \left[1 - \Gamma_t(\tilde{a}_{E,t+1})\right] + \frac{\Gamma_t'(\tilde{a}_{E,t+1}) \left(\frac{R_{E,t+1}}{R_t} \left[\Gamma_t(\tilde{a}_{E,t+1}) - \mu G_t(\tilde{a}_{E,t+1})\right] - 1 \right)}{\Gamma_t'(\tilde{a}_{E,t+1}) - \mu G_t'(\tilde{a}_{E,t+1})} \right\} = 0 \tag{34}$$

$$\Rightarrow \quad \frac{\mathbb{E}_t(R_{E,t+1})}{R_t} = \Psi(\tilde{a}_{E,t+1}, \sigma_{a,t})$$

where:

$$\Psi(\tilde{a}_{E,t+1}, \sigma_{a,t}) = \frac{\Gamma_t'(\tilde{a}_{E,t+1})}{\left[\Gamma_t'(\tilde{a}_{E,t+1}) - \mu G_t'(\tilde{a}_{E,t+1})\right](1 - \Gamma_t(\tilde{a}_{E,t+1}) + \Gamma_t'(\tilde{a}_{E,t+1})[\Gamma_t(\tilde{a}_{E,t+1}) - \mu G_t(\tilde{a}_{E,t+1})]}.$$

As demonstrated by Bernanke *et al.*, (1999), equation (34) implicitly defines a key relationship as follows:

$$Q_t K_t = \Psi\left(\frac{\mathbb{E}_t(R_{E,t+1})}{R_t}\right) N_t \tag{35}$$

with $\Psi(1) = 1$ and $\Psi'(\cdot) > 0$, where $\chi_t \equiv \frac{\mathbb{E}_t(R_{E,t+1})}{R_t}$ [12] represents the EFP defined as $\chi_t(\tilde{a}_{E,t+1})$ which arises due to monitoring costs. Notice that equation (35) defines the equilibrium condition governing investment decisions. As monitoring costs approach zero, reflecting, greater efficiency in bank collections, the expected rate of return on capital converges to the risk-free rate, rendering financial markets frictionless, such that:

$$\lim_{\mu \to 0} [\Psi(\tilde{a}_{E,t+1}, \sigma_{a,t})] = 1$$

$$\Rightarrow \quad \lim_{\mu \to 0} \quad R_{E,t+1} = R_t.$$

Bernanke *et al.*, (1999) demonstrate that for any $\tilde{a}_{E,t+1}$ that can constitute an equilibrium, $\chi_t'(\tilde{a}_{E,t+1}) > 0$ indicating a positive relationship between $\tilde{a}_{E,t+1}$ and ϱ_t. This implies that the EFP rises with increasing leverage. Therefore, the larger the proportion of capital that the entrepreneur can self-finance (increase of $VE_t(l)$), the lower the expected bankruptcy costs, and consequently, the lower the EFP.

Equation (33) in conjunction with the zero-profit condition for banks, (27), determines the optimal debt contract based on the cutoff value of the idiosyncratic shock $\tilde{a}_{E,t+1}$ and the leverage ratio ϱ_t. It is straightforward to confirm that these two contract parameters are identical across all entrepreneurs.

[12] It can also be understood as an function of the leverage and the monitoring costs: $\chi_t = f(\varrho_t, \mu)$.

Table I: Sequence of Events in the Life of an Entrepreneur

	Event Description
1	At the start of period t, entrepreneurs receive a transfer $T_{E,t}$ from unconstrained households. This ensures that both new entrants and survivors have sufficient wealth to acquire capital.
2	By the end of period t, entrepreneurs purchase installed capital $K_t(l)$ from capital producers, using their financial wealth $VE_t(l)$ and a bank loan $L_t(l)$.
3	In period $t+1$, entrepreneurs observe the idiosyncratic productivity shock $a_{E,t+1}(l)$ and rent capital to intermediate goods producers.
4	Loan repayment outcomes depend on the productivity shock. - If $a_{E,t+1}(l) \geq \tilde{a}_{E,t+1}$, the entrepreneur repays the loan $R_{L,t+1}L_t(l)$ and retains $a_{E,t+1}(l)R_{E,t+1}Q_tK_t(l) - R_{L,t+1}L_t(l)$. - If $a_{E,t+1}(l) < \tilde{a}_{E,t+1}$, the entrepreneur defaults. The bank seizes all resources, incurs a monitoring cost μ, and the entrepreneur goes bankrupt.
5	If the entrepreneur remains solvent and survives, they continue operating into the next period. All entrepreneurs who exit the market transfer their wealth to unconstrained households.

2.4 Central Bank

As in Brzoza-Brzezina *et al.*, (2010), we assume that monetary policy follows a Taylor rule, responding to deviations of inflation and output from their deterministic steady-state values while incorporating interest rate smoothing. Additionally, we include a term associated with the external finance premium, allowing monetary authorities to respond to movements in financial conditions, following Gilchrist and Zakrajšek (2011):

$$\frac{R_t}{\bar{R}} = \left(\frac{R_{t-1}}{\bar{R}}\right)^{\gamma_R} \left[\left(\frac{\pi_t}{\bar{\pi}}\right)^{\gamma_\pi} \left(\frac{Y_t}{\bar{Y}}\right)^{\gamma_y} \left(\frac{\chi_t}{\bar{\chi}}\right)^{\gamma_\chi}\right]^{1-\gamma_R} e^{\vartheta_t} \tag{36}$$

where $0 < \gamma_R < 1$, $\gamma_\pi > 0$, $\gamma_Y > 0$, and $\gamma_\chi < 0$ [13] and a bar over a variable indicates its steady-state value, and ϑ_t represents i.i.d. random innovations [14].

[13] A negative value for γ_χ implies a countercyclical response of monetary policy to financial stress. That is, when the external finance premium increases (indicating tighter financial conditions), the central bank lowers the nominal interest rate to stabilize the economy. This assumption is consistent with the findings of Gilchrist and Zakrajšek (2012) and reflects the view that monetary policy should ease in response to deteriorating financial conditions.

[14] The standard deviation is σ_R.

2.5 Market Clearing Conditions and Aggregation

2.5.1 Goods Markets

Final output may be either consumed, invested, or used to cover monitoring costs. Since monitoring costs are real, the aggregate resource constraint is:

$$C_t + i_t + \mu G_t R_{E,t} Q_{t-1} K_{t-1} = Y_t. \tag{37}$$

Since the economy consists of two types of households, aggregate consumption is defined as:

$$\begin{aligned} C_t &= \int_0^\lambda C_{H,t}(i)d(i) + \int_\lambda^1 C_{S,t}(i)d(i) \\ \Rightarrow \quad C_t &= \lambda C_{H,t} + (1-\lambda)C_{S,t}. \end{aligned} \tag{38}$$

2.5.2 Factor Markets

The market-clearing condition for capital states that the total capital available at the beginning of period t, which is the capital stock from the previous period K_{t-1}, must be fully allocated across all intermediate goods firms. This ensures that there is neither excess supply nor excess demand for capital in equilibrium:

$$K_{t-1} = \int_0^1 K_t(j)dj. \tag{39}$$

Likewise, for household labor supply, the aggregate market-clearing condition is:

$$\begin{aligned} N_t &= \int_0^\lambda N_{H,t}(i)d(i) + \int_\lambda^1 N_{S,t}(i)d(i) \\ \Rightarrow \quad N_t &= \lambda N_{H,t} + (1-\lambda)N_{S,t}. \end{aligned} \tag{40}$$

2.5.3 Financial Markets

Since the banking sector is perfectly competitive and obtains funds through deposits from unconstrained households, banks must balance the loans extended to entrepreneurs with the deposits received. The credit market clearing condition ensures that the total value of loans extended by banks equals the total value of deposits collected from households:

$$B_{S,t} = L_t. \tag{41}$$

Clearing of the equity market means that the ownership of shares is distributed equally among the asset holders. In other words:

$$\Omega_{S,t+1} = \Omega_{S,t} = \Omega = \frac{1}{1-\lambda}. \tag{42}$$

2.5.4 Price Dispersion

Taking the individual production function of:

$$Y_t(j) = A_t K_t(j)^{\alpha} N_t(j)^{1-\alpha}.$$

Aggregating:

$$\int_0^1 \left(\frac{P_t(j)}{P_t}\right)^{-\varepsilon} dj = \frac{A_t K_{t-1}^{\alpha} N_t^{1-\alpha}}{Y_t} \equiv \Delta_t \tag{43}$$

where $\Delta_t \geqslant 1$ measures the price dispersion of intermediate goods. In the absence of pricing frictions, all firms would set the same price, which would lead to $\Delta_t = 1$. Consequently, output would be given by $Y_t = A_t K_{t-1}^{\alpha} N_t^{1-\alpha}$. Since, the fraction $(1-\theta)$ of firms able to re-optimize their price in period t will choose the same price, P_t^*. It follows that the dynamics for price dispersion can be expressed as:

$$\Delta_t = \theta \pi^{\varepsilon} \Delta_{t-1} + (1-\theta)\left(\frac{P_t^*}{P_t}\right)^{-\varepsilon}. \tag{44}$$

2.6 Definition of Equilibrium

A rational expectations equilibrium consists of 25 endogenous variables and four exogenous shocks:

- Sequence of prices $\{W_t, MC_t, P_t, P_t^*, \Delta_t, Q_t\}$
- Sequence of allocations $\{C_{H,t}, C_{S,t}, C_t, Z_t, Y_t, N_{H,t}, N_{S,t}, N_t, B_{S,t}, \Omega_{S,t+1}, T_{E,t}, K_t, i_t, VE_t, R_{k,t}, \varrho_t\}$
- Prices related to financial frictions $\{R_{E,t}, \chi_t\}$
- Monetary policy $\{R_t\}$
- Shocks considered $\{\bar{\sigma}_{a,t}, \varepsilon_{s,t}, \vartheta_t, A_t\}$

All variables satisfy 25 equilibrium conditions, two transversality conditions, and four laws of motion for the shocks. These include the optimality conditions of the unconstrained household, along with the labor supply and budget constraints of the constrained household: (1), (2), (5), and (6); the transversality conditions: (8) and (9); the capital adjustment equation (11) and the law of motion for capital (10); the optimality conditions for intermediate goods producers: (17), (18); the price-setting conditions: (20), (21); the aggregate production function (43); the zero-profit condition for banks (27); the first-order condition of the optimal contract (34); the financial accelerator (35); the leverage condition (30) and the average rate of return on capital (24); the law of motion for price dispersion (44); the monetary policy rule (36); the market clearing conditions: (37), (38), (39), (40), (41), and (42); the law of motion for the net worth of entrepreneurs (31); and the laws of motion for the exogenous shocks: productivity of intermediate goods producers (47), monetary policy (48), the entrepreneur exit shock (46), and the idiosyncratic productivity of entrepreneurs (45).[15]

[15]See the Appendix, section 6.2, for the complete nonlinear equilibrium conditions.

3 Log-Linearized Model and Calibration

This chapter begins with defining the steady state, followed by a discussion of the log-linearized model obtained by taking a linear approximation around the unique, zero-inflation, deterministic steady state. We also discuss the calibration of the model parameters. From this point onward, all variables with a subscript SS denote steady-state values. Given this, we normalize $A^{SS} = 1$, and from (44), $\Delta^{SS} = 1$, ensuring no price dispersion and a steady state with zero inflation. Hence:

$$\pi_t^{SS} = \frac{P_t^{SS}}{P_{t-1}^{SS}} = 1$$
$$\Rightarrow \quad P_t^{SS} = P_{t-1}^{SS}$$

dividing (21) aggregate price dynamics expression by $(P_{t-1}^{SS})^{1-\varepsilon}$, we obtain:

$$1 = \theta + (1-\theta)\left(\frac{(P_t^*)^{SS}}{P_{t-1}^{SS}}\right)^{1-\varepsilon}$$
$$\Rightarrow \quad P_{t-1}^{SS} = (P_t^*)^{SS}.$$

From (7) the steady state zero inflation, deterministic steady state is characterized by $R^{SS} = \beta^{-1}$. Now, considering (20) the aggregate price-setting condition under fully flexible prices ($\theta = 0$) gives:

$$(P_t^*)^{SS} = P_t^{SS} = P_{t-1}^{SS} = P^{SS} = \frac{\varepsilon}{\varepsilon - 1} MC^{SS}.$$

Moreover, in the steady state $Q^{SS} = 1$. Likewise for the technology to produce new capital, the value of $i^{SS} = \delta K^{SS}$. Regarding the entrepreneurial sector, from equation (24):

$$R_E^{SS} = \frac{R_k^{SS} + (1-\delta)Q^{SS}}{Q^{SS}}$$
$$\Rightarrow \quad R_k^{SS} = Q^{SS} R_E^{SS} - (1-\delta)Q^{SS}.$$

From equation (34), we observe that frictions induce a spread between R^{SS} and R_E^{SS}. In a frictionless model, these returns would be identical. Therefore, we obtain:

$$R_E^{SS} = \Psi(\tilde{a}_E, \sigma_a) \cdot R^{SS}.$$

Given the ratio $\frac{R_E^{SS}}{R^{SS}}$ (that is, given the external finance premium in the steady state $\Psi(\tilde{a}_E, \sigma_a)$) from (34), we can derive:

$$\mu(\tilde{a}_E) = \frac{1 - \left(\frac{R_E^{SS}}{R^{SS}}\right)^{-1}}{\left[\frac{G'(\tilde{a}_E)}{\Gamma'(\tilde{a}_E)}\right] [1 - \Gamma(\tilde{a}_E)] + G(\tilde{a}_E)}.$$

Next, considering the zero-profit condition for banks (27) , we obtain:

$$\frac{VE^{SS}}{Q^{SS}K^{SS}}(\tilde{a}_E) = 1 - [\Gamma(\tilde{a}_E) - \mu G(\tilde{a}_E)] \frac{R_E^{SS}}{R^{SS}}.$$

We assume that the idiosyncratic productivity shock, $\tilde{a}_E$, follows a log-normal distribution with variance $\sigma_a^{SS} = 0.35$. Following the existing literature, we adopt the steady-state distribution of $\tilde{a}_E$ as specified in Appendix 6.1. Given the variance $\sigma_a^{SS} = 0.35$, we calibrate the distribution to match an annualized business failure rate of 3%, $F(\tilde{a}_E)$. We also calibrate the steady-state risk premium $(R_E - R)$ of 200 basis points, in line with Bernanke *et al.*, (1999), expressed in quarterly terms.

$$\frac{R_E^{SS}}{R^{SS}} = \Psi(\tilde{a}_E, \sigma_a) = 1.00496.$$

Consequently, we obtain the following values for the steady state:

$$\frac{VE^{SS}}{Q^{SS}K^{SS}}(\tilde{a}_E) = 0.51292$$

$$\mu(\tilde{a}_E) = 0.04257.$$

Additionally, Table II summarizes the other steady state values for the financial block.

Table II: Steady-State Values for the Financial Block

Variable	**Description**	**Value**
R_E^{SS}/R^{SS}	Steady-state risk spread	1.00496
$\tilde{a}$	Idiosyncratic threshold	0.48698
$\Gamma(\tilde{a})$	Fraction of gross entrepreneurial earnings going to lender	0.48522
$\Gamma'(\tilde{a})$	Derivative of $\Gamma(\tilde{a})$	0.97000
$G(\tilde{a})$	Average value of a among bankrupt entrepreneurs	0.01285
$G'(\tilde{a})$	Derivative of $G(\tilde{a})$	0.19441
μ	Monitoring cost	0.04257
$\frac{VE^{SS}}{Q^{SS}K^{SS}}$	Net worth to capital ratio	0.51292

According to Table II, we obtain a net worth-to-capital ratio of 0.51, which implies a steady-state leverage ratio of $\varrho^{SS} = 1.95$. We also find a monitoring cost of $\mu = 0.042$. Although the former is close to the value used by Bernanke *et al.*, (1999) ($\varrho^{SS} = 2$), the latter is notably lower, as their model assumes $\mu = 0.12$. This lower monitoring cost results from targeting an annualized business failure rate of 3% and assuming a steady-state risk premium of 200 basis points.

Notice that on average, entrepreneurs are better off leveraging their net worth and investing in projects rather than depositing their net worth in a bank, because the ratio of average entrepreneurial earnings to the opportunity cost is greater than one:

$$[1 - \Gamma(\tilde{a})] \frac{R_E^{SS}}{R^{SS}} \varrho^{SS} = 1.008604 > 1.$$

3.1 Log-Linearization Equilibrium Conditions

The complete log-linearized model is presented in Table III. Most of the equations are consistent with the standard literature. However, we consider it worthwhile to show the derivation of the law of motion for entrepreneurs' net worth and the financial accelerator equation, as they result from the combination of the optimal contract condition (34) and the zero-profit condition for banks (27). This derivation is particularly relevant given the presence of a key parameter in the financial accelerator equation: the elasticity of the external finance premium with respect to leverage (ψ_ϱ). Appendix 6.3 provides a derivation adapted from Del Negro *et al.*, (2013).

In addition to the equations given in Table III, log-linearized model, the following exogenous shocks are included: an idiosyncratic entrepreneur shock, an entrepreneur exit shock, a technology (productivity) shock, and a monetary policy shock:

$$\hat{\bar{\sigma}}_{a,t} = \rho_{\bar{\sigma}_a} \hat{\bar{\sigma}}_{a,t-1} + \eta_{\bar{\sigma}_{a,t}}$$

$$\hat{\varepsilon}_{s,t} = \rho_s \hat{\varepsilon}_{s,t-1} + \eta_{s,t}$$

$$\hat{a}_t = \rho_A \hat{a}_{t-1} + \eta_{A,t}$$

$$\vartheta_t = \eta_{R,t}$$

where $\rho_{\sigma_a}, \rho_s, \rho_A \in (0, 1)$ are the shock persistence parameters.

Table III: Log-Linearized Model

Description	Equation
Households	
Consumption, H	$(\varphi+\sigma)\hat{c}_{H,t}=(1+\varphi)\hat{w}_t$
Labor supply, H	$(\varphi+\sigma)\hat{n}_{H,t}=(1-\sigma)\hat{w}_t$
Euler equation, S	$\mathbb{E}_t[\hat{c}_{S,t+1}]-\hat{c}_{S,t}=\frac{1}{\sigma}(\hat{r}_t-\mathbb{E}_t[\hat{\pi}_{t+1}])$
Labor supply, S	$\varphi\hat{n}_{S,t}=\hat{w}_t-\sigma\hat{c}_{S,t}$
Firms	
Capital adjustment equation	$\hat{q}_t=\kappa\left[\hat{i}_t-\hat{k}_{t-1}\right]$
Law of motion for capital	$\hat{k}_t=(1-\delta)\hat{k}_{t-1}+\delta\hat{i}_t$
Optimal labor demand condition	$\hat{w}_t=\hat{y}_t-\hat{n}_t+\hat{mc}_t$
Optimal capital demand condition	$\hat{r}_{k,t}=\hat{y}_t-\hat{k}_t+\hat{mc}_t$
Production function	$\hat{y}_t=\hat{a}_t+\alpha\hat{k}_{t-1}+(1-\alpha)\hat{n}_t$
Entrepreneurial sector	
Financial accelerator equation	$\hat{\chi}_t=\psi_\varrho[\hat{ve}_t-(\hat{q}_t+\hat{k}_t)]+\psi_{\sigma_a}\hat{\bar{\sigma}}_{a,t}$
Capital return equation	$\hat{r}_{E,t}=\frac{R^{SS}}{R_E^{SS}Q^{SS}}(\hat{r}_{k,t})+\frac{(1-\delta)}{R_E^{SS}}\hat{q}_t-\hat{q}_{t-1}$
External finance premium	$\hat{\chi}_t=\mathbb{E}_t(\hat{r}_{E,t+1})-\hat{r}_t$
Leverage	$\hat{l}_t=\hat{q}_t+\hat{k}_t-\hat{ve}_t$
Law of motion for net worth	$\hat{ve}_t=\eta_{ve,\varepsilon}\hat{\varepsilon}_{s,t}+\psi_{r_E}\hat{r}_{E,t}-\psi_r\hat{r}_{t-1}+\psi_{ve}\hat{ve}_{t-1}$ $+\psi_{qk}(\hat{q}_{t-1}+\hat{k}_{t-1})-\psi_{\sigma_a}\hat{\bar{\sigma}}_{a,t-1}$
Monetary policy	
Taylor Rule	$\hat{r}_t=\gamma_R\hat{r}_{t-1}+(1-\gamma_R)\left[\gamma_\pi\hat{\pi}_t+\gamma_y\hat{y}_t+\gamma_\chi\hat{\chi}_t\right]+\vartheta_t$
New Keynesian Phillips Curve	$\hat{\pi}_t=\left(\frac{(1-\theta)(1-\theta\beta)}{\theta}\right)\hat{mc}_t+\beta\mathbb{E}_t(\hat{\pi}_{t+1})$
Aggregate conditions	
Labor market clearing	$\hat{n}_t=\lambda\frac{N_H^{SS}}{N^{SS}}\hat{n}_{H,t}+(1-\lambda)\frac{N_S^{SS}}{N^{SS}}\hat{n}_{S,t}$
Aggregate consumption	$\hat{c}_t=\lambda\frac{C_H^{SS}}{C^{SS}}\hat{c}_{H,t}+(1-\lambda)\frac{C_S^{SS}}{C^{SS}}\hat{c}_{S,t}$
Aggregate resource constraint	$\hat{y}_t=\frac{C^{SS}}{Y^{SS}}\hat{c}_t+\frac{i^{SS}}{Y^{SS}}\hat{i}_t+\frac{\mu G^{SS}R_E^{SS}Q^{SS}K^{SS}}{Y^{SS}}(\hat{r}_{E,t}+\hat{q}_{t-1}+\hat{k}_{t-1})$

3.2 Calibration

The model is calibrated quarterly and the following parameters are chosen to match key characteristics of the Mexican economy. Following De la Peña (2021), we set $\beta = 0.987$ and $\delta = 0.03$. Furthermore, we adopt $\sigma = 2.0$ and $\theta = 0.75$, as in Gali (2015). We set the inverse of the Frisch labor supply elasticity to $\varphi = 3$, consistent with the values used in León Leyva and Urrutia (2018) and Peterman (2016), who calibrate this parameter based on macroeconomic evidence.

Regarding the fraction of the population that lacks access to credit markets (the degree of LAMP), we calibrate this for the Mexican economy to be $\lambda = 0.7$, using data from the *Encuesta Nacional de Inclusión Financiera* (ENIF, 2024). The parameters associated with the Taylor rule (γ_R, γ_π, and γ_y) are set following Brzoza-Brzezina *et al.*, (2010) and Carrillo *et al.*, (2017), who characterize the Mexican economy as exhibiting a strong response to inflation, no response to real GDP growth, and a high degree of interest rate inertia. In particular, we use two alternative calibrations for the inflation response parameter γ_π: a value of 1.5 for the SADL economy and a lower value of 0.5 for the IADL, to ensure determinacy, as discussed in Bilbiie (2008). Finally, we set $\gamma_\chi = -1$, following Gilchrist and Zakrajšek (2011).

The financial friction parameters are selected following Brzoza-Brzezina *et al.*, (2010) and Bernanke *et al.*, (1999). In addition to the values reported in Table II and Appendix 6.3, we set the entrepreneur survival rate to $\varepsilon_s^{SS} = 0.9728$, which implies an average entrepreneurial working life of 36 quarters. Finally, we set $T_E^{SS} = T_E/VE^{SS} = 0.03$, which represents a transfer equivalent to 3% of steady-state net worth of entrepreneurs, according to Brzoza-Brzezina *et al.*, (2010).

The stochastic processes are calibrated as follows Brzoza-Brzezina *et al.*, (2010). These include shocks to aggregate productivity, monetary policy, entrepreneurial survival, and idiosyncratic entrepreneurial risk. The persistence and standard deviation parameters are chosen to replicate typical fluctuations reported in the literature.

Table IV: Structural Parameters

Parameter	Value	Description	Reference
Households			
β	0.987	Discount rate	De la Peña (2021)
σ	2.0	Inverse intertemporal elasticity	Gali (2015)
φ	3.0	Inverse Frisch elasticity	León Leyva and Urrutia (2018)
λ	0.7 (IADL), 0.3 (SADL)	Degree of LAMP	ENIF (2024)
Producers			
α	1/3	Product elasticity with respect to capital	De la Peña (2021)
δ	0.03	Depreciation rate	De la Peña (2021)
θ	0.75	Calvo probability for prices	Gali (2015)
κ	5.0	Capital adjustment cost	Common on the literature
Taylor rule			
γ_R	0.8	Interest rate smoothing	Brzoza-Brzezina *et al.*, (2010)
γ_π	0.5 (IADL), 1.5 (SADL)	Response to inflation	Carrillo *et al.*, (2017), Bilbiie (2008)
γ_y	0.1	Response to GDP	Carrillo *et al.*, (2017)
γ_χ	-1.0	Response to external finance premium	Gilchrist and Zakrajšek (2011)
Financial sector – EFP			
ε_s^{SS}	0.9728	Survival rate for entrepreneurs	Bernanke *et al.*, (1999)
σ_a^{SS}	0.35	Idiosyncratic productivity std. dev. (SS)	Brzoza-Brzezina *et al.*, (2010)
T_E^{SS}	0.03	Transfers to entrepreneurs	Brzoza-Brzezina *et al.*, (2010)
Stochastic processes – Standard Model			
ρ_A	0.95	Autocorrelation of productivity shock	Brzoza-Brzezina *et al.*, (2010)
σ_A	0.007	Std. dev. of productivity shock	Brzoza-Brzezina *et al.*, (2010)
σ_R	0.001	Std. dev. of monetary policy shock	Gali (2015)
Stochastic processes – Financial Sector			
ρ_s	0.84	Autocorrelation of net worth shock	Brzoza-Brzezina *et al.*, (2010)
σ_s	0.006	Std. dev. of net worth shock	Brzoza-Brzezina *et al.*, (2010)
ρ_{σ_a}	0.83	Autocorrelation of idiosyncratic productivity shock	Brzoza-Brzezina *et al.*, (2010)
σ_a	0.012	Std. dev. of idiosyncratic productivity shock	Brzoza-Brzezina *et al.*, (2010)

The steady-state ratios are calibrated based on Brzoza-Brzezina *et al.*, (2010) and De la Peña (2021). We calibrate the constrained labor share (N_H^{SS}/N^{SS}) to match the observed informality rate. If financial exclusion is interpreted as the condition in which individuals lack access to a formal account at any financial institution, then the labor share of agents in informal employment can be used as a proxy for the share of labor from financially constrained agents. According to INEGI (2025), 54.5% of the labor force is informal; therefore, we set $N_H^{SS}/N^{SS} = 0.547$.

Table V: Steady State Ratios

Variable	**Value**	**Reference**
Consumption share in output	0.63	Brzoza-Brzezina *et al.*, (2010)
Investment share in output	0.21	Brzoza-Brzezina *et al.*, (2010)
Capital share in output	9.97	De la Peña (2021)
Constrained consumption share	0.20	INEGI (2022)
Constrained labor share	0.547	ENIF (2024)
External Finance premium ($R_E - R$)	0.02	Bernanke *et al.*, (1999)

Due to the lack of specific data on the consumption ratio of financially constrained agents relative to total consumption, we rely on household expenditure data from the *Encuesta Nacional de Ingresos y Gastos de los Hogares* (INEGI, 2022). The survey indicates that households in the first four income deciles account for approximately 20% of total consumption, while the ninth and tenth deciles concentrate around 40%. Since lower-income households are more likely to face credit constraints and have limited access to formal financial services, we interpret their consumption share as a reasonable proxy for the consumption share of financially constrained agents. Based on this reasoning, we set $C_H^{SS}/C^{SS} = 0.20$.

4 Model Dynamics

In this section, we present the main results. A natural way to interpret the findings from the previous section is by examining how the models respond to the various shocks discussed earlier, namely, the productivity shock, monetary policy shock, entrepreneur riskiness shock, and net worth shock. The first two shocks are standard; the latter two primarily affect the cost and quantity of loans, respectively [16]. However, before doing so, it is necessary to describe the structure of the model variants under consideration.

Since we rely on a combination of two financial frictions, limited asset market participation (LAMP) and the financial accelerator (EFP), we define four model variants. The *baseline model* includes the standard aggregate demand logic (SADL) and the financial accelerator (EFP). The *IADL-EFP model* incorporates the inverted aggregate demand logic (IADL) along with the financial accelerator. The *frictionless model* excludes both the financial accelerator and IADL. Lastly, the *IADL-FM model* includes IADL and excludes the financial accelerator. A summary of these model variants is provided in Table VI.

Table VI: Summary of Model Variants

Model	**SADL**	**IADL**	**EFP**
Frictionless	✓	–	–
Baseline	✓	–	✓
IADL-FM	–	✓	–
IADL-EFP	–	✓	✓

We now describe how the different model variants are obtained through parameter configurations. In particular, the degree of LAMP, denoted by λ, determines the type of aggregate demand logic that governs the model. When $\lambda \leqslant \lambda^*$, the model exhibits SADL, whereas when $\lambda > \lambda^*$, it generates IADL. Consequently, the baseline model corresponds to the parameterization with $\lambda = 0.3$. In contrast, the IADL-EFP model is obtained by setting $\lambda = 0.7$. Furthermore, we set $\gamma_\pi = 0.5$ to maintain tractability and avoid indeterminacy in a framework where the Taylor Principle does not ensure stability due to the presence of a large share of hand-to-mouth consumers, as Bilbiie (2008) demonstrated. Additionally, we

[16] In the impulse response figures, the x-axis represents percentage deviations from the steady state. For inflation, the interest rate, and external finance premium, the IRFs are rescaled by a factor of 400 (i.e., 100 × 4) to express the responses in annualized percentage point terms. The response of each variable is plotted for a shock of 1 standard deviation, corresponding to the respective shock sizes for σ_R, σ_a, σ_s, and σ_A as calibrated in the model in Table IV.

assume a forward-looking monetary policy rule.

Following Martínez García (2014) and Bernanke *et al.*, (1999), the frictionless model can be derived by "turning off" the financial accelerator mechanism. This mechanism arises from asymmetric information between borrowers and lenders; under perfect information, financial distortions disappear, allowing for an efficient allocation of resources. To ensure this, two conditions must be imposed: (i) the steady-state external finance premium equals one, implying that the cost of external finance matches the real risk-free rate ($\mathbb{E}_t(\hat{r}_{E,t+1}) = \hat{r}_t$) [17]; and (ii) all elasticities associated with the financial accelerator are set to zero ($\eta_{\Psi,\tilde{a}_E} = \eta_{\Psi,\sigma_a} = \eta_{s,\tilde{a}_E} = \eta_{s,\sigma_a} = 0 \Rightarrow \psi_\varrho = \psi_{\sigma_a} = 0$)[18], thereby eliminating the spread between borrowing and risk-free rates. These conditions ensure that capital is accumulated efficiently and optimally, up to the point where its expected real return equals the real risk-free rate. Regarding the role of entrepreneurs, in the absence of financial frictions, their aggregate characteristics, such as leverage and net worth, do not affect borrowing costs or capital demand, and can therefore be omitted without significant loss of generality. This holds if all elasticities related to net worth are set to zero ($\eta_{ve,\varepsilon} = \eta_{ve,ve} = \eta_{ve,R_E} = \eta_{ve,R} = \eta_{ve,QK} = \eta_{ve,\tilde{a}_E} = \eta_{ve,\sigma_a} = 0 \Rightarrow \psi_{r_E} = \psi_r = \psi_{ve} = \psi_{qk} = \psi_{\sigma_a} = 0$).

4.1 The Role of the External Finance Premium under SADL

First, the analysis begins by focusing on the dynamics under SADL. To highlight the role of the financial accelerator, we compare the baseline model with the frictionless model. It is worth noting that the parameter γ_χ (denotes the coefficient that governs the central bank's response to the external finance premium) in the Taylor rule is set to zero in this section to ensure a valid comparison.[19]

4.1.1 Monetary Policy Shock

Following a monetary policy shock that raises the nominal interest rate, both models exhibit an economic contraction. Output and inflation decline as aggregate demand falls. In response, the real price of capital decreases, which has an amplifying effect in the baseline model. This decline in the real price of capital generates capital losses that weaken entrepreneurs' balance sheets by reducing their net worth, thereby increasing the external finance premium by 150 basis points. This amplification mechanism further deepens the decline in investment, and as a result, leverage temporarily increases. Nevertheless, in the

[17] See the financial accelerator equation given in the Table III.

[18] See the Appendix, section 6.3.

[19] A sensitivity analysis regarding this parameter is conducted in a later section.

baseline model, despite the presence of a negative monetary policy shock, the equilibrium exhibits a decline in the interest rate. This occurs due to a reduction in expected future inflation, which results from the deterioration in economic conditions triggered by the amplification effects of the external finance premium.

Over time, as the effects of the monetary shock dissipate, financial conditions improve, the external finance premium declines, and investment, capital, and output gradually recover. Figure 1 illustrates these dynamics. These results are consistent with Bernanke *et al.*, (1999) and Brzoza-Brzezina *et al.*, (2010), who show that the presence of an external finance premium amplifies macroeconomic fluctuations.

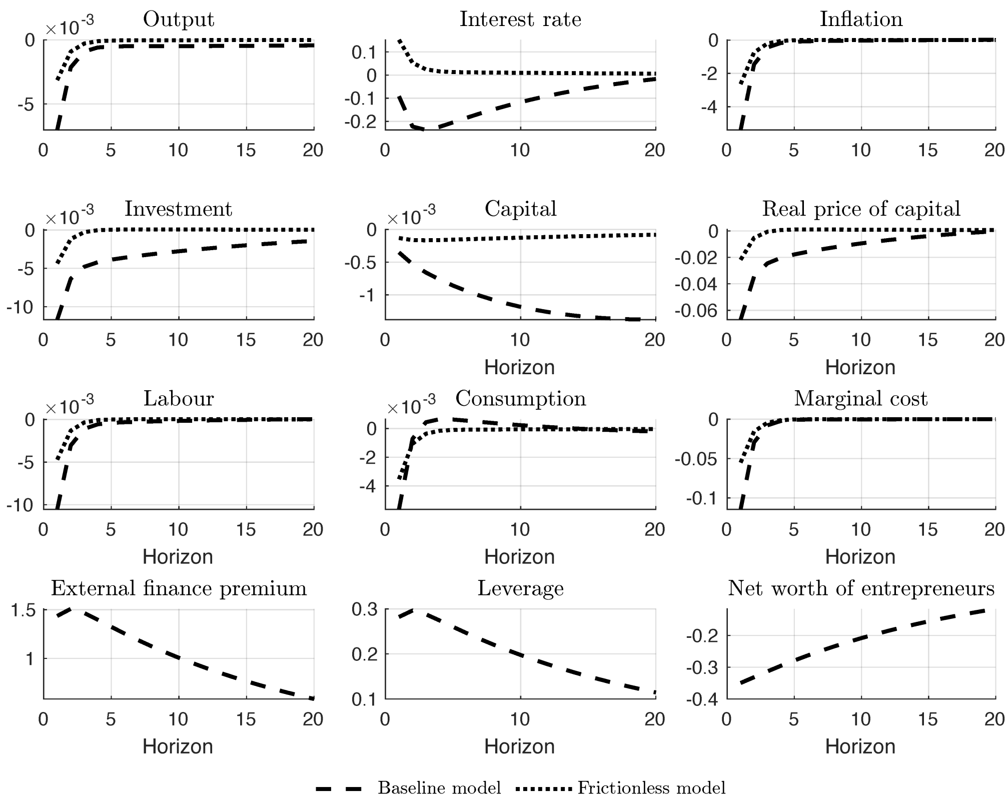

Figure 1: Monetary Shock under SADL: IRFs

4.1.2 Entrepreneur Riskiness Shock

Following a positive entrepreneur riskiness shock, the economy experiences a contraction, as shown in Figure 2. The perceived increase in entrepreneurial risk raises the external finance premium, making it more costly for entrepreneurs to borrow. As a result, entrepreneurs acquire less physical capital, investment declines, and output falls. The reduction in economic activity lowers the real price of capital and compresses rental income, causing a decline in entrepreneurs' net worth. This further amplifies the rise in the external finance premium. Consumption, employment, and real wages also decrease due to the overall economic downturn and tighter financial conditions. Inflation falls as marginal costs decline. These dynamics are consistent with the mechanisms described by Bernanke *et al.*, (1999) and L. J. Christiano *et al.*, (2014), where the credit spread acts as a countercyclical amplifier in the presence of financial frictions, while investment, capital accumulation and consumption remain procyclical.

In a nutshell, since the external finance premium fluctuates with changes in $\hat{\sigma}_{a,t}$ and leads to a contraction in the economy because an increase in risk effectively represents a negative shock to the demand for goods; consequently, the model implies that inflation falls. It is worth noting that there is no dynamic response in the frictionless model because the financial accelerator mechanism is "turned off."

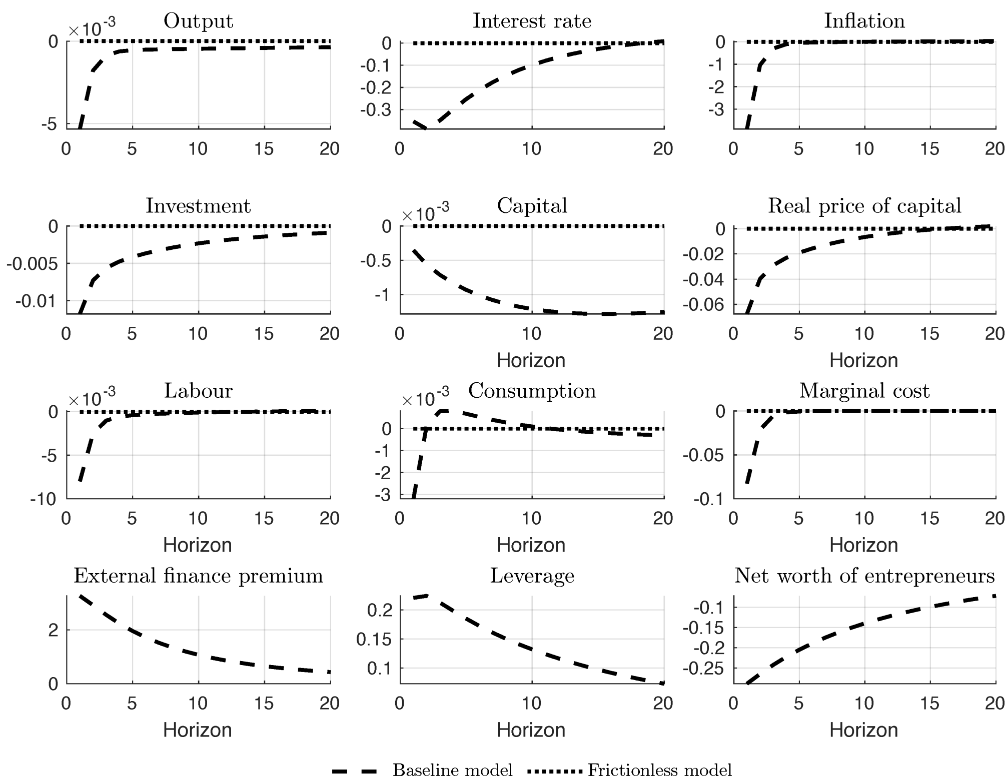

Figure 2: Entrepreneur Riskiness Shock under SADL: IRFs

4.1.3 Net Worth Shock

Figure 3 depicts the dynamic response to a positive net worth shock to entrepreneurs (implemented as an increase in the entrepreneurial survival rate), similar to the formulation in

Brzoza-Brzezina *et al.*, (2010).

As entrepreneurs' net worth increases, their financial position improves, leading to a decline in leverage and, consequently, a decrease in the external finance premium. This decline in financing costs facilitates investment, leading to a rise in the real price of capital, capital accumulation, and output. Inflation increases moderately, prompting a mild monetary policy response through higher nominal interest rates. These dynamics are consistent with the amplification mechanism of financial frictions in Bernanke *et al.*, (1999), where improved entrepreneurial balance sheets foster procyclical movements in investment and output.

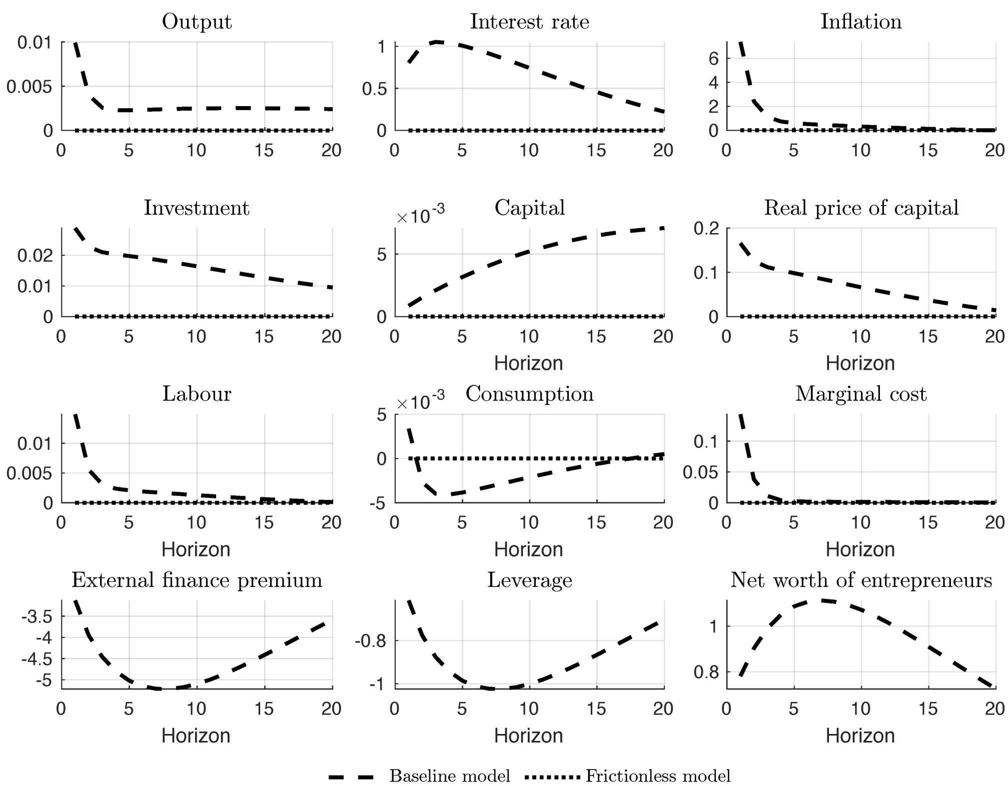

Figure 3: Net Worth Shock under SADL: IRFs

4.1.4 Productivity Shock

Figure 4 presents the impulse response functions to a positive productivity shock. This shock lowers marginal costs, which in turn drives inflation and the nominal interest rate downward. In the frictionless model, output rises gradually, while investment and the real price of capital respond more quickly. Capital, however, accumulates more slowly due to adjustment costs and the law of motion of capital.

In the baseline model, although a positive productivity shock improves production efficiency, it can initially lead to a reduction in investment and capital accumulation when the external finance premium is present. The decline in marginal costs reduces the marginal return to capital and lowers its real price, diminishing the incentive to invest. Simultaneously, entrepreneurs' financial positions deteriorate due to a decline in net worth, which increases the external finance premium. As financing becomes more expensive, investment contracts further, leading to a temporary decline in the capital stock despite the positive productivity shock. At this stage, the contractionary financial effects dominate the expansionary impact of higher productivity, resulting in a short-run decline in output. Over time, as the productivity shock fades, the real price of capital, investment, and the capital stock gradually recover. Output eventually rises, while both leverage and the external finance premium decline.

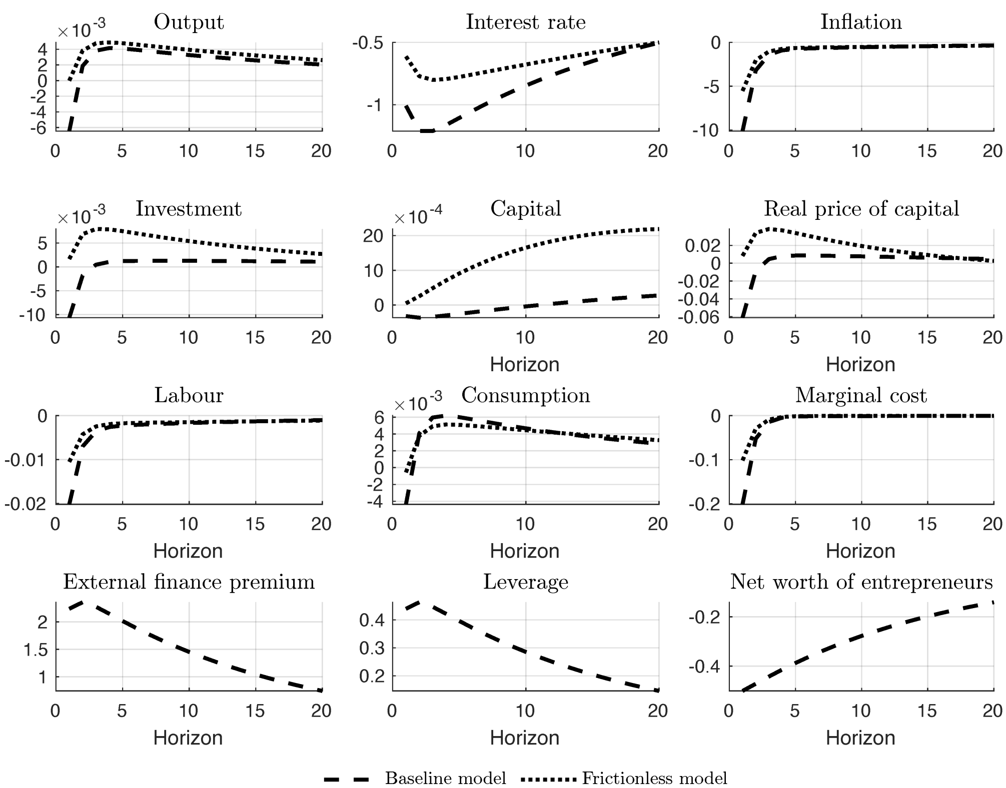

Figure 4: Productivity Shock under SADL: IRFs

4.1.5 Summary of Shock Transmission under SADL

The Table VII summarizes the dynamic effects of the four structural shocks under the SADL framework, emphasizing the role played by the EFP in shaping macroeconomic responses. Across all shocks, the EFP acts as an amplification mechanism, either reinforcing downturns or boosting expansions, depending on the nature of the shocks. The EFP plays a key role in amplifying macroeconomic dynamics. Contractionary monetary policy and increases in perceived risk raise the EFP, by up to 150 and 200 basis points, respectively, worsening financial conditions of the firms and deepening recessions. In contrast, a positive net worth shock improves balance sheets, reduces the EFP by up to 500 basis points, and fosters expansion. A positive productivity shock initially raises the EFP by weakening net worth, partially dampening its expansionary effects, but this reverses over time as the economy recovers.

Table VII: Summary of Shock Effects and the Role of the EFP under SADL

Shock	**Business Cycle Response**	**Effect on EFP**	**Role of EFP**	**Financial Channel**
Monetary policy shock ($\uparrow \vartheta_t$)	Recession	$\uparrow$ 150 bps	Countercyclical amplifier (deepens downturn)	$\downarrow$ real price of capital $\rightarrow$ capital losses $\rightarrow$ $\downarrow$ net worth $\rightarrow$ $\uparrow$ EFP
Entrepreneur riskiness shock ($\uparrow \hat{\hat{\sigma}}_{a,t}$)	Recession	$\uparrow$ 200 bps	Countercyclical amplifier (tightens credit)	$\uparrow$ perceived risk $\rightarrow$ $\uparrow$ EFP $\rightarrow$ $\downarrow$ investment and output $\rightarrow$ $\downarrow$ net worth $\rightarrow$ $\uparrow$ EFP
Net worth shock ($\uparrow \hat{\varepsilon}_{s,t}$)	Expansion	$\downarrow$ 500 bps	Procyclical amplifier (boosts expansion)	$\uparrow$ net worth $\rightarrow$ $\downarrow$ EFP $\rightarrow$ $\downarrow$ financing costs $\rightarrow$ $\uparrow$ investment and output
Productivity shock ($\uparrow \hat{a}_t$)	Short-run recession, long-run expansion	$\uparrow$ 200 bps	Countercyclical amplifier (initial drag on expansion)	$\downarrow$ marginal cost $\rightarrow$ $\downarrow$ return to capital $\rightarrow$ $\downarrow$ price of capital $\rightarrow$ $\downarrow$ net worth $\rightarrow$ $\uparrow$ EFP

4.2 The Role of The External Finance Premium under IADL.

We now compare two models that incorporate the IADL. On the one hand, the model that includes the financial accelerator through the external finance premium (IADL-EFP model); on the other hand, the model with the IADL alone (IADL-FM model). In other words, we are interested in assessing the role of the external finance premium within a framework characterized by IADL. This case is particularly relevant for the Mexican economy, where, as discussed in the introduction, a significant portion of the population remains excluded from formal credit markets. This persistent exclusion highlights the structural nature of LAMP in Mexico, making the IADL framework especially suitable for analyzing its macro-financial dynamics.

4.2.1 Monetary Policy Shock

As Bilbiie (2008) explains, under the inverted aggregate demand logic (IADL), an increase in the interest rate can have expansionary effects. Figure 5 illustrates this dynamic: output, investment, capital accumulation, the real price of capital, and inflation all rise, while leverage and the external finance premium (EFP) decline, reflecting improved economic conditions. Although constrained consumers increase their consumption, the consumption of unconstrained consumers decreases due to the rise in the interest rate. Despite being a minority, unconstrained consumers account for a larger share of total consumption ($C_S^{SS}/C^{SS} = 0.80$), which causes aggregate consumption to decline. However, this decline is not sufficient to prevent an overall expansion.

The responses of both models are nearly indistinguishable at the onset of the shock. However, investment, capital, and the real price of capital are initially slightly lower in the model with financial frictions, despite the EFP turning negative. As the economy evolves, leverage increases and entrepreneurs' net worth deteriorates, eventually pushing the EFP into positive territory. This shift activates the traditional financial accelerator mechanism, moderating the expansion and accelerating the return to the steady state. In this context, the EFP does not amplify the expansion, as it typically does in response to adverse shocks, but instead acts as a stabilizing force, flattening the response relative to the frictionless benchmark.

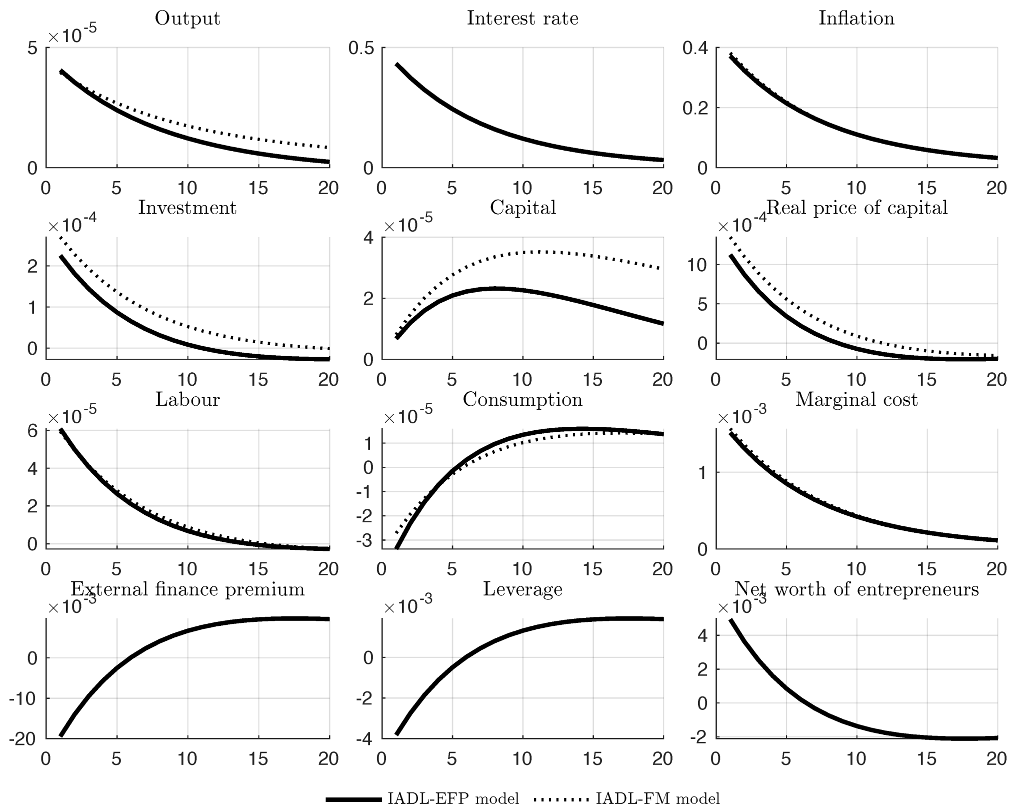

Figure 5: Monetary Shock under IADL: IRFs

4.2.2 Entrepreneur Riskiness Shock

Figure 6 shows the response to a positive shock to the idiosyncratic risk of entrepreneurs in the IADL-EFP model. The shock increases the external finance premium, which restricts investment and leads to a decline in both the capital stock and the value of capital. Entrepreneurs' net worth deteriorates and leverage rises, amplifying financial tightening through the usual financial accelerator mechanism.

Interestingly, under the IADL-EFP framework, it is possible to observe a macroeconomic configuration in which aggregate consumption by both types of households (constrained and unconstrained) increases, the nominal interest rate rises, and yet aggregate output falls. Although this outcome may initially seem paradoxical, it can be consistent with the inverted aggregate demand logic when combined with financial frictions. The shock leads to an increase in real wages, boosting the labor income of constrained households. As a result, these households raise their current consumption. Unconstrained households may also increase consumption due to an income effect that outweighs the intertemporal substitution effect of a higher real interest rate. However, the increase in consumption is not sufficient to offset the negative impact on investment, causing output to decline. Furthermore, the increase in marginal costs associated with rising wages puts upward pressure on inflation. The central bank, following a Taylor-type rule, responds to this inflationary pressure by raising the nominal interest rate, but the adjustment is insufficient to fully offset the rise in inflation. As a result, the real interest rate declines, an outcome consistent with the IADL. This scenario thus illustrates how a financial shock under IADL can produce a contraction in output while simultaneously increasing consumption and the policy interest rate.

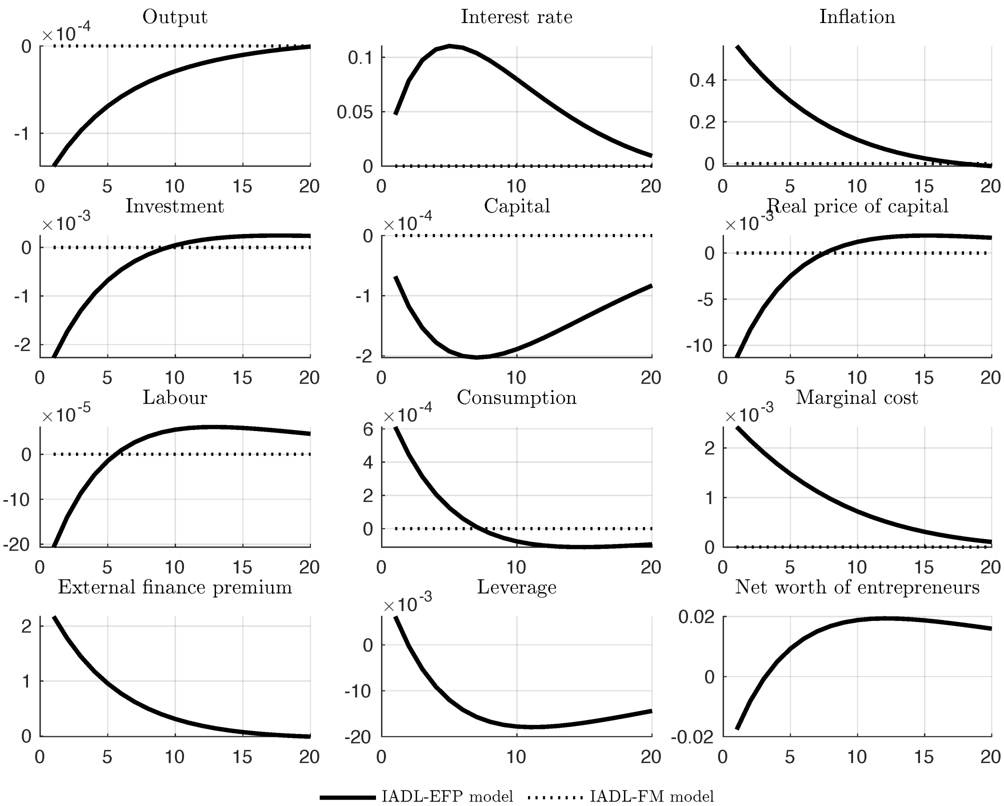

Figure 6: Entrepreneur Riskiness Shock under IADL: IRFs

4.2.3 Net Worth Shock

Figure 7 presents the dynamic response of the IADL-EFP model to a positive net worth shock to entrepreneurs. The shock strengthens entrepreneurs' balance sheets, leading to a substantial decline in the external finance premium (by 400 basis points) and a reduction in leverage. As financing conditions improve, the demand for capital rises, pushing up the real price of capital, stimulating investment, and driving capital accumulation over time. This investment, led expansion translates into higher output and labor demand, which in turn raises employment and real wages. Despite stronger economic activity, inflation declines slightly due to a reduction in marginal costs, which allows the nominal interest rate to fall modestly. Additionally, aggregate consumption decreases because, in this version of the model, a positive net worth shock is implemented as a reduction in the exit rate of entrepreneurs. This results in lower wealth transfers to unconstrained households. In the steady state, the consumption ratio, driven by the spending of unconstrained households, is greater than that of constrained households. The expansion is thus driven by improved financial conditions and amplified by distributional effects, in line with the IADL.

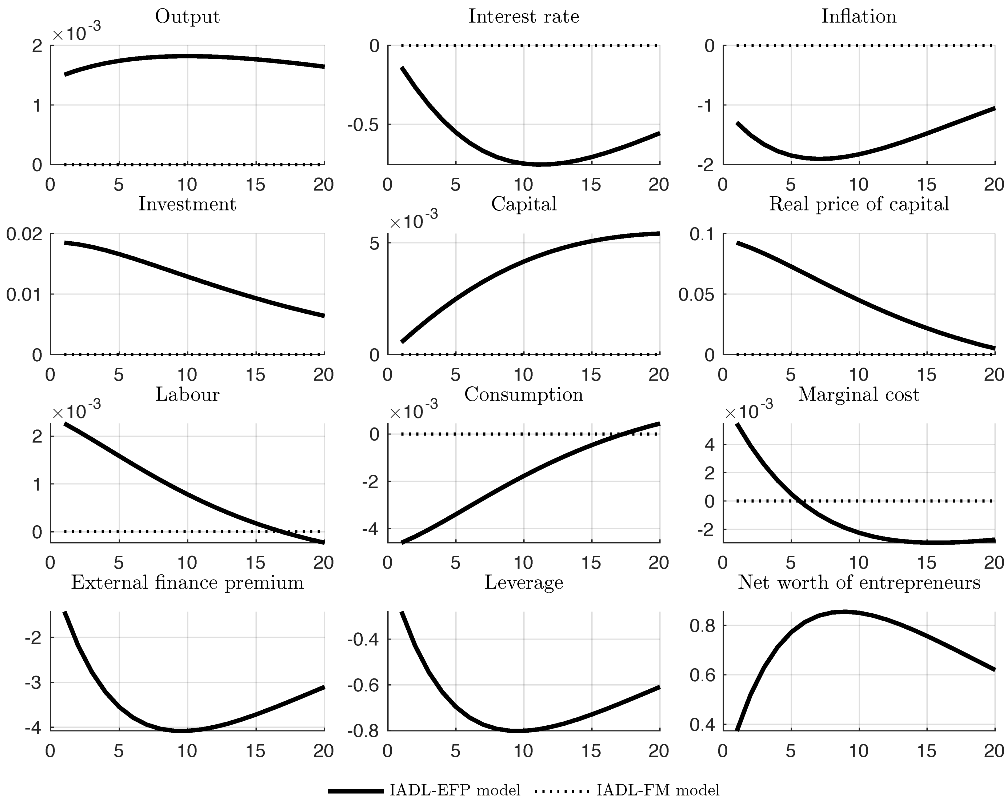

Figure 7: Net Worth Shock under IADL: IRFs

4.2.4 Productivity Shock

As shown in Figure 8, a positive productivity shock generates an expansionary effect in both the IADL-EFP and IADL-FM models. Similar to the monetary policy shock, the differences between the model with an external finance premium (EFP) and the frictionless version are minimal for most macroeconomic variables. Initially, the shock improves entrepreneurs' net worth, leading to a decline in both the EFP and leverage. As financing becomes more accessible, investment increases, stimulating capital accumulation and reinforcing the expansion, albeit modestly.

Consumption and real wages also rise, supported by stronger aggregate demand and growing household income. As the economy returns to its steady state, the EFP and leverage gradually rise after their initial decline, introducing a mild contractionary force. However, this effect is outweighed by the dominant expansionary impact of the productivity shock. The only variable that displays a notable divergence is inflation. In the IADL-EFP model, price pressures are more contained relative to the frictionless case. This occurs because the financial accelerator mechanism dampens the expansionary momentum, resulting in lower expected inflation.

In summary, under the IADL-EFP framework, a positive productivity shock leads to an expansion that is initially slightly amplified by improved financial conditions. Although financing tightens gradually as the EFP normalizes, the expansionary effects on output, consumption, and employment persist. At the same time, financial frictions temper inflationary pressures by moderating the pace of the expansion.

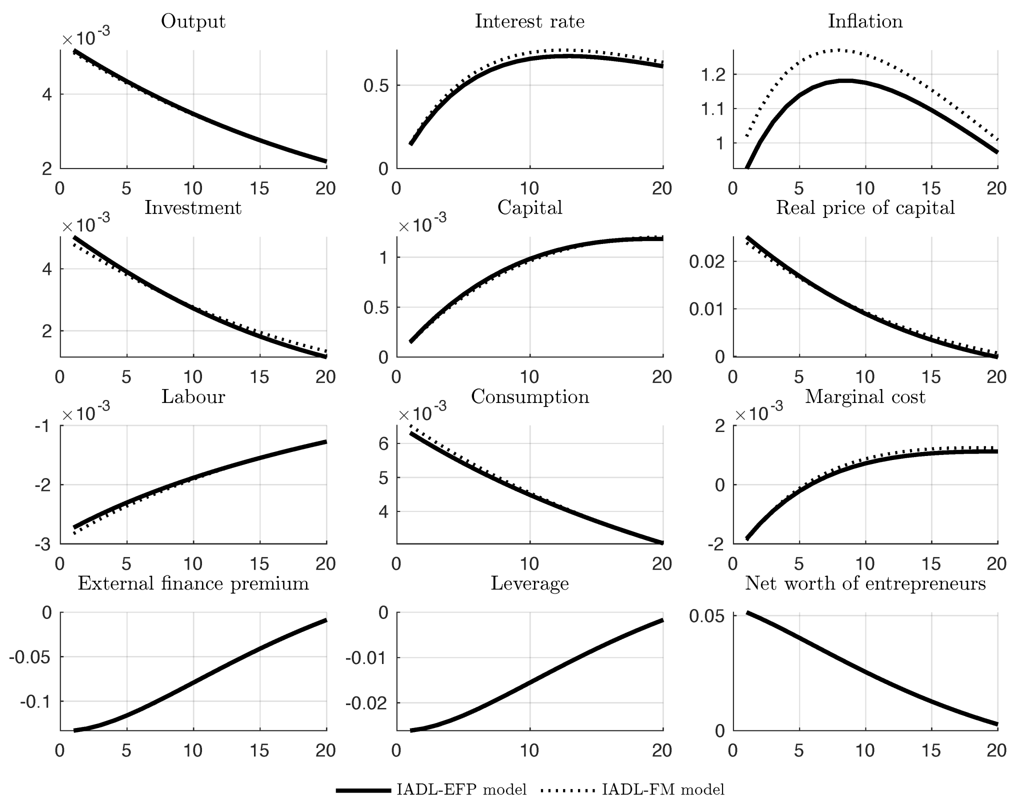

Figure 8: Productivity Shocks under IADL: IRFs

4.2.5 Summary of Shock Transmission under IADL

Table VIII summarizes the effects of structural shocks under the IADL framework. A contractionary monetary policy shock leads to an expansion, driven by income effects on constrained households and an initial decline in the EFP that stimulates investment. Over time, the EFP increases, moderating the expansion. Riskiness shocks generate stagflation: consumption rises, but investment and output fall as the EFP surges, tightening credit. In contrast, positive net worth shocks reduce the EFP significantly, lowering borrowing costs and amplifying the expansion. Finally, productivity shocks yield broad expansions with modest EFP declines that normalize gradually, highlighting the EFP's mild stabilizing role.

Table VIII: Summary of Shock Effects and the Role of the EFP under IADL

Shock	**Business Cycle Response**	**Effect on EFP**	**Role of EFP**	**Financial Channel**
Monetary policy shock ($\uparrow \vartheta_t$)	Expansion	$\downarrow$ 2 bps	Stabilizing force (dampens expansion in later periods)	Initial $\downarrow$ EFP $\rightarrow$ $\uparrow$ investment and capital; later $\uparrow$ leverage $\rightarrow$ $\uparrow$ EFP $\rightarrow$ moderates expansion
Entrepreneur riskiness shock ($\uparrow \hat{\bar{\sigma}}_{a,t}$)	Stagflation	$\uparrow$ 200 bps	Countercyclical amplifier (tightens credit)	$\uparrow$ risk $\rightarrow$ $\uparrow$ EFP $\rightarrow$ $\downarrow$ investment and capital $\rightarrow$ $\downarrow$ net worth $\rightarrow$ further $\uparrow$ EFP
Net worth shock ($\uparrow \hat{\varepsilon}_{s,t}$)	Expansion	$\downarrow$ 400 bps	Procyclical amplifier (reinforces expansion)	$\uparrow$ net worth $\rightarrow$ $\downarrow$ EFP $\rightarrow$ $\uparrow$ investment $\rightarrow$ $\uparrow$ capital and output
Productivity shock ($\uparrow \hat{a}_t$)	Expansion	$\downarrow$ 15 bps	Mild stabilizing role (temporary easing, later normalization)	$\uparrow$ productivity $\rightarrow$ $\uparrow$ net worth $\rightarrow$ $\downarrow$ EFP $\rightarrow$ $\uparrow$ investment; EFP normalizes as expansion continues

4.3 Leverage Elasticity of the External Finance Premium: A Sensitivity Analysis

A key component of the financial accelerator mechanism is the elasticity of the external finance premium (EFP) with respect to leverage. This parameter determines how strongly financing costs respond to changes in entrepreneurs' balance sheets. Naturally, this raises an important question: how sensitive are the model's dynamics to variations in this elasticity?

In the baseline specification, we used a value of $\psi_{\varrho} = -0.013$, derived as explained in Appendix 6.3.[20] In this section, we examine how the behavior of the model changes when the leverage elasticity of the EFP is increased in absolute value. Specifically, we consider two alternative calibrations: $\psi_{\varrho} = -0.05$ and $\psi_{\varrho} = -0.08$. By exploring these higher elasticities, we aim to assess the extent to which the financial accelerator mechanism amplifies macroeconomic fluctuations and interacts with the inverted aggregate demand logic (IADL) under varying degrees of financial fragility.

4.3.1 Monetary Policy Shock

Among the scenarios considered, the one with the lowest (absolute) sensitivity of the EFP to leverage displays the strongest and most persistent expansion in response to a monetary policy shock. Although leverage declines more sharply in this case, the EFP responds only mildly, which mitigates the tightening of financial conditions. As the economy transitions back to its steady state and leverage rises, potentially exceeding its long-run level, credit costs remain relatively stable, preventing a strong amplification of the cyclical downturn. Consequently, the financial accelerator play a limited role in reinforcing the deceleration.

As previously discussed, the EFP acts as a stabilizing mechanism within the IADL framework in response to a monetary policy shock. When the sensitivity of the premium to leverage increases, the initial decline in the premium becomes more pronounced for a given drop in leverage, exceeding 200 basis points. This enhances the dampening effect of financial conditions, causing the economy to reverse more quickly from expansion to contraction. The effects are especially notable in capital, investment, and the relative price of capital, all of which fall below their steady-state levels by quarter 5 under the high-sensitivity scenarios.

Inflation and the nominal interest rate, however, display broadly similar dynamics across

[20] This implies that a 1 percentage point increase in leverage, i.e., a 1 percentage point decrease in net worth relative to collateral, raises the external finance premium by approximately 1.27 basis points.

all cases. Nonetheless, price pressures tend to be slightly more subdued when the sensitivity of the EFP is lower, reflecting the more gradual adjustment of financial conditions. These dynamics are illustrated in Figure 9.

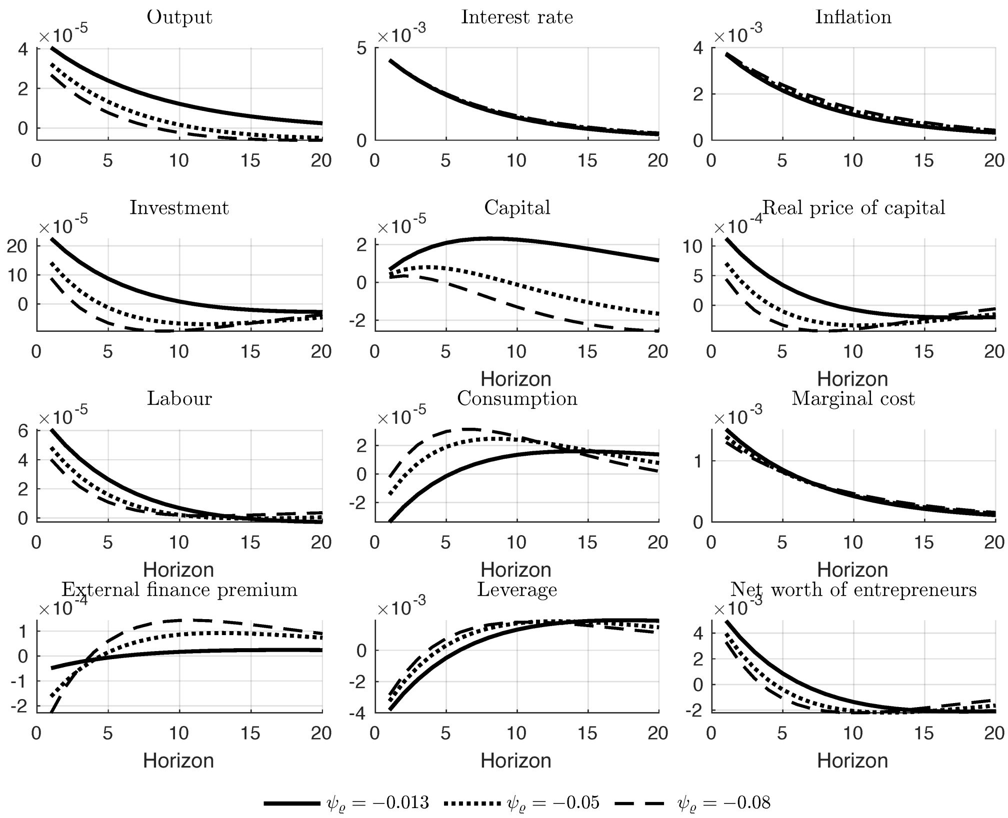

Figure 9: Sensitivity Analysis: EFP-Leverage Elasticity under a Monetary Shock.

4.3.2 Entrepreneur Riskiness Shock

Following a positive shock to the idiosyncratic risk of entrepreneurial projects, interpreted as an increase in the perceived riskiness of entrepreneurs, the scenario with the lowest sensitivity of EFP to leverage exhibits the deepest contraction, as depicted in Figure 10. As discussed earlier, this type of shock directly increases the EFP across all sensitivity levels, by approximately 200 basis points, thereby increasing credit costs and dampening economic activity. However, a higher sensitivity attenuates the transmission of this shock: the EFP responds more flexibly to leverage adjustments, mitigating the overall contraction. As a result, the decline in capital, investment, the relative price of capital, inflation, and the nominal interest rate is more moderate in the high-sensitivity scenario.[21]

[21] This is analogous to the monetary policy shock, where greater sensitivity also reduces the persistence and severity of the downturn.

Importantly, the elasticity of the EFP also shapes the responses of unconstrained households. In the low-sensitivity scenario, these households exhibit an increase in consumption and a decrease in labor supply, suggesting that wealth effects dominate substitution effects. In contrast, under higher sensitivity, consumption by unconstrained agents falls and labor supply rises, pointing to a stronger substitution effect driven by intertemporal trade-offs. Nevertheless, aggregate consumption and labor supply dynamics are largely driven by constrained households, who constitute the majority in the economy under the IADL framework. For this reason, aggregate consumption rises and labor supply falls across all scenarios, primarily due to the wealth effects associated with rising real wages.

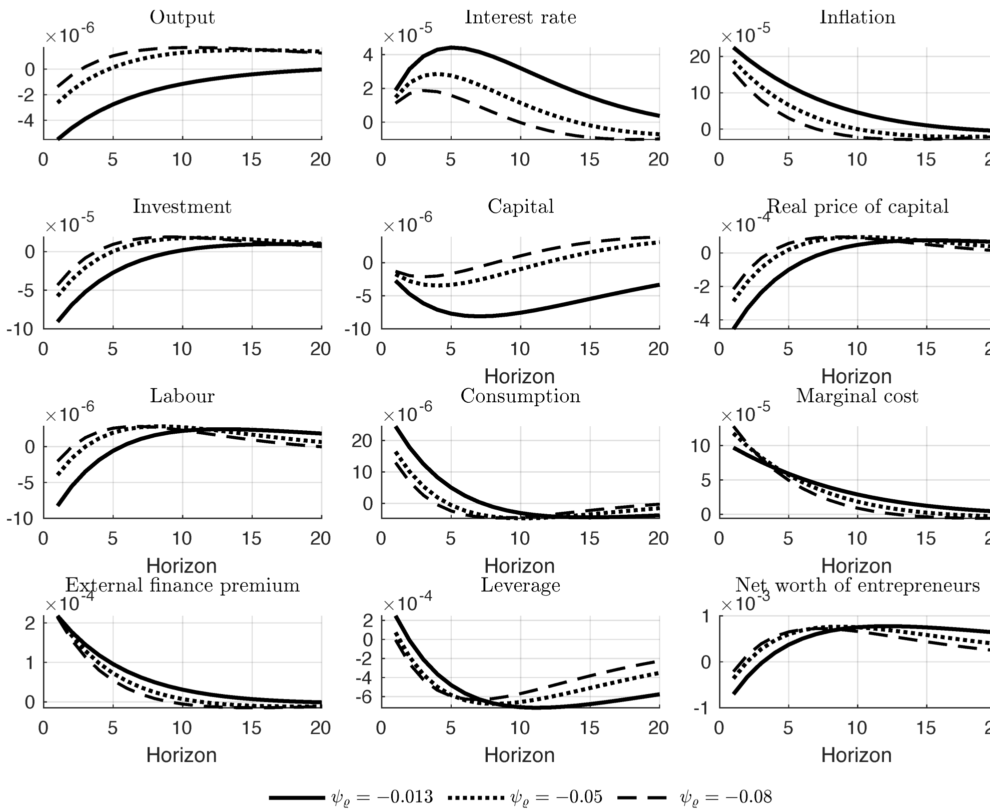

Figure 10: Sensitivity Analysis: EFP-Leverage Elasticity under an Entrepreneur riskiness shock IRFs

4.3.3 Net Worth Shock

Figure 11 presents the responses of the economy to a positive shock to entrepreneurs' net worth under different values of the elasticity of the external finance premium (EFP) with respect to leverage. As anticipated, a higher sensitivity leads to a larger decline in the EFP in response to the same shock, which relaxes financing conditions. This facilitates greater lending, stimulates investment, accelerates capital accumulation, and increases the real price of capital.

Simultaneously, inflation and the nominal interest rate decline due to a contraction in marginal cost. In this context, the financial accelerator continues to play its traditional role of amplifying macroeconomic fluctuations. When the EFP is more sensitive to leverage, the amplification of shock effects is more pronounced. Conversely, lower sensitivity dampens the economy's response, resulting in a more muted adjustment across key variables. It is worth noting that even under higher sensitivity, the amplification effect is weaker in the IADL context than in SADL.

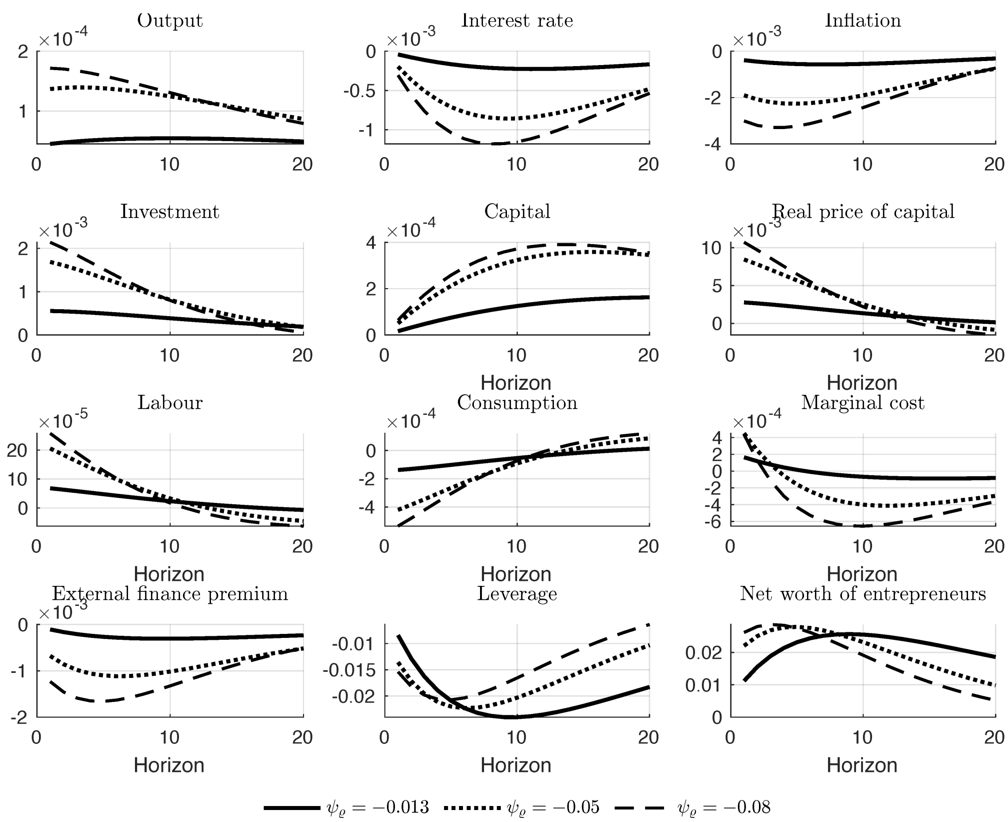

Figure 11: Sensitivity Analysis: EFP-Leverage Elasticity under a Net worth shock IRFs

4.3.4 Productivity Shock

Following a positive productivity shock, as shown in Figure 12,the different impacts on output, capital stock, and the real price of capital are minimal. However, a higher elasticity of EFP with respect to leverage amplifies the initial decline in the EFP for the same level of leverage, reflecting improved economic conditions in the high-sensitivity scenario. Subsequently, the EFP reverts more rapidly to its steady-state level, indicating a gradual tightening of credit conditions relative to the immediate aftermath of the shock. This tightening leads to lower marginal costs and, hence, lower inflation expectations, resulting in subdued price pressures and a modest reduction in the nominal interest rate. The central mechanism remains that following an expansionary shock, the EFP initially falls, but as the economy normalizes, the increasing EFP acts to temper the persistence of the expansion by imposing tighter credit constraints than those present immediately after the shock. Nonetheless, the net effect of the productivity shock dominates the moderating influence of the EFP.

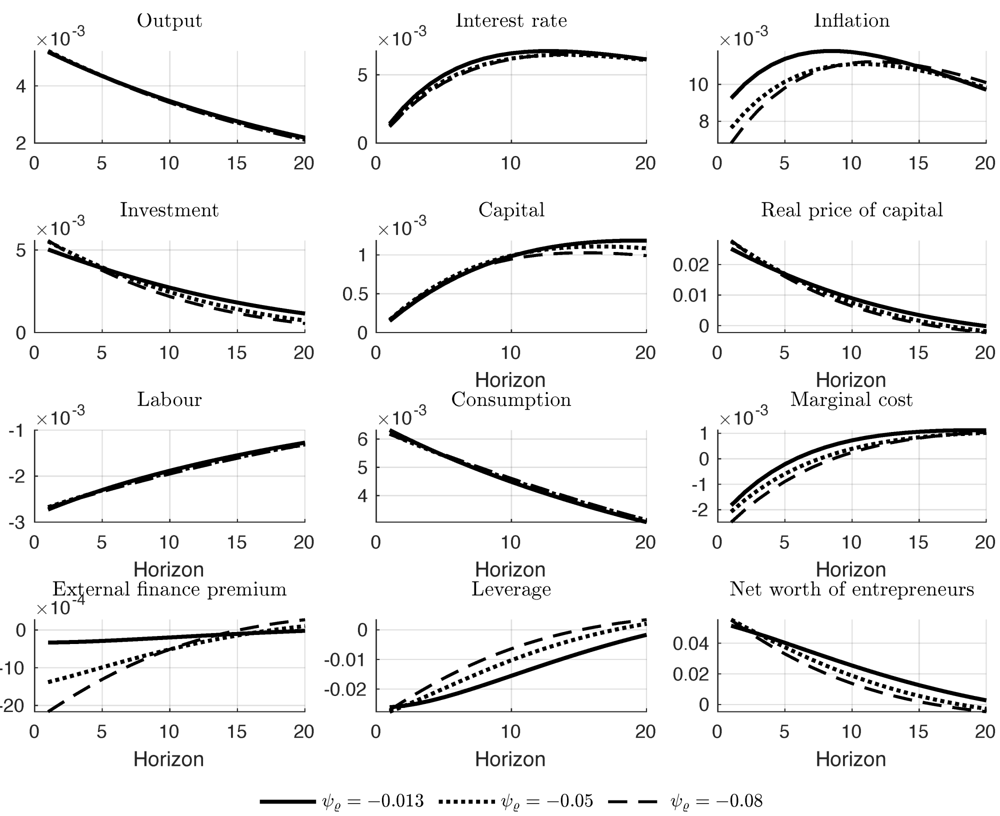

Figure 12: Sensitivity Analysis: EFP-Leverage Elasticity under a Productivity shock IRFs

4.3.5 Qualitative Summary of Sensitivity Analysis

In summary, the role of EFP under the IADL framework is not uniform across shocks; rather, its sensitivity to leverage acts as a shock-contingent adjustment mechanism. Table IX summarizes how different values of the leverage elasticity shape macroeconomic dynamics depending on the nature of the shock.

For adverse shocks, such as interest rate hikes or increases in entrepreneurial risk, higher EFP sensitivity stabilizes the economy by responding more forcefully to deteriorating financial conditions. Even under IADL, where monetary tightening initially reduces the EFP and stimulates activity, a stronger EFP response ensures that rising leverage and falling net worth quickly restore tighter financial conditions, thereby curbing excess expansion and facilitating a quicker return to steady state. In the case of risk shocks, a more responsive EFP mitigates the downturn by tightening credit conditions more rapidly. Conversely, for positive shocks, such as improvements in entrepreneurial net worth, greater EFP sensitivity amplifies the expansion by improving the transmission of easier credit conditions to investment and output. Even in response to real shocks like productivity gains, EFP sensitivity influences inflation dynamics, underscoring that financial frictions remain relevant for nominal adjustment even when their effects on real activity are limited.

Table IX: Sensitivity of Macroeconomic Dynamics to EFP-Leverage Elasticity under IADL

Shock	**Effect of Higher EFP-Leverage Elasticity** ($\lvert\psi_{\varrho}\rvert$)	**Main Transmission Mechanism**
Monetary policy shock ($\uparrow \vartheta_t$)	Slows the expansion and facilitates faster return to steady state	Initial drop in EFP stimulates activity; as leverage rises, faster EFP rebound restores financial tightening and stabilizes the cycle
Entrepreneur riskiness shock ($\uparrow \hat{\bar{\sigma}}_{a,t}$)	Mitigates contraction in output and inflation	EFP reacts more strongly to higher risk, offsetting credit tightening and containing the downturn
Net worth shock ($\uparrow \hat{\varepsilon}_{s,t}$)	Amplifies the expansionary effects	Lower EFP from improved credit access triggers stronger investment and output growth
Productivity shock ($\uparrow \hat{a}_t$)	Inflation adjusts more rapidly; real variables are less affected	Faster EFP normalization accelerates nominal stabilization; real activity remains driven by productivity

4.4 Taylor Rule: A Sensitivity Analysis

How should monetary policy respond to an increase in the interest rate spread? To explore this, we analyze the potential responses of the central bank to movements in the EFP. Specifically, we consider three values for the sensitivity parameter in the Taylor rule with respect to the EFP, denoted by γ_χ: $\gamma_\chi = -1$ (countercyclical), $\gamma_\chi = 0$ (neutral), and $\gamma_\chi = 1$ (procyclical). These configurations reflect different roles that EFP can play within the IADL framework. It is worth noting that the case with $\gamma_\chi = 0$, represented by the solid black line, corresponds to the IADL-EFP model previously analyzed.

4.4.1 Monetary Policy Shock

Figure 13 illustrates the sensitivity of the IADL-EFP model to alternative monetary policy responses to the EFP, following a contractionary monetary policy shock that reduces the EFP. The results clearly demonstrate that a countercyclical position, in which the central bank increases the policy rate in response to a reducing EFP, amplifies the expansionary effects observed under the IADL framework. Output, investment, capital accumulation, and the real price of capital all increase more strongly and persistently in this setting.

In contrast, a procyclical response, in which the central bank decreases the policy rate when the EFP declines, tends to moderate the initial decline in the EFP, thereby dampening the expansion triggered by the IADL mechanism. This accelerates the normalization of the EFP and weakens the transmission of the monetary policy shock. Overall, the results suggest that incorporating a countercyclical EFP response into the Taylor rule can serve as an effective stabilization tool under IADL, reinforcing expansionary effects when financial constraints are active.

It is important to note that these dynamics differ significantly under the SADL framework. In that case, a contractionary monetary policy shock increases the EFP from the outset, tightening financial conditions, and reinforcing the downturn. A countercyclical policy response can partially offset this amplification mechanism, thus softening the negative impact of the shock. Conversely, a procyclical stance can lead to an overcorrection, pushing the EFP down prematurely and even generating a slight expansionary effect, which stands in stark contrast to the standard financial accelerator mechanism. This contrast underscores the fundamentally different role monetary policy plays in economies with IADL versus SADL structures, especially in the presence of financial frictions.

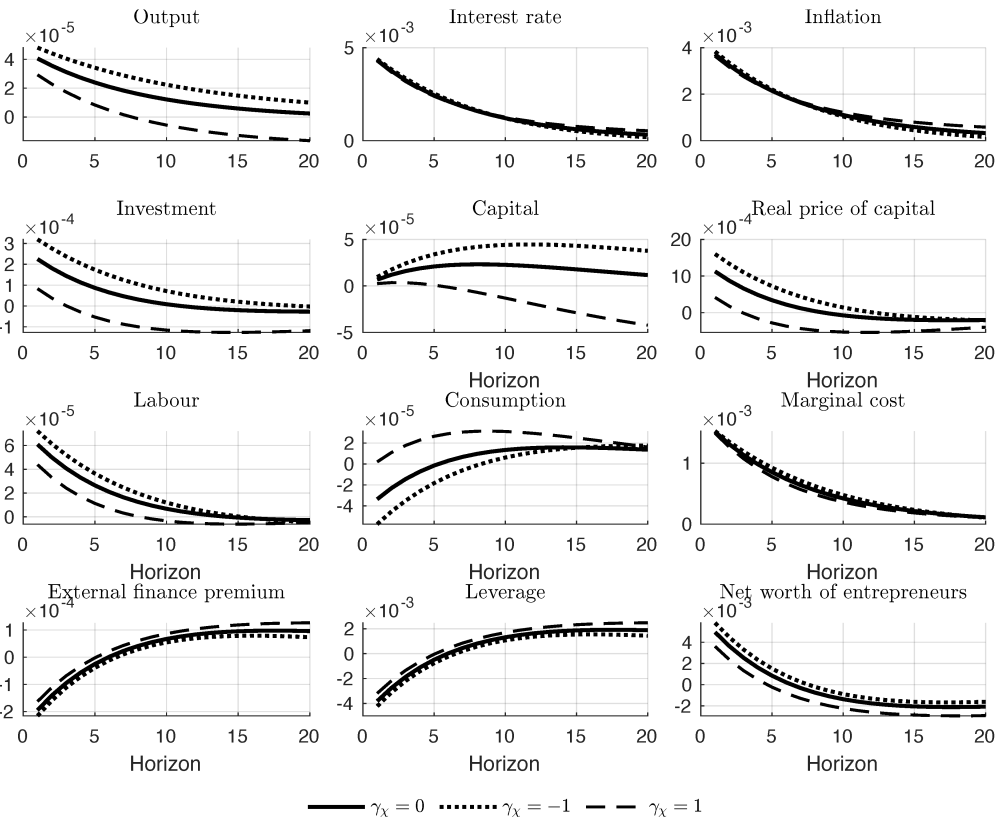

Figure 13: Sensitivity to γ_χ: Monetary shock IRFs

4.4.2 Entrepreneur Riskiness Shock

Figure 14 shows the response to a positive shock to the idiosyncratic risk of entrepreneurs in the IADL-EFP model. As discussed previously, the shock increases the EFP, which restricts investment and leads to a decline in both the capital stock and the value of capital. Entrepreneurs' net worth deteriorates and leverage rises, amplifying financial tightening through the usual financial accelerator mechanism. We now extend the analysis by comparing alternative monetary policy responses to the EFP. A countercyclical rule ($\gamma_\chi = -1$), in which the central bank lowers the interest rate when the EFP increases, is expected to mitigate the tightening of financial conditions. However, the results reveal that this specification yields intermediate outcomes: while it reduces the severity of the contraction relative to the procyclical rule ($\gamma_\chi = 1$), it performs worse than the neutral rule ($\gamma_\chi = 0$) in stabilizing output, investment, and capital. In contrast, under the SADL framework, a countercyclical policy can help mitigate these negative effects by directly easing credit conditions and partially supporting aggregate demand, albeit at the cost of slightly higher inflation.

The procyclical rule ($\gamma_\chi = 1$), which raises the nominal interest rate in response to an increase in the EFP, generates stronger inflationary pressures and deeper contraction. The rise in the policy rate further tightens financial conditions, amplifying the increase in the EFP. This, in turn, raises real wages and marginal costs, as labor quickly returns to its steady-state level, leading to higher inflation. The central bank responds to this inflationary pressure with additional rate hikes, reinforcing the tightening and exacerbating the deterioration of the entrepreneurs' balance sheets. Rather than stabilizing the economy, the procyclical response introduces a feedback loop that intensifies both financial and macroeconomic volatility.

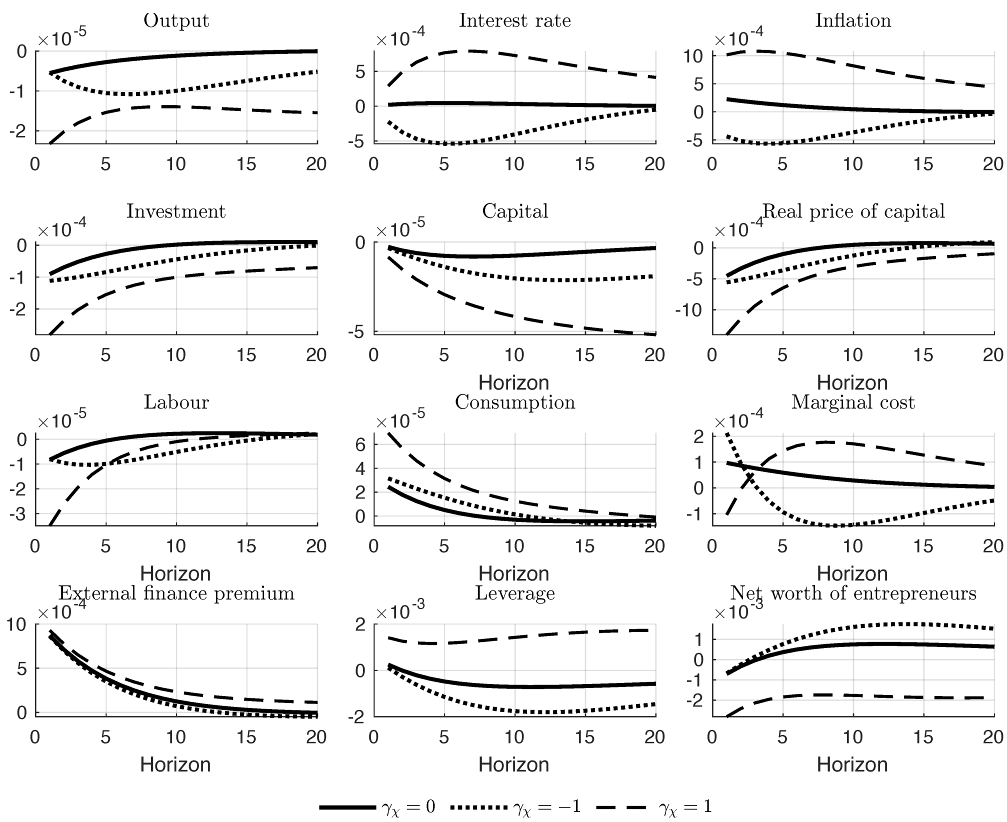

Figure 14: Sensitivity to γ_χ:Entrepreneur riskiness shock IRFs

4.4.3 Net Worth Shock

Figure 15 displays the dynamics of the model in the three scenarios of response to monetary policy. Recall that a net worth shock represents a direct increase in entrepreneurs' wealth, which leads to a decline in leverage and, consequently, a reduction in EFP.

In the procyclical scenario, the interest rate decreases in response to the falling EFP, thereby amplifying the positive effects on the economy. The impact is stronger and more persistent than previously described under a neutral monetary stance in the IADL-EFP model. In contrast, under the SADL framework, a procyclical policy also reinforces expansion. However, the resulting inflationary pressures are more pronounced, such that the policy rate ends up decreasing only slightly. This limited policy accommodation eventually leads to a modest contraction, partially reversing the initial expansionary impulse and even causing an increase in the EFP.

Under a countercyclical monetary rule, the interest rate rises, significantly offset by the expansionary impact of the shock. This response causes marginal costs and labor demand to decline, while consumption increases slightly at first due to a rise in real income, driven by lower inflation expectations among constrained households. In contrast, in the SADL setting, a countercyclical policy dampens expansion by tightening credit conditions, thus limiting the transmission of improved financial conditions to the broader economy. Although this response can help contain inflation, it reduces the effectiveness of the shock in stimulating aggregate activity.

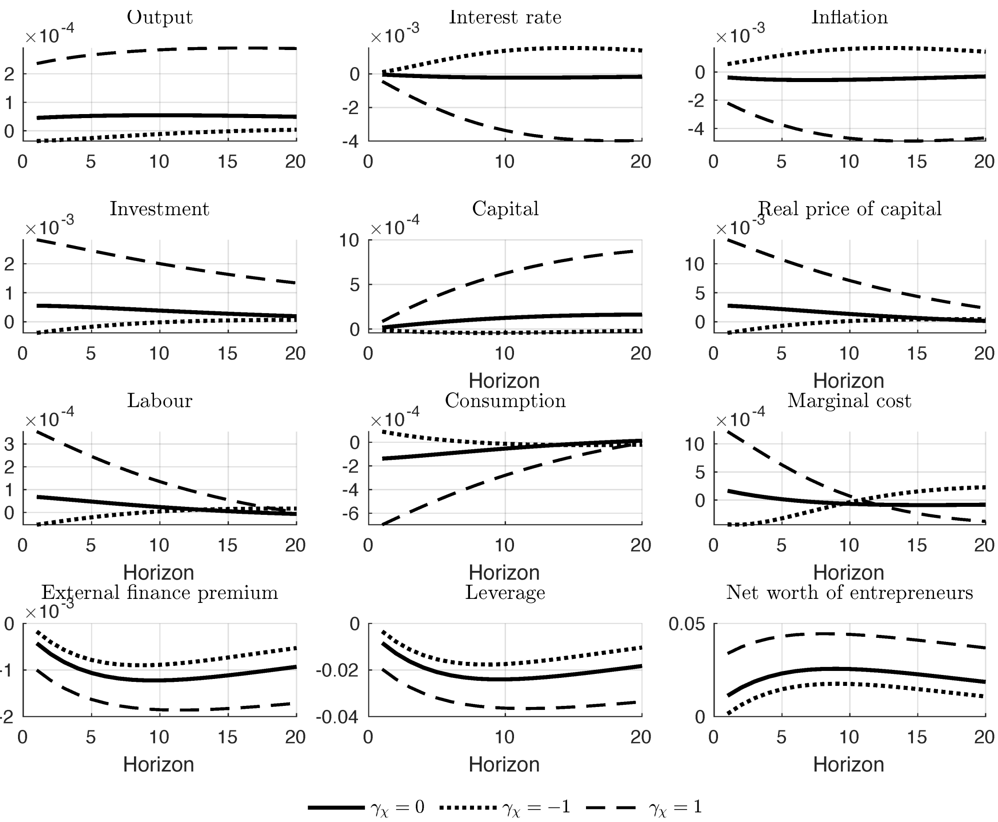

Figure 15: Sensitivity to γ_χ: Net Worth Shock IRFs

4.4.4 Productivity Shock

Figure 16 illustrates how the macroeconomic effects of a positive productivity shock vary depending on the monetary policy response to EFP. While the neutral case ($\gamma_\chi = 0$) has been previously described, the comparison with countercyclical and procyclical responses offers additional insights. Under the countercyclical scenario ($\gamma_\chi = -1$), the central bank increases the policy rate as the EFP declines. This partially offsets the easing in financial conditions, leading to a more moderate expansion in investment, capital accumulation, and output. The responses in consumption and employment are also less pronounced. However, inflation exhibits the strongest increase among the three scenarios. The EFP returns to its steady state more quickly, and leverage begins to recover sooner. The procyclical rule ($\gamma_\chi = 1$) leads the central bank to further reduce the policy rate in response to the fall in EFP. This action reinforces the positive effects of the shock by improving financial conditions, allowing for a larger and more persistent decline in the EFP. As a result, investment, capital, and output expand more strongly. Inflation rises modestly due to the increased aggregate demand. These results highlight how monetary policy design can either amplify or dampen the transmission of positive supply-side shocks under the IADL-EFP framework.

As in previous cases, the dynamics under SADL differ markedly. A positive productivity shock initially raises the EFP due to a decline in the net worth of entrepreneurs. A countercyclical policy mitigates this by lowering interest rates, easing credit conditions, and supporting demand. Conversely, a procyclical response tightens policy as EFP falls, compressing spreads, and improving balance sheets, which amplifies the expansion beyond that observed under neutral or countercyclical rules.

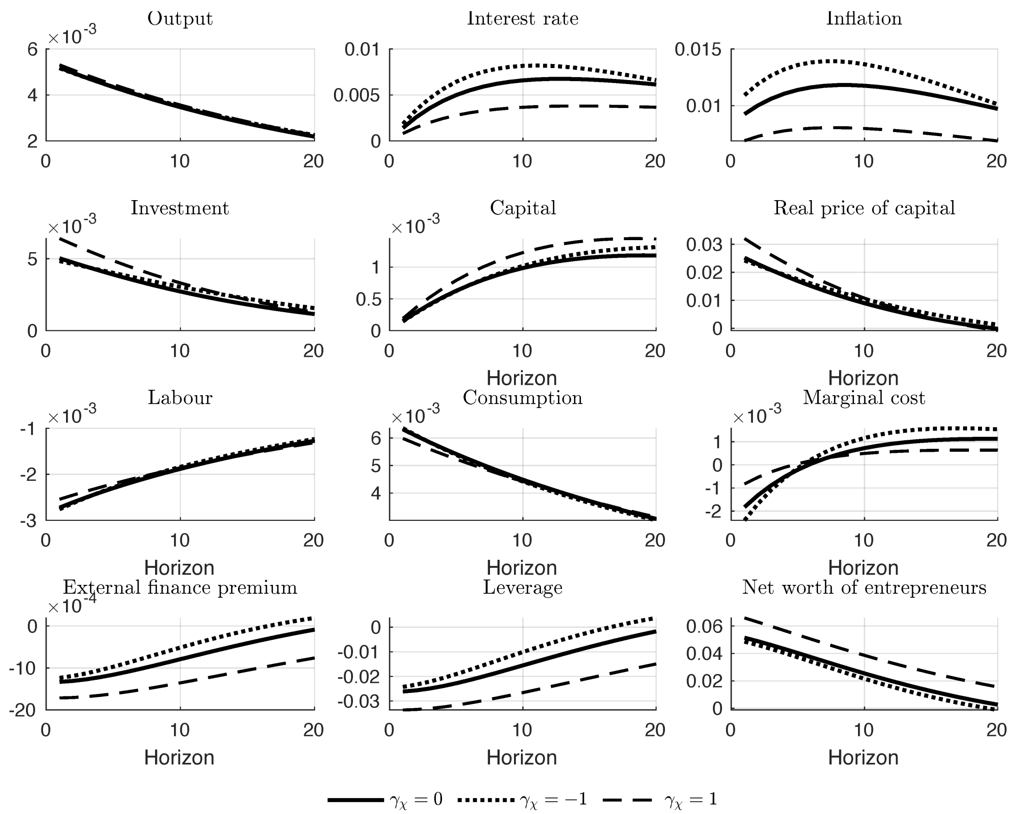

Figure 16: Sensitivity to γ_χ: Productivity shock IRFs

4.4.5 Summary of Effects by Shock Type and Policy Configuration

As Table X shows, a countercyclical monetary policy response—one that lowers the interest rate when the EFP rises—tends to amplify expansionary shocks and mitigate contractionary ones, thereby strengthening the financial channel. However, the effectiveness of this approach depends on the nature of the shock: for risk-related shocks, a neutral policy stance may be more appropriate to avoid destabilizing feedback loops, whereas for wealth and productivity shocks, a procyclical stance can reinforce expansions without generating significant inflationary pressures. In contrast to the SADL model, where countercyclical policy is generally stabilizing, the optimal rule design under IADL must be tailored to the specific shock and its interaction with endogenous financial frictions.

Table X: Sensitivity of Macroeconomic Dynamics to Taylor Rule Stance under IADL

Shock	**Effect of Policy Stance** (γ_χ)	**Main Transmission Mechanism**
Monetary policy shock ($\uparrow \vartheta_t$)	**Countercyclical**: Stronger expansion; **Neutral**: Moderate expansion; **Procyclical**: Weakens expansion	Lower policy rate (via EFP feedback) boosts output, investment, and capital more when stance is countercyclical; procyclical stance raises rates as EFP rises, muting transmission
Entrepreneur riskiness shock ($\uparrow \hat{\bar{\sigma}}_{a,t}$)	**Neutral**: Best stabilization; **Countercyclical**: Partial stabilization; **Procyclical**: Exacerbates tightening	Higher risk raises EFP; neutral stance avoids amplifying this, while procyclical stance tightens policy further, worsening the downturn
Net worth shock ($\uparrow \hat{\varepsilon}_{s,t}$)	**Procyclical**: Stronger expansion; **Neutral**: Moderate and sustained; **Countercyclical**: Dampens expansion	Improved credit access reduces EFP; under procyclical stance, lower EFP reduces policy rate, amplifying expansion; countercyclical stance offsets this
Productivity shock ($\uparrow \hat{a}_t$)	**Procyclical**: Stronger expansion; **Neutral**: Balanced expansion; **Countercyclical**: Moderated expansion	Productivity lowers EFP and boosts output; procyclical stance reinforces expansion via further rate cuts; countercyclical stance contains inflation and stabilizes EFP faster

5 Conclusion

In this thesis, I study the macroeconomic implications of financial frictions in a New Keynesian DSGE framework that incorporates a financial accelerator mechanism primarily based on Bernanke *et al.*, (1999), combined with LAMP. These frictions are especially relevant for emerging economies such as Mexico, where access to financial markets is limited and balance sheet effects play a central role in business cycle dynamics. The model features two types of households, constrained and unconstrained, and entrepreneurial borrowing is subject to an external finance premium that depends on leverage. The model also embeds inverted aggregate demand logic, allowing interest rate increases to potentially generate expansionary effects depending on the degree of asset market segmentation.

The model is calibrated to the Mexican economy, capturing key macro-financial features such as credit frictions, segmented asset markets, and the amplification or attenuation of shocks through financial channels. The analysis focuses on the transmission of four key structural shocks: a monetary policy shock, an entrepreneur riskiness shock, a net worth shock, and a productivity shock. Special attention is given to the role of the external finance premium and to the central bank's response to it, governed by the parameter γ_χ in the Taylor rule. Additionally, the model explores how varying the sensitivity of the EFP with respect to leverage affects macroeconomic dynamics. These elements play a crucial role in shaping the propagation and persistence of shocks under different configurations of financial and policy frictions.

The main findings are as follows. First, in response to a contractionary monetary policy shock, modeled as an increase in the nominal interest rate, the presence of financial frictions attenuates the expansionary effect predicted under IADL. Specifically, the financial accelerator moderates the boom by increasing the EFP, especially when its elasticity to leverage is high. A stronger sensitivity leads to a faster reversal of the expansion and a faster convergence to the steady state. Moreover, incorporating γ_χ reveals that a procyclical policy response (raising the interest rate when the EFP increases) further reduces the expansion, while a countercyclical response amplifies it. Quantitatively, under SADL, the EFP increases by approximately 200 basis points, while under IADL the decrease is only around 2 basis points, underscoring the subdued financial reaction in the inverse demand setting.

Second, under an entrepreneur riskiness shock, modeled as a rise in the perceived risk of entrepreneurial returns, the IADL-EFP framework yields a nonstandard result: a simultaneous decline in output and an increase in inflation. This paradoxical outcome arises due to higher real wages and the consumption behavior of hand-to-mouth households. The analysis shows that a higher sensitivity of the EFP mitigates the negative effects by accelerating its return to the steady state. In this context, the optimal monetary policy stance appears to be neutral, as a countercyclical or procyclical response can either overcorrect or exacerbate the volatility in output and prices.

Third, in response to a net worth shock, represented as a direct improvement in entrepreneurs' financial position, the economy experiences an expansion driven by a decline in the EFP and leverage. While this expansion is evident under both SADL and IADL, it is slightly weaker under the latter. Importantly, greater sensitivity of the EFP enhances the expansion. Given the prolonged nature of the boom, a countercyclical monetary policy response is advisable to contain inflationary pressures and guide the economy back to equilibrium.

Finally, a positive productivity shock generates an expansionary response in both the IADL-EFP and frictionless models. However, the inclusion of the financial accelerator does not significantly alter the outcome, suggesting that the supply-side effect dominates any friction-induced moderation. A lower sensitivity of the EFP tends to increase inflationary pressures by allowing for a more pronounced expansion. Therefore, a contractionary monetary policy stance is recommended to stabilize prices without dampening the benefits of productivity gains.

The analysis highlights that, under the IADL framework with endogenous financial frictions captured by the EFP, monetary policy in Mexico should be carefully tailored to the nature of shocks affecting the economy. In particular, countercyclical policy responses can effectively amplify expansionary effects following contractionary monetary shocks by easing financial conditions. However, in the presence of shocks that raise entrepreneurial risk, a neutral stance may be preferable to avoid excessive volatility, since both procyclical and countercyclical policies risk destabilizing outcomes. For shocks that improve the financial position of entrepreneurs, a moderately countercyclical policy can help contain inflation without sacrificing growth. Finally, when positive productivity shocks occur, a cautious contractionary approach is warranted to stabilize prices while preserving the gains in output. Importantly, the sensitivity of the EFP to leverage acts as a flexible transmission mechanism, amplifying expansions when financial conditions improve and stabilizing the economy by tightening credit quickly during adverse shocks. This adaptive behavior means that, unlike the SADL framework where countercyclicality is broadly stabilizing, the IADL-EFP model requires a nuanced, shock-contingent monetary policy. Therefore, a one-size-fits-all monetary rule is suboptimal for Mexico, and central bank actions should remain flexible and responsive to the interplay between financial frictions and macroeconomic shocks, enhancing the effectiveness of policy in promoting stability and growth. These dynamics and policy implications are summarized in Table XI.

Table XI: Summary: EFP Dynamics Across Shocks and Policy Regimes

Shock	**Role of EFP under SADL**	**Role of EFP under IADL**	**Effect of Higher EFP-Leverage Elasticity** **IADL**	**Effect of Taylor Rule Stance** (γ_χ) **IADL**
Monetary Policy ($\uparrow \vartheta_t$)	Amplifies recession: EFP ↑ (150 bps), tightens credit, reduces net worth	Stabilizes late expansion: EFP ↓ (2 bps), supports early growth, tightens later	Slower expansion, faster return to steady state	**Countercyclical**: Amplifies expansion; **Procyclical**: Dampens expansion
Entrepreneur Riskiness ($\uparrow \hat{\bar{\sigma}}_{a,t}$)	Amplifies recession: EFP ↑ (200 bps), tightens credit via risk channel	Causes stagflation: EFP ↑ (200 bps), reduces investment and net worth	Mitigates contraction; faster EFP adjustment offsets risk tightening	**Neutral**: Best stabilization; **Procyclical**: Worsens tightening
Net Worth ($\uparrow \hat{\varepsilon}_{s,t}$)	Amplifies expansion: EFP ↓ (500 bps), lowers costs, boosts investment	Reinforces expansion: EFP ↓ (400 bps), supports capital formation	Strengthens expansion via lower EFP and more credit	**Procyclical**: Strong amplification; **Countercyclical**: Dampens boom
Productivity ($\uparrow \hat{a}_t$)	Initial drag: EFP ↑ (200 bps), due to lower marginal cost and capital losses	Mild stabilizer: EFP ↓ (15 bps), temporary easing, later normalization	Faster EFP normalization; inflation adjusts more rapidly	**Procyclical**: Reinforces expansion; **Countercyclical**: Contains inflation

6 Appendix

6.1 Probability Distributions

In this section we show the analytical formulas for functions of entrepreneurs' idiosyncratic productivity distribution.

If a_E has a log-normal distribution F_t with mean equal to 1, then $\log a_E \sim \mathcal{N}(-\frac{\sigma_a^2}{2}, \sigma_a^2)$, where σ_a^2 is the variance of $\log a_E$. This observation leads to the following formulas, which we use in the derivations presented in the chapter 3.

We define:

$$z \equiv \frac{\log \tilde{a}_{E,t} + \frac{1}{2}\sigma_a^2}{\sigma_a}$$

$$F_t(\tilde{a}_{E,t}) = \int_0^{\tilde{a}_{E,t}} dF(a_E) = \Phi(z) \tag{A.1.1}$$

$$F_t'(\tilde{a}_{E,t}) = \frac{1}{\tilde{a}_{E,t}\sigma_a}\phi(z) \tag{A.1.2}$$

$$G_t(\tilde{a}_{E,t}) = \Phi(z - \sigma_a) \tag{A.1.3}$$

$$G_t'(\tilde{a}_{E,t}) = \frac{1}{\sigma_a}\phi(z) \tag{A.1.4}$$

$$G_t''(\tilde{a}_{E,t}) = -\frac{z}{\tilde{a}_{E,t}\sigma_a^2}\phi(z) \tag{A.1.5}$$

$$\Gamma_t(\tilde{a}_{E,t}) = \Phi(z - \sigma_a) + \tilde{a}_{E,t}\left[1 - \Phi(z)\right] \tag{A.1.6}$$

$$\Gamma_t'(\tilde{a}_{E,t}) = 1 - \Phi(z) \tag{A.1.7}$$

$$\Gamma_t''(\tilde{a}_{E,t}) = -\frac{1}{\tilde{a}_{E,t}\sigma_a}\phi(z) \tag{A.1.8}$$

$$G_{\sigma_a,t}(\tilde{a}_{E,t}) = -\left(\frac{z}{\sigma_a}\right)\phi(z - \sigma_a) \tag{A.1.9}$$

$$G'_{\sigma_a,t}(\tilde{a}_{E,t}) = -\frac{\phi(z)}{\sigma_a^2}[1 - z(z - \sigma_a)] \tag{A.1.10}$$

$$\Gamma_{\sigma_a,t}(\tilde{a}_{E,t}) = -\phi(z - \sigma_a) \tag{A.1.11}$$

$$\Gamma'_{\sigma_a,t}(\tilde{a}_{E,t}) = \left(\frac{z}{\sigma_a} - 1\right)\phi(z) \tag{A.1.12}$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ are the probability density function (PDF) and the cumulative distribution function (CDF) of a standard normal distribution, respectively.

6.2 Nonlinear Equilibrium Conditions

$$C_{H,t} = \frac{W_t}{P_t} N_{H,t} \tag{1}$$

$$N_{H,t} = \left(\frac{W_t}{P_t}\right)^{\frac{1-\sigma}{\varphi+\sigma}} \left(\frac{1}{\omega}\right)^{\frac{1}{\varphi+\sigma}} \tag{2}$$

$$\beta \left(\frac{C_{S,t}}{C_{S,t+1}}\right)^{\sigma} = \Lambda_{t,t+1} \frac{P_{t+1}}{P_t} \tag{5}$$

$$\omega N_{S,t}^{\varphi} = \frac{1}{C_{S,t}^{\sigma}} \frac{W_t}{P_t} \tag{6}$$

$$Q_t = \left[\Phi' \left(\frac{i_t}{K_{t-1}}\right)\right]^{-1} \tag{11}$$

$$K_t = (1-\delta)K_{t-1} + \Phi \left(\frac{i_t}{K_{t-1}}\right) K_{t-1} \tag{10}$$

$$W_t = (1-\alpha) \left(\frac{Y_t}{N_t}\right) MC_t \tag{17}$$

$$R_{K,t} = \alpha \left(\frac{Y_t}{K_t}\right) MC_t \tag{18}$$

$$P_t^* = \frac{\varepsilon}{\varepsilon - 1} \frac{\mathbb{E}_t \left\{\sum_{i=0}^{\infty} \theta^i \Lambda_{t,t+i} MC_{t+i} P_{t+i}^{\varepsilon} Y_{t+i}\right\}}{\mathbb{E}_t \left\{\sum_{i=0}^{\infty} \theta^i \Lambda_{t,t+i} P_{t+i}^{\varepsilon} Y_{t+i}\right\}} \tag{20}$$

$$P_t^{1-\varepsilon} = \theta P_{t-1}^{1-\varepsilon} + (1-\theta)(P_t^*)^{1-\varepsilon} \tag{21}$$

$$\int_0^1 \left(\frac{P_t(i)}{P_t}\right)^{-\varepsilon} di = \frac{A_t K_{t-1}^{\alpha} N_t^{1-\alpha} - F}{Y_t} \equiv \Delta_t \tag{43}$$

$$\left[\Gamma_t(\tilde{a}_{E,t+1}) - \mu G_t(\tilde{a}_{E,t+1})\right] R_{E,t+1} \varrho_t = (\varrho_t - 1) R_t \tag{27}$$

$$\mathbb{E}_t \left\{ \frac{R_{E,t+1}}{R_t} \left[1 - \Gamma_t(\tilde{a}_{E,t+1})\right] + \frac{\Gamma_t'(\tilde{a}_{E,t+1}) \left(\frac{R_{E,t+1}}{R_t} \left[\Gamma_t(\tilde{a}_{E,t+1}) - \mu G_t(\tilde{a}_{E,t+1})\right] - 1 \right)}{\Gamma_t'(\tilde{a}_{E,t+1}) - \mu G_t'(\tilde{a}_{E,t+1})} \right\} = 0 \tag{34}$$

$$Q_t K_t = \Psi \left(\frac{\mathbb{E}_t(R_{E,t+1})}{R_t} \right) N_t \tag{35}$$

$$\varrho_t \equiv \frac{Q_t K_t}{V E_t} \tag{30}$$

$$R_{E,t+1} \equiv \frac{R_{k,t+1} + (1-\delta) Q_{t+1}}{Q_t} \tag{24}$$

$$\Delta_t = \theta \pi^{\varepsilon} \Delta_{t-1} + (1-\theta) \left(\frac{P_t^*}{P_t} \right)^{-\varepsilon} \tag{44}$$

$$\frac{R_t}{\bar{R}} = \left(\frac{R_{t-1}}{\bar{R}} \right)^{\gamma_R} \left[\left(\frac{\pi_t}{\bar{\pi}} \right)^{\gamma_\pi} \left(\frac{Y_t}{\bar{Y}} \right)^{\gamma_y} \left(\frac{\chi_t}{\bar{\chi}} \right)^{\gamma_\chi} \right]^{1-\gamma_R} e^{\varphi_t} \tag{36}$$

$$VE_t = \varepsilon_{s,t}\left[R_{E,t}Q_{t-1}K_{t-1} - \left(R_{t-1} + \frac{\mu G_t R_{E,t} Q_{t-1} K_{t-1}}{L_{t-1}}\right) L_{t-1}\right] + T_{E,t} \tag{31}$$

$$C_t + i_t + \mu G_t R_{E,t} Q_{t-1} K_{t-1} = Y_t \tag{37}$$

$$C_t = \lambda C_{H,t} + (1-\lambda) C_{S,t} \tag{38}$$

$$K_{t-1} = \int_0^1 K_t(j)dj \tag{39}$$

$$N_t = \lambda N_{H,t} + (1-\lambda) N_{S,t} \tag{40}$$

$$B_{S,t} = L_t \tag{41}$$

$$\Omega_{S,t+1} = \Omega_{S,t} = \Omega = \frac{1}{1-\lambda} \tag{42}$$

$$\log(\bar{\sigma}_{a,t}) = \rho_{\bar{\sigma}_a} \log(\bar{\sigma}_{a,t-1}) + \eta_{\bar{\sigma}_{a,t}}, \quad \eta_{\bar{\sigma}_{a,t}} \sim \mathcal{N}(0, \sigma_a^2) \tag{45}$$

$$\log(\varepsilon_{s,t}) = \rho_s \log(\varepsilon_{s,t-1}) + \eta_{s,t}, \quad \eta_{s,t} \sim \mathcal{N}(0, \sigma_s^2) \tag{46}$$

$$\log(A_t) = \rho_A \log(A_{t-1}) + \eta_{A,t}, \quad \eta_{A,t} \sim \mathcal{N}(0, \sigma_A^2) \tag{47}$$

$$\log(\vartheta_t) = \eta_{R,t}, \quad \eta_{R,t} \sim \mathcal{N}(0, \sigma_R^2) \tag{48}$$

6.3 Derivation of the Financial Accelerator Equation

As we mentined, equation (34) in conjunction with the zero-profit condition for banks, equation (27), determines the optimal debt contract based on the cutoff value of the idiosyncratic shock $\tilde{a}_{E,t+1}$ and the leverage ratio ϱ_t. Hence, the joint solution can be expressed by the next process:

From (34)

$$\frac{\mathbb{E}_t(R_{E,t+1})}{R_t} = \Psi(\tilde{a}_{E,t+1}, \sigma_{a,t}).$$

After log-linearizing:

$$\mathbb{E}_t(\hat{r}_{E,t+1}) - \hat{r}_t + \eta_{\Psi,\tilde{a}_E}\hat{\tilde{a}}_t + \eta_{\Psi,\sigma_a}\hat{\sigma}_{a,t} = 0 \qquad (*)$$

where η represents the elasticities, which are defined as follows:

$$\eta_{\Psi,\tilde{a}_E} = \frac{\partial\Psi(\tilde{a}_E,\sigma_a)}{\partial\tilde{a}_E}\cdot\frac{\tilde{a}_E}{\Psi(\tilde{a}_E,\sigma_a)}$$

$$\Rightarrow \quad \eta_{\Psi,\tilde{a}_E} = \frac{\mu\left(\Gamma(\tilde{a}_E) - \mu G(\tilde{a}_E)\frac{R_E^{SS}}{R^{SS}} - 1\right)\frac{G''(\tilde{a}_E)\Gamma'(\tilde{a}_E) - G'(\tilde{a}_E)\Gamma''(\tilde{a}_E)}{\left(\Gamma'(\tilde{a}_E) - \mu G'(\tilde{a}_E)\right)^2}}{\frac{R_E^{SS}}{R^{SS}}\left[1 - \Gamma(\tilde{a}_E) + \frac{\Gamma'(\tilde{a}_E)}{\Gamma'(\tilde{a}_E) - \mu G'(\tilde{a}_E)}\left(\Gamma(\tilde{a}_E) - \mu G(\tilde{a}_E)\right)\right]}\cdot\tilde{a}_E$$

$$\eta_{\Psi,\sigma_a} = \frac{\partial\Psi(\tilde{a}_E,\sigma_a)}{\partial\sigma_a}\cdot\frac{\sigma_a}{\Psi(\tilde{a}_E,\sigma_a)}$$

$$\Rightarrow \quad \eta_{\Psi,\sigma_a} = \frac{\left[\frac{1-\mu\frac{G_{\sigma_a}(\tilde{a}_E)}{\Gamma_{\sigma_a}(\tilde{a}_E)}}{1-\mu\frac{G'(\tilde{a}_E)}{\Gamma'(\tilde{a}_E)}} - 1\right]\Gamma_{\sigma_a}(\tilde{a}_E)\frac{R_E^{SS}}{R^{SS}} + \mu\left(\frac{VE^{SS}}{Q^{SS}K^{SS}}\right)\frac{G'(\tilde{a}_E)\Gamma'_{\sigma_a}(\tilde{a}_E) - G'_{\sigma_a}(\tilde{a}_E)\Gamma'(\tilde{a}_E)}{\left(\Gamma'(\tilde{a}_E) - \mu G'(\tilde{a}_E)\right)^2}}{[1-\Gamma]\frac{R_E^{SS}}{R^{SS}} + \frac{\Gamma'(\tilde{a}_E)}{\Gamma'(\tilde{a}_E) - \mu G'(\tilde{a}_E)}\frac{R_E^{SS}}{R^{SS}}\left(\Gamma(\tilde{a}_E) - \mu G(\tilde{a}_E)\right)}\cdot\sigma_a.$$

From (27)

$$\varrho_t = s\left(\frac{R_{E,t+1}}{R_t}\right).$$

After log-linearizing:

$$\mathbb{E}_t(\hat{r}_{E,t+1}) - \hat{r}_t + \eta_{s,\tilde{a}_E}\hat{\tilde{a}}_t + \eta_{s,\sigma_a}\hat{\sigma}_{a,t} = -\frac{1}{\varrho^{SS}} \cdot (\hat{ve} - \hat{q} - \hat{k}) \qquad (**)$$

where η represents the elasticities, which are defined as follows:

$$\eta_{s,\tilde{a}_E} = \frac{\partial s(\tilde{a}_E, \sigma_a)}{\partial \tilde{a}_E} \cdot \frac{\tilde{a}_E}{s(\tilde{a}_E, \sigma_a)}$$

$$\Rightarrow \quad \eta_{s,\tilde{a}_E} = \frac{\Gamma'(\tilde{a}_E) - \mu G'(\tilde{a}_E)}{\Gamma(\tilde{a}_E) - \mu G \tilde{a}_E)} \cdot \tilde{a}_E$$

$$\eta_{s,\sigma_a} = \frac{\partial s(\tilde{a}_E, \sigma_a)}{\partial \sigma_a} \cdot \frac{\sigma_a}{s(\tilde{a}_E, \sigma_a)}$$

$$\Rightarrow \quad \eta_{s,\sigma_a} = \frac{\Gamma_{\sigma_a}(\tilde{a}_E) - \mu G_{\sigma_a}(\tilde{a}_E)}{\Gamma(\tilde{a}_E) - \mu G \tilde{a}_E)} \cdot \sigma_a.$$

Solving for $\hat{\tilde{a}}_t$ from $**$ and substituting into $*$, we obtain the financial accelerator equation:

$$\hat{\chi}_t = \psi_\varrho[\hat{ve}_t - (\hat{q}_t + \hat{k}_t)] + \psi_{\sigma_a}\hat{\sigma}_{a,t}$$

where:

$$\hat{\chi}_t = \mathbb{E}_t(\hat{r}_{E,t+1}) - \hat{r}_t$$

$$\psi_\varrho = -\frac{\frac{\eta_{\Psi,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}}}{1 - \frac{\eta_{\Psi,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}}} \cdot \frac{1}{\varrho^{SS}}$$

$$\psi_{\sigma_a} = \frac{\frac{\eta_{\Psi,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}}\eta_{s,\sigma_a} - \eta_{\Psi,\sigma_a}}{1 - \frac{\eta_{\Psi,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}}}$$

Finally, using the expressions in Appendix 6.1 and the steady-state values reported in Table II to compute the elasticities (ψ_ϱ, ψ_{σ_a}), we obtain the log-linearized equation for the financial accelerator:

$$\hat{\chi}_t = -0.0127 \cdot [\hat{ve}_t - (\hat{q}_t + \hat{k}_t)] + 0.0178 \cdot \hat{\sigma}_{a,t}.$$

Regarding the law of motion for net worth of entrepreneurs, by log-linearizing (31) and using $(**)$, after some manipulations, we obtain:

$$\begin{aligned}\hat{ve}_t &= \eta_{ve,\varepsilon}\hat{\varepsilon}_{s,t} + \left(\eta_{ve,R_E} - \frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}}\right)\hat{r}_{E,t} + \left(\eta_{ve,R} + \frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}}\right)\hat{r}_{t-1} \\ &+ \left(\eta_{ve,ve} - \frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}\varrho^{SS}}\right)\hat{ve}_{t-1} + \left(\eta_{ve,Q} + \frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}\varrho^{SS}}\right)\hat{q}_{t-1} \\ &+ \left(\eta_{ve,K} + \frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}\varrho^{SS}}\right)\hat{k}_{t-1} + \left(\eta_{ve,\sigma_a} - \eta_{s,\sigma_a}\frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}}\right)\hat{\sigma}_{a,t-1}\end{aligned}$$

where:

$$\eta_{ve,\varepsilon} = \frac{\partial VE^{SS}(\cdot)}{\partial \varepsilon^{SS}} \cdot \frac{\varepsilon^{SS}}{VE^{SS}(\cdot)} = \frac{\varrho^{SS}\left[R_E^{SS}(1-\mu G(\tilde{a}_E,\sigma_a,\mu) - R^{SS}\right] + R^{SS}}{\varepsilon^{SS}\left(\varrho^{SS}\left[R_E^{SS}(1-\mu G(\tilde{a}_E,\sigma_a,\mu) - R^{SS}\right] + R^{SS}\right) + \frac{T_E}{VE^{SS}}} \cdot \varepsilon^{SS}$$

$$\eta_{ve,ve} = \frac{\partial VE^{SS}(\cdot)}{\partial VE^{SS}} \cdot \frac{VE^{SS}}{VE^{SS}(\cdot)} = \frac{\varepsilon^{SS}R^{SS}}{\varepsilon^{SS}\left(\varrho^{SS}\left[R_E^{SS}(1-\mu G(\tilde{a}_E,\sigma_a,\mu) - R^{SS}\right] + R^{SS}\right) + \frac{T_E}{VE^{SS}}}$$

$$\eta_{ve,R_E} = \frac{\partial VE^{SS}(\cdot)}{\partial R_E^{SS}} \cdot \frac{R_E^{SS}}{VE^{SS}(\cdot)} = \frac{\varepsilon^{SS}\varrho^{SS}[1-\mu G(a_E,\tilde{\sigma}_a,\mu)]}{\varepsilon^{SS}\left(\varrho^{SS}\left[R_E^{SS}(1-\mu G(\tilde{a}_E,\sigma_a,\mu) - R^{SS}\right] + R^{SS}\right) + \frac{T_E}{VE^{SS}}} \cdot R_E^{SS}$$

$$\eta_{ve,R} = \frac{\partial VE^{SS}(\cdot)}{\partial R^{SS}} \cdot \frac{R^{SS}}{VE^{SS}(\cdot)} = -\frac{\varepsilon^{SS}\varrho^{SS} + 1}{\varepsilon^{SS}\left(\varrho^{SS}\left[R_E^{SS}(1-\mu G(\tilde{a}_E,\sigma_a,\mu) - R^{SS}\right] + R^{SS}\right) + \frac{T_E}{VE^{SS}}} \cdot R^{SS}$$

$$\eta_{ve,Q} = \frac{\partial VE^{SS}(\cdot)}{\partial Q^{SS}} \cdot \frac{Q^{SS}}{VE^{SS}(\cdot)} = \frac{\varepsilon^{SS}\left(\varrho^{SS}\left[R_E^{SS}(1-\mu G(\tilde{a}_E,\sigma_a,\mu) - R^{SS}\right]\right)}{\varepsilon^{SS}\left(\varrho^{SS}\left[R_E^{SS}(1-\mu G(\tilde{a}_E,\sigma_a,\mu) - R^{SS}\right] + R^{SS}\right) + \frac{T_E}{VE^{SS}}}$$

$$\eta_{ve,K} = \frac{\partial VE^{SS}(\cdot)}{\partial K^{SS}} \cdot \frac{K^{SS}}{VE^{SS}(\cdot)} = \frac{\varepsilon^{SS}\left(\varrho^{SS}\left[R_E^{SS}(1-\mu G(\tilde{a}_E,\sigma_a,\mu) - R^{SS}\right]\right)}{\varepsilon^{SS}\left(\varrho^{SS}\left[R_E^{SS}(1-\mu G(\tilde{a}_E,\sigma_a,\mu) - R^{SS}\right] + R^{SS}\right) + \frac{T_E}{VE^{SS}}}$$

$$\eta_{ve,\tilde{a}_E} = \frac{\partial VE^{SS}(\cdot)}{\partial G(\cdot)} \cdot \frac{\partial G(\cdot)}{\partial \tilde{a}_E} \cdot \frac{\tilde{a}_E}{VE^{SS}(\cdot)} = -\frac{\varepsilon^{SS}\varrho^{SS}R_E^{SS}\mu G'(\tilde{a}_E,\sigma_a,\mu)}{\varepsilon^{SS}\left(\varrho^{SS}\left[R_E^{SS}(1-\mu G(\tilde{a}_E,\sigma_a,\mu) - R^{SS}\right] + R^{SS}\right) + \frac{T_E}{VE^{SS}}} \cdot \tilde{a}_E$$

$$\eta_{ve,\sigma_a} = \frac{\partial VE^{SS}(\cdot)}{\partial G(\cdot)} \cdot \frac{\partial G(\cdot)}{\partial \sigma_a} \cdot \frac{\sigma_a}{VE^{SS}(\cdot)} = -\frac{\varepsilon^{SS} \varrho^{SS} R_E^{SS} \mu G_{\sigma_a}(\tilde{a}_E, \sigma_a, \mu)}{\varepsilon^{SS} \left(\varrho^{SS} \left[R_E^{SS}(1 - \mu G(\tilde{a}_E, \sigma_a, \mu) - R^{SS}\right] + R^{SS}\right) + \frac{T_E}{VE^{SS}}} \cdot \sigma_a.$$

Since $\eta_{ve,QK} \equiv \eta_{ve,K} = \eta_{ve,Q}$, the log-linearizing is given by:

$$\begin{aligned}
\hat{ve}_t = {} & \eta_{ve,\varepsilon} \hat{\varepsilon}_{s,t} + \left(\frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}} - \eta_{ve,R_E}\right) \hat{r}_{E,t} + \left(\eta_{ve,R} + \frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}}\right) \hat{r}_{t-1} \\
& + \left(\eta_{ve,ve} - \frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E} \varrho^{SS}}\right) \hat{ve}_{t-1} + \left(\eta_{ve,QK} + \frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E} \varrho^{SS}}\right) (\hat{q}_{t-1} + \hat{k}_{t-1}) \\
& + \left(\eta_{s,\sigma_a} \frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}} - \eta_{ve,\sigma_a}\right) \hat{\sigma}_{a,t-1}
\end{aligned}$$

and thus:

$$\hat{ve}_t = \eta_{ve,\varepsilon} \hat{\varepsilon}_{s,t} + \psi_{r_E} \hat{r}_{E,t} - \psi_r \hat{r}_{t-1} + \psi_{ve} \hat{ve}_{t-1} + \psi_{qk} (\hat{q}_{t-1} + \hat{k}_{t-1}) - \psi_{\sigma_a} \hat{\sigma}_{a,t-1}$$

where:

$$\begin{aligned}
\psi_{r_E} &= \left(\eta_{ve,R_E} - \frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}}\right) \\
\psi_r &= \left(\eta_{ve,R} + \frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}}\right) < 0 \\
\psi_{ve} &= \left(\eta_{ve,ve} - \frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E} \varrho^{SS}}\right) \\
\psi_{qk} &= \left(\eta_{ve,QK} + \frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E} \varrho^{SS}}\right) \\
\psi_{\sigma_a} &= \left(\eta_{s,\sigma_a} \frac{\eta_{ve,\tilde{a}_E}}{\eta_{s,\tilde{a}_E}} - \eta_{ve,\sigma_a}\right) < 0.
\end{aligned}$$

Finally, using the expressions in Appendix 6.1 and the steady-state values reported in Table II to compute the elasticities ($\eta_{ve,\varepsilon}$, ψ_{r_E}, ψ_r, ψ_{ve}, ψ_{qk}, ψ_{σ_a}), we obtain the log-linearized equation for law of motion for net worth of entrepreneurs:

$$\hat{ve}_t = 0.971 \cdot \hat{\varepsilon}_{s,t} + 1.894 \cdot \hat{r}_{E,t} - 2.876 \cdot \hat{r}_{t-1} + 0.967 \cdot \hat{ve}_{t-1} + 0.004 \cdot (\hat{q}_{t-1} + \hat{k}_{t-1}) - 0.005 \cdot \hat{\sigma}_{a,t-1}.$$

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