# Fair-Value Capital and Bank Solvency over the Monetary Policy Cycle *

**Vedant Agarwal**† **Jan Schäfer**‡

April 30, 2026

**Abstract**

We develop a quantitative general equilibrium model of banks that issue credit-risky loans and hold long-term, default-free government bonds to study how including unrealized gains and losses in regulatory capital affects lending and solvency over the monetary policy cycle. Despite partial hedging from deposit franchises, bond valuation changes shape credit supply. Regulatory accounting rules generate strongly asymmetrical effects across the monetary cycle: during tightening, fair-value accounting sharply reduces bank failures while only moderately contracting credit; during easing, it amplifies credit expansions with smaller increases in failures. Welfare gains from fair-value accounting are modest.

*Keywords*: Interest rate risk, credit risk, regulatory capital, accounting rules, financial stability

*JEL Classification*: G21, G28, G32, G33, E44, E51

*We are indebted to Rafael Repullo and Javier Suarez for guidance and support throughout this project. This paper has benefited from helpful comments and suggestions provided by Amil Dasgupta, Mausumi Das, Tetiana Davydiuk, Loriana Pelizzon, B Ravikumar, Anatoli Segura, as well as by participants at the 21st Macroeconomics and Finance Conference organized by IGIDR and the 5th Macroeconomics Conference organized by Shiv Nadar Institution of Eminence. A big part of this work was completed during Agarwal's PhD studies at CEMFI. Schäefer acknowledges financial support from grant PRE2022-101467, the Maria de Maeztu Unit of Excellence CEMFI MDM-2016-0684, funded by MCIN/AEI/10.13039/501100011033, and CEMFI.

†CAFRAL: vedant.agarwal@cafral.org.in

‡CEMFI: jan.schaefer@cemfi.edu.es

## Disclusure Statements

Vedant Agarwal states that he has nothing to disclose.

Jan Schäfer states that he has nothing to disclose.

# 1 Introduction

Banks hold a substantial fraction of their assets in long-term fixed-income securities that are highly liquid and nearly free of default risk. These securities allow banks to meet unexpected withdrawals from their predominantly short-term funding while earning a term premium. However, they also expose banks to interest rate risk: when the yield curve shifts upward, the market value of long-term securities declines, generating accounting losses that erode bank equity. Should such gains and losses affect banks' regulatory capital?

Recent regulatory debates have focused on this question. The Basel III framework contains proposals to incorporate unrealized gains and losses on certain securities into regulatory capital calculations. Yet, some bank managers, regulators and academics have argued that doing so may increase volatility in banks' regulatory capital and therefore amplify fluctuations in credit supply (see, e.g., Barth, Landsman, and Wahlen, 1995; Basel Committee on Banking Supervision, 2017).[1] At the same time, excluding unrealized valuation changes may allow banks to operate with inflated regulatory capital during periods of rising interest rates, potentially increasing effective leverage and financial stability risks (see, e.g., Flannery and Sorescu, 2023). Concerns along these lines were highlighted in the Federal Reserve's review of the failure of Silicon Valley Bank (Barr, 2023).

This paper contributes to the literature by studying this trade-off in a quantitative macro-banking model that jointly accounts for banks' exposure to credit and interest rate risk, and in which financial stability risks from unexpectedly high interest rates are most severe when accompanied by high default rates in banks' loan portfolio. We then evaluate how alternative regulatory accounting regimes affect credit supply, financial stability, and welfare.

To this end, we embed a credit-risk framework à la Mendicino et al. (forthcoming) in a

[1] Regulators have historically applied prudential filters that partially shield regulatory capital from fluctuations in the market value of debt securities. See Argimón, Dietsch, and Estrada (2018) for evidence on the heterogeneous use of such filters across euro area countries prior to the global financial crisis. Kim, Kim, and Ryan (2019) provide an overview of accounting and regulatory capital treatment of securities holdings in U.S. banks.

standard New-Keynesian model with investment. The credit-risk framework adds banks in a setup following the Bernanke, Gertler, and Gilchrist (1999) financial-accelerator tradition and we extend it extend by introducing long-term government bonds on bank balance sheets: banks use insured deposits and equity to extend one-period risky loans to entrepreneurial firms and invest in a portfolio of default-free long-term government bonds. The credit-risk framework explicitly takes into account the structure of asset returns implied by holding of risky loans whose risk of default is not fully diversifiable at the bank level. Investing in default-free long-term bonds issued by the government creates a maturity mismatch and exposes banks to interest rate risk. This is despite banks running a deposit franchise, setting deposit rates that are a fixed fraction of the policy rate, which implies that deposit spreads increase when the policy rate rises (see Drechsler, Savov, and Schnabl, 2021). This mechanism only partially, but not fully, hedges the interest rate risk associated with the long-term bond portfolio.

A key feature of the model is that regulatory capital requirements are based on a measure of bank equity that may differ from the economic value of bank assets. In the baseline regime, unrealized gains and losses on long-term bonds are excluded from the calculation of regulatory capital, consistent with accounting treatments that value such assets at amortized cost. As a result, when interest rates rise and bond prices fall, banks' regulatory capital may overstate their true loss-absorbing capacity. Limited liability and safety net guarantees then imply that banks operate with elevated effective leverage during periods of monetary tightening, amplifying the consequences of credit losses for bank solvency and macroeconomic outcomes.

To discipline the quantitative analysis, we estimate the model using the simulated method of moments, targeting macroeconomic, banking, and financial moments from euro area data over the period 1995–2016. The calibration replicates key features of bank balance sheets, including the average loans-to-bonds ratio and the maturity structure of bond holdings, which are central for capturing banks' exposure to interest rate risk. The model also generates loan pricing responses to balance-sheet losses that are consistent with empirical evidence: banks raise lending rates in response to unrealized losses on their bond portfolios, although less strongly than in response to realized changes in regulatory capital. Furthermore, the model generates episodes of large unrealized losses that are broadly consistent with the historical experience during the post-COVID tightening cycle, when aggressive monetary policy hikes after a period of particularly low policy rates led to substantial valuation losses on banks' long-term bond portfolios, as documented by Marsh and Laliberte (2023).

Using the estimated model, we compare two regulatory accounting regimes. In the baseline regime, regulatory capital is calculated using amortized-cost valuations of long-term bonds. In the alternative regime, unrealized gains and losses on bonds are included in the calculation of regulatory capital, so that bank capital more closely reflects the market value of bank assets. Recognizing unrealized valuation changes makes regulatory capital more sensitive to interest rate movements and therefore increases the volatility of credit supply. At the same time, it improves the alignment between regulatory constraints and banks' true loss-absorbing capacity. When unrealized losses are excluded, banks expand lending up to regulatory limits that are based on overstated capital during periods of rising interest rates. This increases their effective leverage and raises the probability of bank insolvencies when borrower defaults materialize. By contrast, including unrealized gains and losses in regulatory capital reduces banks' effective leverage in such periods and leads to more prudent lending decisions.

The magnitude of these effects is state-dependent, giving rise to pronounced asymmetries over the monetary policy cycle. The reason is that credit risk is an important amplifier of the accounting rules' effect on bank solvency: when underlying credit risk is high, the impact of the accounting regime on bank default probabilities becomes markedly larger. Therefore, amortized-cost accounting is particularly detrimental to bank solvency during tightening episodes, when higher rates both depress bond values and increase borrower default risk. During easing episodes, the logic reverses: lower policy rates improve bond valuation and contribute to lower firm default probabilities, implying that amortized-cost accounting leads to a more modest improvement in bank solvency.

This asymmetric impact of the accounting regime on bank solvency shapes its impact on lending. During tightening episodes, the increased bank default probability and resulting losses in bank equity under amortized-cost accounting partially offset the looser regulatory constraint implied by that regime.

As a result of this asymmetry, bank and firm default probabilities decline on average, lowering the deadweight costs associated with bankruptcies and thus freeing up resources for consumption. Despite somewhat more volatile credit, the economy experiences higher average consumption and lower consumption volatility, implying modest welfare gains from recognizing unrealized valuation changes in regulatory capital.

**Related literature** This paper belongs to the literature on quantitative models of bank regulation. Following the formalization of welfare trade-offs associated with capital regulation in Van den Heuvel (2008), a big strand of the literature has studied the optimal level of capital requirement (Begenau, 2020; Elenev, Landvoigt, and Van Nieuwerburgh, 2021; Abad, Martinez-Miera, and Suarez, 2024; Mendicino et al., forthcoming), the interaction of capital regulation and monetary policy (Angeloni and Faia, 2013; Collard, Dellas, Diba, and Loisel, 2017), the interaction of capital regulation and banking market structure (Corbae and D'Erasmo, 2021; Begenau and Landvoigt, 2022), and the rationale behind dynamic capital requirements (Davydiuk, 2017; Malherbe, 2020). In the models considered in this literature, banks' assets and liabilities are typically assumed to last only one period, thus rendering the discussion on interest rate risk and the capital treatment of unrealized gains or losses irrelevant. We extend the analysis adding long-term bonds to banks' assets and complement the existing literature by focusing on the implications of the prudential treatment of unrealized gains and losses for credit supply and banks' solvency.

A further innovation from a modeling perspective is that we integrate market power in deposit taking in such a framework. This is not trivial, as it makes the bank's objective function convex in lending: while deposit profits are safe, lending is risky. As a result, banks remain riskless up to a threshold level of lending determined by the size of deposit franchise profits, but beyond this point the probability of bank default rises with loan supply. Limited liability and safety-net guarantees imply that once banks become risky, their marginal incentives change. In equilibrium, bank equity is sufficiently scarce that banks lend up to the maximum level permitted by the regulatory capital requirement.

Our work is related to Begenau, Bigio, Majerovitz, and Vieyra (2025), who study a macroeconomic model in which differences in banks' book equity (relevant for regulation) and market equity arise from accounting rules which allow a delayed recognition of loan losses. As a result, regulation requiring instantaneous recognition of loan losses effectively tightens capital requirements. In contrast, the regulatory requirement to recognize revaluations of the long-term bonds portfolio in our model results in tighter capital requirements during monetary policy tightening and weaker requirements during monetary policy expansions.

Our work is also related to the literature on "accounting" (or capital measurement) issues in banking.[2] Several studies in this literature share a common theme that fair value accounting may lead financial institutions subject to capital regulation to conduct fire sales of illiquid or credit-risky assets (carrying a positive regulatory risk-weight, such that selling the asset improves the regulatory-equity-to-risk-weighted-assets ratio).[3] Among the papers studying accounting regimes with a focus on risky assets, Acharya, Mukherjee, and Sundaram (2021) are closest in spirit to our work in providing an ex-ante welfare analysis of fair-value versus historical-cost accounting that jointly considers lending and financial stabil-

[2] See Freixas and Tsomocos (2004) for an early theoretical contribution.

[3] For example, Allen and Carletti (2008) show that when financial markets are illiquid, such as during a financial crisis, the use of fair value accounting to assess solvency may lead to undesirable liquidation of banks' assets. See also Plantin, Sapra, and Shin (2008). Ellul, Jotikasthira, Lundblad, and Wang (2015) argue that when regulatory capital reflects fair value of risky assets, it creates incentives for financial institutions to sell risky assets during a financial crisis since it improves their risk-weighted capital ratios. However, the evidence presented in Laux and Leuz (2010) suggests it is unlikely that fair value accounting contributed to the severity of the 2008 financial crisis in a sizable way.

ity. Their mechanism, however, differs from ours, reflecting a different focus and leading to different implications for financial stability. They study how accounting regimes affect information disclosure about risky loans and the possibility of bank runs in a two-period model with asymmetric information. By contrast, our paper analyzes the regulatory treatment of unrealized valuation changes on relatively safe liquid debt securities such as government bonds, whose prices primarily respond to interest-rate movements and which carry a zero regulatory risk weight in many jurisdictions.

The prudential treatment of the latter became the focus of the accounting discussions in the wake of the 2023 U.S. regional banking crisis involving the failure of Silicon Valley Bank, for which valuation losses on US government bonds played an important role (see Barr, 2023). Greenwald, Krainer, and Paul (2024) and Orame, Ramcharan, and Robatto (2025) study how the regulatory accounting framework influences the transmission of monetary policy onto bank lending, showing that monetary policy is more effective in stimulating (or contracting) lending under fair-value accounting. Related to this, Gomez, Landier, Sraer, and Thesmar (2021) find evidence that a bank experiencing an increase (decrease) in its net interest income due to a change in the monetary policy rate augments (reduces) its lending compared to peers. The implications produced by our model regarding the same are consistent with these and other empirical findings (see e.g. Beutler, Bichsel, Bruhin, and Danton, 2020; Marsh and Laliberte, 2023). We complement these studies by underscoring the financial stability consequences of the regulatory accounting framework, so our work bridges this literature with the renewed discussions on the importance and implications of banks' interest rate risk exposure (Drechsler et al., 2021; Drechsler, Savov, Schnabl, and Wang, 2023; Haddad, Hartman-Glaser, and Muir, 2023; Jiang, Matvos, Piskorski, and Seru, 2024; DeMarzo, Krishnamurthy, and Nagel, 2024; Begenau, Landvoigt, and Elenev, 2024; Varraso, 2024).

**Outline** The rest of the paper is organized as follows. Section 2 describes our macro-banking model. Section 3 contains the solution method and calibration strategy, presents the baseline parameterization, and discusses the quantitative performance of the model. In Section 4 we analyze the performance of the economy under alternative regulatory accounting frameworks, identifying the approach that maximizes social welfare. The Appendix contains a complete list of equilibrium conditions and full description of the data sources, solution method, and several complementary materials referred throughout the main text.

# 2 The Model

We consider a discrete-time, infinite-horizon economy in which dates are indexed by $t$. The baseline framework is a financial accelerator model embedded in a standard New Keynesian model with investment.[4] Following the tradition of Gertler and Karadi (2011) each household consists of workers, entrepreneurs, and bankers. Workers supply labor to the production sector and transfer their wage income back to the household. Entrepreneurs and bankers provide equity to entrepreneurial firms and banks, respectively.

There exist a continuum of measure one of islands. In each island there is a continuum of measure one of entrepreneurial firms and a representative bank. Entrepreneurial firms and banks live for one period, issue equities among entrepreneurs and bankers, respectively, and obtain external financing by issuing non-contingent debt in the form of bank loans and deposits, respectively. Entrepreneurial firms use equity and loans to buy physical capital, which some intermediate good producers rent in the next period. Their terminal net worth is subject to both idiosyncratic and island-specific shocks. The latter is non-diversifiable from the banks' perspective. In addition to providing loans, banks invest in a portfolio of long-term bonds. Both entrepreneurial firms and banks operate under limited liability and default when their terminal asset value is lower than their debt obligations. Non-defaulted

[4] See e.g., Smets and Wouters (2007) and Christiano, Eichenbaum, and Evans (2005).

entrepreneurial firms and banks pay their terminal net worth to entrepreneurs and bankers, respectively.

In the rest of this section, we present the model ingredients in more detail.

## 2.1 Households

There is a unit continuum of households indexed by $h$, that provide consumption insurance to three types of members: workers, bankers and entrepreneurs.

Households derive utility from consumption $C_t$ and disutility from labor $H_t$. To improve the quantitative performance of the model, consumption is subject to internal habit formation governed by the parameter $b$.[5] Households provide differentiated labor hours $H_{ht}$ to intermediate goods-producing firms, remunerated at a nominal wage $W_{ht}$. The disutility derived from labor is governed by the inverse Frisch elasticity $\varphi_H$ and a scaling parameter $\xi_H$.

Households can save in fully insured bank deposits $D_t$ remunerated at gross interest rate $R_{Dt}$. To account for non-bank funding, households can also invest in physical capital $K_t^H$ at real price $Q_t$, subject to a management cost $\varsigma_t$, and rent it to intermediate good producers at rate $z_t$.[6] Physical capital depreciates at rate $\delta$. The nominal price of the single consumption good is denoted by $P_t$, and inflation is defined as $\Pi_t = P_t/P_{t-1}$ with steady state $\bar{\Pi}$.

With all these ingredients, the maximization problem of household $h$ is stated as:

$$\max_{\{C_{ht}, D_{ht}, K_{ht}^H, H_{ht}\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[ \frac{(C_{ht} - bC_{ht-1})^{1-\sigma}}{1-\sigma} - \frac{\xi_H H_{ht}^{1+\varphi_H}}{1+\varphi_H} \right], \tag{1}$$

[5]See, for example, Smets and Wouters (2007), Christiano et al. (2005), and Christiano, Motto, and Rostagno (2014).

[6]Capturing the non-bank-dependent part of the economy prevents our model from overstating the macroeconomic consequences of changes in credit supply.

subject to the budget constraint:

$$P_tC_{ht} + P_tD_{ht} + P_t(Q_t + \varsigma_t)K^H_{ht} = W_{ht}H_{ht}$$
$$+ R_{Dt-1}P_{t-1}D_{ht-1} + P_t[z_t + (1-\delta)Q_t]K^H_{ht-1} + \Sigma_{ht}, \quad (2)$$

where $\Sigma_{ht}$ summarizes other cash flows that the household receives, but which are irrelevant for its optimization problem. We assume that the household invests its deposits symmetrically in all the (symmetric) banks in the economy. Appendix A.1 provides the FOCs for this problem.

### 2.1.1 Nominal Wage Setting

The model features sticky wages.[7] A labor union collects all household-differentiated varieties of labor $H_{ht}$, which are sold to a competitive labor packer after setting nominal wages $W_{ht}$. The elasticity of substitution between varieties is $\epsilon_W$. Wage setting is subject to Rotemberg (1982) adjustment costs governed by parameter $\theta_W$ which the union finances by charging households a lump-sum fee. Since these elements are standard in New Keynesian models, further details are relegated to Appendix A.2.

### 2.1.2 Bankers & Entrepreneurs

Bankers and entrepreneurs are modeled in a symmetric manner, and are therefore discussed together in this section.

At date $t$, bankers and entrepreneurs invest symmetrically in an all-islands portfolio of one-period banks and entrepreneurial firms, respectively. Bankers and entrepreneurs receive the terminal net worth of their banks and firms at the beginning of $t+1$. At that point,

[7] As discussed in, e.g., Galí (2015) and Smets and Wouters (2007), sticky wages contribute to dampen the rise in inflation after, e.g., an expansionary monetary policy shock, consistent with data. In our setup this adds realism to the impact of debt deflation on financial sector defaults.

bankers are also charged a lump sum tax by the government to finance the deposit insurance agency (DIA).

To make bankers and entrepreneurs net worth scarce, we assume that in every period a fraction $(1-\theta_\chi), \chi \in \{B, E\}$ of bankers and entrepreneurs retire and become workers, while the same measure of workers becomes bankers and entrepreneurs. When they retire, they pay out their wealth to households. New bankers and entrepreneurs in period $t$ on the other hand receive a fraction $\xi_\chi$ of the net worth of the bankers and entrepreneurs that have retired in period $t$. Calibration of the parameters will ensure that equity is scarce enough for banks and entrepreneurs never to finance all their investments without debt.

In every period, continuing and new bankers and entrepreneurs decide how much (real) dividends $\nu_t^\chi$ to pay out to their households and how much (real) equity $\chi_t$ to invest in the equity portfolio (where $\chi_t = B_t$ for bankers and $\chi_t = E_t$ for entrepreneurs, respectively). Bankers and entrepreneurs take the nominal return on their equity $\rho_t^\chi$ as given. Stating the maximization problem in real terms, the value function of a representative banker or entrepreneur $i$ is

$$V_t^\chi(\chi_{it}) = \max_{\nu_{it}^\chi \geq 0, \chi_{it} \geq 0} \mathbb{E}_t \left[ \nu_{it}^\chi + \mathbb{E}_t \Lambda_{t,t+1} \left( (1-\theta_\chi)\chi_{t+1} + \theta_\chi V_{t+1}^\chi(\chi_{it+1}) \right) \right], \tag{3}$$

where $\Lambda_{t,t+1}$ is the household's real stochastic discount factor, and

$$\chi_{it+1} = \frac{\rho_{t+1}^\chi}{\Pi_{t+1}} (\chi_{it} - \nu_{it}^\chi). \tag{4}$$

Following the established approach in the literature, we guess and verify that the value function is linear in the net worth of banker or entrepreneur $i$: $V_t^\chi(\chi_{it}) = s_t^\chi \chi_{it}$.[8] We further guess (and later verify) that in the vicinity of the steady state we have $s_t^\chi > 1$, which implies

[8]See, for example, Gertler and Kiyotaki (2010).

$\nu_t^\chi = 0$ by the Envelope Theorem.[9] It then follows that

$$s_t^\chi = \mathbb{E}_t \underbrace{\Lambda_{t,t+1}\left(1-\theta_\chi+\theta_\chi s_{t+1}^\chi\right)}_{=\Lambda_{t,t+1}^\chi} \frac{\rho_{t+1}^\chi}{\Pi_{t+1}}. \tag{5}$$

Equation (5) defines the bankers', or entrepreneurs', stochastic discount factor for later use as $\Lambda_{t,t+1}^\chi = \Lambda_{t,t+1}(1-\theta_\chi+\theta_\chi s_{t+1}^\chi)$. Finally, the aggregate law of motion of equity of bankers or entrepreneurs is

$$\chi_{t+1} = [\theta_\chi + \xi_\chi(1-\theta_\chi)]\frac{\rho_{t+1}^\chi}{\Pi_{t+1}}\chi_t - \frac{T_{t+1}}{P_{t+1}}, \tag{6}$$

where $T_{t+1}$ are nominal lump-sum taxes imposed by the deposit insurance agency, described below in detail.

## 2.2 Entrepreneurial Firms

Entrepreneurial firms provide the key connection between the financial sector and the real economy: they rely on bank loans to invest in physical capital used in the production sector. They hence transmit conditions in the financial sector to the real economy through their (physical) capital supply, and in turn transmit conditions in the real economy to the financial sector through the impact of the real return on (physical) capital on the loan default probability.

Each island is populated by a unit continuum of entrepreneurial firms indexed by $j$. These are one-period institutions owned by entrepreneurs. Entrepreneurial firms purchase physical capital $K_{jt}^E$ from capital producers at real price $Q_t$. To finance their investment, they use loans $L_{jt}$ from the bank on their island and entrepreneurial equity $E_{jt}$:

$$E_{jt} + L_{jt} = Q_t K_{jt}^E. \tag{7}$$

[9] We make sure that under our calibration of the model parameters $s_t^\chi = 1$ with a probability close to 0 and thus directly impose $\nu_t^\chi = 0$.

At date $t+1$, entrepreneurial firms rent capital acquired at the end of $t$ to intermediate good producers against a rental price $z_{t+1}$, and sell undepreciated capital $(1-\delta)K_{jt}$ back to capital producers at real price $Q_{t+1}$.[10] Following Mendicino et al. (forthcoming), the final asset value of every entrepreneurial firm is subject to an idiosyncratic shock $\omega_j$ and an island specific shock $\omega_k$, engendering loan default risk which is only partly diversifiable at the island-specific banks. By limited liability, the nominal terminal net worth of entrepreneurial firm $j$ on island $k$ at time $t+1$ is

$$P_{t+1}\Omega^{Firm}_{jkt+1}(\omega_j,\omega_k) = \max\{\omega_j\omega_k[P_{t+1}Q_{t+1}(1-\delta)K^E_{jt} + P_{t+1}z_{t+1}K^E_{jt}] - R_{Ljt}P_tL_{jt}, 0\}. \quad (8)$$

According to Equation (8), entrepreneurial firm $j$ defaults at $t+1$ if its idiosyncratic shock is below the threshold $\bar{\omega}_{Ft+1}(\omega_k)$:

$$\bar{\omega}_{Ft+1}(\omega_k) = \frac{R_{Ljt}L_{jt}}{\omega_k\Pi_{t+1}\left[Q_{t+1}(1-\delta)K^E_{jt} + z_{t+1}K^E_{jt}\right]}. \quad (9)$$

To capture the impact of uncertainty on the fluctuation of default risk, we introduce Christiano et al. (2014) risk shocks in the same way as Mendicino et al. (forthcoming). Specifically, we assume the shocks $\omega_j$ and $\omega_k$ are independent and log-normal distributed, with time-varying mean and variance:

$$\ln(\omega_\Xi) \sim N\left(-\frac{\sigma^2_{\omega_\Xi t}}{2}, \sigma^2_{\omega_\Xi t}\right),\ \Xi \in \{j,k\}, \quad (10)$$

where the standard deviation $\sigma_{\omega_\Xi t}$ follows:

$$\ln(\sigma_{\omega_\Xi t}) = (1-\rho_{\omega_\Xi})\ln(\bar{\sigma}_{\omega_\Xi}) + \rho_{\omega_\Xi}\ln(\sigma_{\omega_\Xi t-1}) + \sigma_{\sigma_\Xi}\epsilon_{\sigma_\Xi},\ \epsilon_{\sigma_\Xi} \sim N(0,1). \quad (11)$$

[10]In contrast to models in which all production factors are pre-financed with loans (e.g., Mendicino et al. forthcoming and Hristov and Hülsewig, 2017), our setup with only pre-financed capital allows output at $t$ to respond to the monetary policy rate, as in the canonical New Keynesian model.

While the risk shocks $\epsilon_{\sigma_\Xi}$ are mean preserving ($\mathbb{E}(\omega_{\Xi t}) = 1 \; \forall t$), a higher value of $\sigma^2_{\omega_{\Xi t}}$ implies that the distribution of $\omega$'s has fatter tails, leading to higher default risk.

At the end of each period, all terminal net worth of entrepreneurial firms is paid out to entrepreneurs. The nominal return on entrepreneurial equity is:

$$\rho^E_{t+1} = \frac{\Pi_{t+1} \int_0^\infty \int_0^\infty \Omega^{Firm}_{jkt+1}(\omega_j, \omega_k) dF_{jt+1}(\omega_j) dF_{kt+1}(\omega_k)}{E_t}. \tag{12}$$

## 2.3 Banks

Each island is populated by a representative bank $k$. Like entrepreneurial firms, banks are active between two consecutive periods $t$ and $t+1$. In period $t$ banks combine equity $B_{kt}$ from bankers and insured deposits $D_{kt}$ from households in order to extend loans $L_{kt}$ to entrepreneurial firms operating in their island. The bank can also invest in both one-period government bonds $S_{kt}$, remunerated at the policy rate $R_t$ set by the central bank, and long-term zero-coupon bonds $S^L_{kt}$, trading at market price $Q^S_t$. The latter are purchased by banks from a *bond management company* in period $t$ and, if not maturing, resold to it in period $t+1$. The role of this company is discussed below in detail. For tractability, as in Hatchondo and Martinez (2009) and Chatterjee and Eyigungor (2012), these bonds are assumed to reach maturity in an independent random manner with probability $\frac{1}{m}$ per period so that in each period a fraction $\frac{1}{m}$ of them mature. This implies that the average maturity of the bonds is $m$ periods. In market value terms, banks face the following balance-sheet constraint

$$L_{kt} + S_{kt} + Q^S_t S^L_{kt} = B_{kt} + D_{kt}. \tag{13}$$

At the beginning of period $t$, every bank $k$ is endowed with an identical amount of equity $\bar{B}_t$ by bankers, such that $B_{kt} = \bar{B}_t$.

Banks extend loans in a perfectly competitive manner. It is assumed that in addition to the loan rate $R_{Lt}$, banks reap a non-pecuniary benefit $c_R$ per unit of lending, reflecting the value of lending relationships (recent empirical evidence of the value of such relationships to banks is provided in Agarwal, Chomsisengphet, Liu, Song, and Souleles (2018), with Boot (2000) surveying the theoretical underpinnings). It is thus costly for the bank to reduce lending beyond the bank's lending capacity implied by capital requirements (to be discussed below), reflecting a weakening in lending relationships.[11] The role of this assumption will be discussed below, alongside the bank's profit maximization problem.

Banks raise insured deposits $D_{kt}$ in a monopolistic manner at rate $R_{Dkt}$. The demand for deposits of bank $k$ is:

$$D(R_{Dkt}, R_{Dt}) = \left(\frac{R_{Dkt}}{R_{Dt}}\right)^{-\epsilon_D} D_t,$$

$\epsilon_D < -1$. (14)

Banks take the aggregate deposit rate

$$R_{Dt} = \left(\int_0^1 R_{Dkt}^{1-\epsilon_D} dk\right)^{\frac{1}{1-\epsilon_D}}$$

as given. This structure implies that deposit rate setting exhibits imperfect competition and delivers a sensitivity of deposit rates to the policy rate $R_t$ consistent with Drechsler et al. (2021), namely that deposit spreads are increasing in the policy rate.

In line with the deposit franchise framework of Drechsler et al. (2021), banks incur a per-period operating cost. As discussed therein, the operating cost has two important implications. First, it allows to view the deposit franchise as an implicit interest rate swap. Second, its presence helps the model generate empirically plausible levels of return on bank

[11] While each bank is a one-period institution, the bank's shareholders continue to profit from the banking relationship in the future. While we do not model such dynamics, this can for example be thought of as relationships embodied in the employees of the bank $k$ (documented in D'Andrea and Stivella, 2025), not in the institution per se, with a constant set of employees employed by the succession of banks on island $k$. Each bank is managed in the interest of shareholders, and internalizes the benefits of the lending relationship in this manner, but cannot use it to avoid default due to its non-pecuniary nature.

equity.

We model this operating cost as $C_{ft} = c_f L_t$ (in real terms). While the deposit franchise is conceptually tied to deposits—since deposit funding generates a margin $(R_t - R_{Dkt})D_{kt}$ —in general equilibrium deposits are tightly linked to lending through the balance sheet identity, implying that $D_t$ is proportional to $L_t$, up to fluctuations in leverage. Motivated by this relationship, we express the franchise in units of lending, which provides a parsimonious normalization in a setting where bank size is naturally measured by total lending.

Under this representation, the net payoff from deposit funding can be written as

$$L_t \left[ (R_t - R_{Dkt}) \frac{D_t}{L_t} - c_f \right]$$

highlighting that the relevant object is the deposit spread, expressed per unit of lending. This formulation preserves the economic role of the fixed cost emphasized by Drechsler et al. (2021), while maintaining model stability. This is because a strictly fixed operating cost would not adjust with bank size and can lead to dynamics in which banks are unable to rebuild equity when capital becomes scarce, thereby generating instability and counterfactual corner solutions with zero aggregate lending. By contrast, the proportional specification preserves increasing returns to equity in such states and ensures well-behaved equilibrium dynamics, including satisfaction of the Blanchard–Kahn conditions.

Finally, to allow the model to jointly match (i) the average spread between deposit rates and the policy rate and (ii) the low pass-through of policy rates to deposit rates documented by Drechsler et al. (2021), we introduce adjustment costs in deposit rate setting in the spirit of Gerali, Neri, Sessa, and Signoretti (2010). Each bank $k$ faces a quadratic cost

$$\frac{\kappa_D}{2} \left( \frac{R_{Dkt}}{R_{Dkt-1}} - 1 \right)^2 R_{Dkt} D_{kt}$$

which penalizes deviations from the deposit rate of the previous period. This friction slows down the adjustment of deposit rates and is key to reproducing the empirically observed sluggishness in deposit pass-through. A more detailed discussion is provided when deriving the optimal deposit rate condition.

**Intertemporal trade of the long-term bonds.** The banking industry operates a long-term bond management company which centralizes the trade of bonds between the subsequent cohort of banks. The main role of this company is to keep track of the amortized-cost value of the loans to replicate the situation in which bonds were held by banks operating over multiple periods. At date $t$, this company buys the bonds at (real) market price $Q_t^S$ from surviving banks that bought them at $t-1$ and from the Deposit Insurance Agency (DIA), which repossesses the bonds from failing banks that bought them at $t-1$. Then, the company sells the bonds at market price to the new cohort of banks that buy them (together with the newly issued long-term bonds) at $t$.

Importantly, this company provides a "certificate of amortized-cost value" to the bonds, which allows banks to write their balance sheet for regulatory purposes (in real terms) as follows:

$$L_{kt} + S_{kt} + Q_t^{AC} S_{kt}^L = \bar{B}_t + D_{kt} + (Q_t^{AC} - Q_t^S) S_{kt}^L, \tag{15}$$

where $Q_t^{AC}$ is the real average amortized-cost value of bonds according to the certificate, and $(Q_t^{AC} - Q_t^S)S_{kt}^L$ measures what would be regarded as unrealized capital losses (if $Q_t^{AC} > Q_t^S$) or gains (if $Q_t^{AC} < Q_t^S$) if the bank were measuring the value of its bonds at their certified amortized cost. Given the permanent inventory dynamics of the stock of long-term bonds, the law of motion of $Q_t^{AC}$ is given by:

$$Q_t^{AC} S_{kt}^L = \frac{Q_{t-1}^{AC}}{\Pi_t} \left(1 - \frac{1}{m}\right) S_{kt-1}^L + Q_t^S \left[ S_{kt}^L - \left(1 - \frac{1}{m}\right) S_{kt-1}^L \right], \tag{16}$$

where the first term in the right hand side represents the continuation amortized-cost value of the non-matured bonds, and the second term is the market value of the newly issued bonds acquired by the bond management company in the primary bond market.[12]

**Capital requirement.** Banks are subject to a minimum capital requirement, which imposes that banks must operate with *regulatory* equity capital greater than or equal to a fraction $\gamma$ of their loans. The key novelty in our analysis is the comparison of capital requirements under two different definitions of regulatory capital. Under a fair-value definition, the capital requirement is of the following form:

$$\gamma L_{kt} \leq \bar{B}_t. \tag{17}$$

Under the amortized-cost definition, the requirement takes the following form:

$$\gamma L_{kt} \leq B_{kt}^{AC}, \tag{18}$$

where

$$B_{kt}^{AC} \equiv \bar{B}_t + (Q_t^{AC} - Q_t^S) S_{kt}^L \tag{19}$$

represents the amortized-cost value of bank equity, which is defined using Equation (15). Therefore, the difference between the two resulting capital requirements arises from the prudential treatment of *unrealized* gains and losses associated with banks' long-term bonds portfolio.

**Terminal net worth of a bank.** As derived in Equation (9), conditional on the island-idiosyncratic shock $\omega_k$, an entrepreneurial firm pays back its loan in full when it experiences a firm-idiosyncratic shock no lower than $\bar{\omega}_{Ft+1}(\omega_k)$. In case of default of an entrepreneurial firm, the bank only recovers a fraction $(1-\delta_M)$ of the firm's terminal asset value in Equation (8), where $\delta_M$ is an asset repossession cost. Hence, the nominal ex-post gross rate of return

[12] Note that the amortized-cost value of the newly issued bonds coincides with the market value.

on loans of the bank in island $k$ is

$$\tilde{R}_{Lkt+1}(\omega_k) = \frac{\omega_k(1-\delta_M)\Pi_{t+1}[Q_{t+1}(1-\delta)+z_{t+1}]K_t^E}{L_t} \int_0^{\bar{\omega}_{Ft+1}(\omega_k)} \omega_j dF_{jt+1}(\omega_j)$$
$$+ R_{Lkt} \int_{\bar{\omega}_{Ft+1}(\omega_k)}^{\infty} dF_{jt+1}(\omega_j), \tag{20}$$

where $K_t^E$ denotes the aggregate level of physical capital held by entrepreneurs. By definition of the entrepreneurial firm's default threshold in Equation (9), the first term is bounded by $R_{Lkt}$: when borrowers default, they repay less than the agreed loan rate, otherwise they repay fully. Thus the model features a structural link between bank asset returns and borrower defaults, which is crucial to accurately capture the importance of the feedback loop between conditions in the real economy and the financial sector (see Mendicino et al., forthcoming).

Due to the stochastic maturity of the long-term bond portfolio, the nominal gross rate of this portfolio is:

$$R_{kt+1}^S = \frac{\frac{1}{m} + \left(1 - \frac{1}{m}\right)\Pi_{t+1}Q_{t+1}^S}{Q_t^S}. \tag{21}$$

The nominal terminal net worth of the bank on island $k$ is then

$$P_{t+1}\Omega_{kt+1}^B(\omega_k) = P_t\Big[\tilde{R}_{Lkt+1}(\omega_k)L_{kt} + R_tS_{kt} + R_{kt+1}^SQ_t^SS_{kt}^L - C_{ft}$$
$$- R_{Dkt}D_{kt} - \frac{\kappa_D}{2}\left(\frac{R_{Dkt}}{R_{Dkt-1}} - 1\right)^2 R_{Dkt}D_{kt}. \tag{22}$$

Banks default on their deposits if their terminal net worth is negative. From Equation (22), it is useful to define a threshold value for the island-specific shock $\omega_k$ below which the bank in island $k$ defaults. This is implicitly done in the next equation

$$\tilde{R}_{Lkt+1}(\bar{\omega}_{bkt+1})L_{kt} + R_tS_{kt} + R_{kt+1}^SQ_t^SS_{kt}^L - R_{Dkt}D_{kt} - C_{ft} - \frac{\kappa_D}{2}\left(\frac{R_{Dkt}}{R_{Dkt-1}} - 1\right)^2 R_{Dkt}D_{kt} = 0. \tag{23}$$

Equation (23) implies that the banks' failure rate at the beginning of period $t+1$ is

$F_{kt+1}(\bar{\omega}_{bkt+1})$. Thus, the nominal gross rate of return on the portfolio of equity of a banker that symmetrically invests in all banks is

$$\rho^B_{t+1} = \frac{\Pi_{t+1} \int_{\bar{\omega}_{bkt+1}}^{\infty} \Omega^B_{kt+1}(\omega_k) dF_{kt+1}(\omega_k)}{\bar{B}_t}. \tag{24}$$

**Bank's profit maximization problem.** Banks are managed in the interest of bankers, and maximize:

$$\max_{L_{kt}, S_{kt}, S^L_{kt}, R_{Dkt}} \mathbb{E}_t \frac{\Lambda^B_{t,t+1}}{\Pi_{t+1}} \left\{ c_R L_{kt} + \int_0^{\infty} \max \left[ \tilde{R}_{Lkt+1}(\omega) L_{kt} + R_t S_{kt} + \right.\right. \tag{25}$$
$$\left.\left. R^S_{t+1} Q^S_t S^L_{kt} - C_{ft} - \left[ 1 + \frac{\kappa_D}{2} \left( \frac{R_{Dkt}}{R_{Dkt-1}} - 1 \right)^2 \right] R_{Dkt} D_{kt}, 0 \right] F_{kt+1}(\omega) \right\}$$

subject to

$$L_{kt} + S_{kt} + Q^S_t S^L_{kt} = D_{kt} + \bar{B}_t, \tag{26}$$

$$D_{kt} = \left( \frac{R_{Dkt}}{R_{Dt}} \right)^{-\epsilon_D} D_t, \tag{27}$$

and under fair-value capital requirements:

$$\gamma L_{kt} \leq \bar{B}_t, \tag{28}$$

while under amortized-cost requirements:

$$\gamma L_{kt} \leq B^{AC}_{kt}. \tag{29}$$

First, the problem implies the following arbitrage condition for the two bond types:

$$\mathbb{E}_t \frac{\Lambda^B_{t,t+1}}{\Pi_{t+1}} \left[ R^S_{kt+1} - R_t \right] \left[ 1 - F_{kt+1}(\bar{\omega}_{bkt+1}) \right] = 0. \tag{30}$$

The expression shows the close link between the policy rate and the yield of the long-term bond portfolio. This relationship is central to the effects of monetary policy on unrealized gains or losses that banks' faces. In line with the empirical evidence in Marsh and Laliberte (2023), it implies that banks in the model face valuation losses on their long-term bond portfolio when the policy rate rises.

Next, the optimal deposit rate $R_{Dt}$ is independent of all other choices, and is determined by:

$$-1 + \epsilon_D - \epsilon_D(R_t - R_{Dkt}) - \kappa_D \left( \frac{R_{Dkt}}{R_{Dkt-1}} - 1 \right) \frac{R_{Dkt}}{R_{Dkt-1}} = 0 \tag{31}$$

We restrict attention to a symmetric equilibrium in which all banks offer the same deposit rate in every period. This implies $R_{Dt} = R_{Dkt}$, as well as $D_t = D_{kt}$.

To understand the role of adjustment costs, note that in their absence, the deposit rate would be given by

$$R_{Dt}^{noAdj} = \frac{\epsilon_D}{\epsilon_D - 1} R_t$$

In order for the model to reproduce realistic deposit spreads, the ratio $\frac{\epsilon_D}{\epsilon_D - 1} < 1$ has to be close to 1. However, since in the case without adjustment costs the ratio coincides with the sensitivity of the deposit rate to the policy rate (i.e., the deposit beta), this is at odds with empirical evidence of a deposit beta well below 1 (Drechsler et al., 2021; Bonfim and Queiró, 2024). Adjustment costs for deposit rates allow the model to reproduce simultaneously a realistic deposit spread and a realistic sensitivity of the deposit rate to the policy rate. This is important in our context, since Drechsler et al. (2021) argue that the relative insensitivity of deposit rates to changes in the policy rate hedges interest rate risk exposure of banks.

Furthermore, it can be proven that for any deposit rate (including the optimal deposit rate), the objective function is convex in the loan volume $L_{kt}$ (but not necessarily strictly convex). Banks are indifferent between any $L_{kt} \in [0, \bar{L}_t]$ (where $\bar{L}_t = \frac{\bar{B}_t}{\gamma}$ under fair-value capital requirements or $\bar{L}_t = \frac{B_t^{AC}}{\gamma}$ under amortized-cost capital requirements) if two conditions are simultaneously satisfied: if (i) a bank makes profits on non-lending activities that are so high that the bank never fails for any feasible loan volume $L < \bar{L}_t$ , and (ii) the loan rate fulfills:

$$\mathbb{E}_t \frac{\Lambda^B_{t,t+1}}{\Pi_{t+1}} \left[ c_R + \int_{\bar{\omega}_{bkt+1}}^{\infty} \left[ \tilde{R}_{Lt+1}(\omega) - R_t \right] dF_{kt+1}(\omega) \right] = 0. \tag{32}$$

Otherwise, there is a corner solution and either $L^*_{kt} = 0$ or the bank chooses the maximum loan volume it can extend without violating the capital requirement, i.e. $L^*_{kt} = \frac{\bar{B}_t}{\gamma}$ under fair-value based capital requirements, and $L^*_{kt} = \frac{B^{AC}_t}{\gamma}$ under amortized-cost based requirements. Which corner is optimal for the bank depends on the loan rate $R_{Lkt}$, which the bank takes as given. The proof can be found in the Appendix. In summary, banks strictly prefer extending loans if the expected ex-post return is such that:

$$\begin{aligned} &\mathbb{E}_t \frac{\Lambda^B_{t,t+1}}{\Pi_{t+1}} \int_{\bar{\omega}_{bkt+1}}^{\infty} \Bigg\{ [\tilde{R}_{Lkt+1}(\omega) - R_t(1-\gamma)]\bar{L}_t + (R_t - R_{Dt})D_t - \frac{\kappa_D}{2}\left(\frac{R_{Dt}}{R_{Dt-1}} - 1\right)^2 R_{Dt}D_t \\ &+ (R^S_{t+1} - R_t)Q^S_t S^L_{kt} - C_{ft} \Bigg\} dF_{kt+1}(\omega) \\ &> \mathbb{E}_t \frac{\Lambda^B_{t,t+1}}{\Pi_{t+1}} \left[ (R^S_{t+1} - R_t)Q^S_t S^L_{kt} + (R_t - R_{Dt})D_t - \frac{\kappa_D}{2}\left(\frac{R_{Dt}}{R_{Dt-1}} - 1\right)^2 R_{Dt}D_t - C_{ft} + R_t\bar{B}_t - c_R\bar{L}_t \right]. \end{aligned} \tag{33}$$

This condition is verified numerically under the calibration explained in the next section. The role of the non-pecuniary benefit $c_R$ is to make sure that under that calibration banks don't switch between extending zero loans and operating at maximum lending capacity, a pattern not observed in the data.[13]

Assuming that (33) is fulfilled, all banks choose identical loan volumes $\bar{L}_t$, as they receive the same level of equity from bankers. The $k$ index is therefore dropped in continuation. Bank payoffs at time $t$ are then a function of the maximum loan volume $\bar{L}_{t-1}$ the bank can

[13] If $c_R$ were set to zero, equity would need to be made artificially scarce for (33) to hold in every period, implying counterfactually large loan spreads.

extend at time $t-1$ to comply with capital requirements, and are given by:

$$\Omega_t^B(\bar{L}_{t-1}) = \Bigg[(R_{t-1} - R_{Dt-1})D_{t-1} + \frac{\kappa_D}{2}\left(\frac{R_{Dt-1}}{R_{Dt-2}} - 1\right)^2 R_{Dt-1}D_{t-1}$$
$$- C_{ft-1} + (R_t^S - R_{t-1})Q_{t-1}^S S_{t-1}^L\Bigg](1 - F_{kt}(\bar{\omega}_{kt})) + \int_{\bar{\omega}_{bt}}^{\infty}\left[(\tilde{R}_{Lkt}(\omega) - R_{t-1}(1-\gamma))\bar{L}_{t-1}\right] dF_{kt}(\omega). \tag{34}$$

**Deposit insurance agency.** The DIA supervises the liquidation process of failed-bank assets, which is subject to proportional repossession costs $\delta_B$.[14] It imposes a nominal lump-sum tax $T_{t+1}$ on bankers to (ex-post) balance its budget period-by-period. The total nominal lump sum tax $T_{t+1}$ is

$$\frac{T_{t+1}}{P_t} = \left[R_{Dt}D_t + \frac{\kappa_D}{2}\left(\frac{R_{Dt}}{R_{Dt-1}} - 1\right)^2 R_{Dt}D_t + C_{ft} - R_{t+1}^S Q_t^S S_t^L - R_t S_t\right] F_{kt+1}(\bar{\omega}_{kt+1})$$
$$- (1-\delta_B)\left[\int_0^{\bar{\omega}_{bt+1}} \tilde{R}_{Lt+1}(\omega) L_t \, dF_{kt+1}(\omega)\right]. \tag{35}$$

## 2.4 Contracting Problem Between Firms & Banks

Entrepreneurial firms enter a contract with the bank on their island $k$ that specifies the loan rate and the leverage of entrepreneurs (or equivalently: the loan rate, the loan volume and the total amount of capital bought). Bankers are indifferent between any combination of

[14] The model follows Bernanke et al. (1999) in adopting a "costly state verification" setup, by which the DIA must incur a cost that is proportional to the assets of the bank in order to observe the realization of the idiosyncratic shocks.

loan rates and leverage on their iso-expected-profit curve:

$$\bar{\Omega}_t^b = \mathbb{E}_t \frac{\Lambda_{t,t+1}^B}{\Pi_{t+1}} \int_{\bar{\omega}_{bt+1}}^{\infty} \Bigg[ (\tilde{R}_{Lt+1}(\omega) - R_t(1-\gamma))L_t + (R_t - R_{Dt})D_t - \frac{\kappa_D}{2}\left(\frac{R_{Dt}}{R_{Dt-1}} - 1\right)^2 R_{Dt}D_t + (R_{t+1}^S - R_t)Q_t^S S_{kt}^L - C_{ft} \Bigg] dF_{kt+1}(\omega). \tag{36}$$

Entrepreneurial firm $jk$ active from time $t$ to $t+1$ maximizes its properly discounted value for entrepreneurs $\mathbb{E}_t(\Lambda_{t,t+1}^E \Omega_{jkt+1}^{Firm})$, by choosing a point on the bank's isoprofit curve.[15] From the perspective of the firms, the total loan volume $L_t$ intermediated by each bank is exogenous (and given by either $\frac{\bar{B}_t}{\gamma}$ or $\frac{B_t^{AC}}{\gamma}$ depending on the type of capital requirements). As in Mendicino et al. (forthcoming), firms also take the bank's default cutoff as given. Using Eq. (5), in equilibrium it must be that $s_t\bar{B}_t = \bar{\Omega}_t^b$. The contracting problem between the entrepreneurial firm and the bank on island $k$ is then given by:

$$\max_{K_{jkt}, L_{jkt}, R_{Ljkt}} \mathbb{E}_t \Lambda_{t,t+1}^E \Omega_{jkt+1}^{Firm} \tag{37}$$

subject to Eq. (7), Eq. (36).

The FOCs are presented in Appendix A.7.

## 2.5 Fiscal Policy

As discussed above, there are two types of government bonds in this model: one-period bonds and long-term bonds. Both are assumed to be in fixed real supply: for the one-period bonds we assume a zero net-supply, while for the long-term bonds we assume a positive real supply $S^L$, a parameter to be calibrated. To introduce a demand side shock, we also assume that the fiscal authority engages in government spending $G_t$, governed by the following AR(1)

[15] There is no reason for entrepreneurial firms to make bankers better off than necessary for them to participate, therefore the contract they offer lies on the bank's iso-expected-profit curve.

process:

$$\ln(G_t) = (1-\rho_g)\ln(G) + \rho_g \ln(G_{t-1}) + \sigma_g \epsilon_{Gt},\ \epsilon_{Gt} \sim N(0,1). \tag{38}$$

We assume that the government balances its budget in every period by charging households a lump-sum tax.

## 2.6 Monetary Policy

We assume that there is a central bank which sets the nominal gross policy rate $R_t$ according to the following Taylor rule:

$$R_t = R^{1-\phi_R} R_{t-1}^{\phi_R} \left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\phi_\pi(1-\phi_R)} \left(\frac{Y_t}{Y_{t-1}}\right)^{\phi_Y(1-\phi_R)} \tau_t, \tag{39}$$

where $R$ is the long-term target monetary policy rate, and $\bar{\Pi}$ is steady state inflation. $\phi_R$ is a smoothing parameter, while $\phi_Y$ and $\phi_\pi$ govern how strongly the central bank reacts to deviations from GDP and inflation, respectively. $\tau_t$ is a monetary policy shock evolving according to

$$\ln(\tau_t) = \rho_\tau \ln(\tau_{t-1}) + \sigma_\tau \epsilon_{\tau t}, \quad \epsilon_{\tau t} \sim N(0,1). \tag{40}$$

## 2.7 Production

The description of the production side of the economy follows a standard New Keynesian formulation and its full description is relegated to Appendix A.3. Here, it shall suffice to state a few elements. The aggregate production function is

$$Y_t = \theta_t K_{t-1}^{\alpha} H_t^{1-\alpha},\ \text{with } \alpha \in [0,1], \tag{41}$$

where $K_t$ and $H_t$ are aggregate physical capital and aggregate labor hours, respectively, and aggregate productivity $\theta_t$ is stochastic and follows an AR(1) process:

$$\ln(\theta_t) = \rho_\theta \ln(\theta_{t-1}) + \sigma_\theta \epsilon_{\theta t}, \quad \epsilon_{\theta t} \sim N(0,1). \tag{42}$$

The New Keynesian Phillips Curve of the model, arising from the problem of a unit continuum of final good producers facing a stochastic elasticity of substitution between intermediate goods $\mu_t$, as well as Rotemberg (1982) price adjustment costs is

$$\theta_R \left(\frac{\Pi_t}{\bar{\Pi}} - 1\right) \frac{\Pi_t}{\bar{\Pi}} = \mathbb{E}_t \Lambda_{t,t+1} \theta_R \left(\frac{\Pi_{t+1}}{\bar{\Pi}} - 1\right) \frac{\Pi_{t+1}}{\bar{\Pi}} \frac{Y_{t+1}}{Y_t} + mc_t \mu_t + (1 - \mu_t). \tag{43}$$

The stochastic elasticity of substitution $\mu_t$ also follows an AR(1) process:

$$\ln(\mu_t) = (1 - \rho_\mu)\ln(\mu) + \rho_\mu \ln(\mu_{t-1}) + \sigma_\mu \epsilon_{\mu t}, \quad \epsilon_{\mu t} \sim N(0,1). \tag{44}$$

Physical capital is produced by combining the final good with undepreciated capital, subject to an adjustment cost of $\mathcal{C}\left(\frac{I_t}{K_{t-1}}\right)$ as in Jermann (1998).[16] The aggregate capital stock evolves according to:

$$K_t = I_t + (1 - \delta)K_{t-1} + \mathcal{C}\left(\frac{I_t}{K_{t-1}}\right) K_{t-1}. \tag{45}$$

[16]The functional form is $\mathcal{C}\left(\frac{I_t}{K_{t-1}}\right) = \frac{a_{k,1}}{1-\frac{1}{\kappa}} \left(\frac{I_t}{K_{t-1}}\right)^{1-\frac{1}{\kappa}} + a_{k,2}$. While $\kappa$ is estimated, $a_{k,1}$ and $a_{k,2}$ are set such that in steady state $I = \delta K$ and $\mathcal{C}(\delta) = 1$.

## 2.8 Capital Management Firms

There is a unit continuum of competitive capital management firms. They charge households a fee $\varsigma_t$ per unit of capital, and face costs of $\frac{\kappa_H}{2}(K_t^H)^2$. Their maximization problem is:

$$\max_{K_t^H} \varsigma_t K_t^H - \frac{\kappa_H}{2}(K_t^H)^2. \tag{46}$$

# 3 Solution, Estimation, and Model Validation

This section outlines the computational method used to obtain the numerical solution of the model, discusses the calibration strategy, and explores the quantitative properties of the model.

## 3.1 Solution Method

The model is solved around the zero inflation steady state ($\bar{\Pi} = 1$), in line with much of the New Keynesian literature (see Galí, 2015). We employ third-order perturbation methods to obtain an approximation of the policy functions around the deterministic steady state.[17] The integrals involving the realized ex-post returns on bank loans (as well their derivatives) cannot be written as an explicit function of the state variables, which introduces a complication. We follow Mendicino et al. (forthcoming) in overcoming this challenge by approximating the integrals by a sum of third-order Taylor approximations. More details are provided in Appendix A.7.

[17] See Christiano et al. (2014), Born and Pfeifer (2014), and Mendicino et al. (forthcoming) for discussions on the necessity of third-order approximations to appropriately capture the effects of volatility shocks, such as those affecting the cumulative distribution functions of the firm-idiosyncratic and island-specific shocks.

## 3.2 Model Estimation

The model is calibrated to quarterly euro-area data from 1995 Q1 to 2016 Q4. Following standard practices, the calibration of the model proceeds in two steps.[18]

**First step.** The coefficient of relative risk aversion $\sigma$ is set to 1, which implies log-utility, the Frisch elasticity of labor supply $\varphi_H$ to 1, the capital-share parameter of the intermediate goods production function $\alpha$ to 0.25, and the value of capital depreciation $\delta$ to 0.025. The elasticity of substitution parameters for differentiated labor services $\epsilon_W$ and final goods $\mu$ are set to 5 and 7.25, respectively, resulting in a wage markup of 20% (Smets and Wouters, 2003), and a markup of 16% in the goods market which is consistent with euro-area estimates reported in Christopoulou and Vermeulen (2012). The scaling parameter $\xi_N$ associated with labor disutility is set to normalize a steady-state labor supply of $H = 1$. Following Stähler and Thomas (2012), the steady state government spending $G$ is set to 22.56% of GDP. Following Born and Pfeifer (2014), we estimate the government spending shocks externally by OLS on Equation (38) (in logs).

The maturity of long-term bonds $m$ is set to 13.6, which implies an average maturity of bank bond holdings of 3.4 years (Hoffmann, Langfield, Pierobon, and Vuillemey, 2019). The value of bankruptcy parameters $\delta_B$ and $\delta_M$ are both set equal to 0.30, in line with empirical studies (e.g. Alderson and Betker, 1995; Djankov, Hart, McLiesh, and Shleifer, 2008; Granja, Matvos, and Seru, 2017). We set both $\theta_B$ and $\theta_E$ to 0.975, implying that bankers and entrepreneurs remain active for ten years on average. Finally, the minimum capital requirement $\gamma$ is set to 0.08, consistent with the requirement under Basel II.

[18]See e.g. Fernández-Villaverde, Guerrón-Quintana, Rubio-Ramirez, and Uribe (2011) and Born and Pfeifer (2014) for examples of DSGE models estimated in a two-step procedure using the Simulated Method of Moments.

**Second step.** The remaining parameters are estimated using the Simulated Method of Moments (SMM).[19,20] We obtain the model implied moments by simulating our baseline economy, under which banks' regulatory capital is defined on the basis of the amortized-cost of their bonds portfolio. Our estimation targets include a number of macroeconomic, financial, and banking moments. We target the standard deviations and first two auto-correlations of GDP, consumption, investment, inflation, wages, the policy rate and labor hours, as well as their correlation with GDP. We also target a range of moments related to financial markets. These are the mean and standard deviation of the conditional expectation of firm and bank default rates and the unconditional correlation between the two default probabilities, the mean and standard deviation of the loan rate spread, the average deposit rate spread, the average central bank policy rate, the average aggregate loan to GDP ratio, the share of physical capital owned by households, and the average ratio of loans to bonds on bank's balance sheets. We also target the sensitivity of the deposit rate to the policy rate, given its importance in determining the degree of interest rate hedging of the deposit franchise (Drechsler et al., 2021). Known as deposit beta, it is commonly measured as the coefficient of a linear regression of the deposit rate on the policy rate. For Euro Area household deposits, Bonfim and Queiró (2024) report a deposit beta of 0.67. Finally, we target the size of GDP contractions after a large decrease in bank equity: Baron, Verner, and Xiong (2021) report an average 4% equity decline within a year after a 30% drop in bank equity.

Tables 1 and 2 provide the values of moments targeted in the data, and compare them to their model generated counterparts. Parameters value are reported in the Appendix (Table 6). We obtain data on GDP, consumption, investment, government spending, total wages, hours worked, the GDP deflator and population from the OECD Quarterly National Ac-

[19]The set of estimated parameters is $\beta, \xi_B, \xi_E, \sigma_{\omega_k}, \rho_{\omega_k}, \rho_{\omega_j}, \sigma_{\omega_j}, \bar{\sigma}_{\omega_k}, \bar{\sigma}_{\omega_j}, \sigma_\theta, \rho_\theta, \sigma_\tau, \rho_\tau, \sigma_\mu, \rho_\mu, b, \theta_R, \theta_W, \kappa, \kappa_H, \kappa_D, \phi_R, \phi_\Pi, \phi_Y, S^L$.

[20]The good properties of SMM for estimation of non-linear DSGE models have been established in Ruge-Murcia (2012).

counts. Data on financial corporation loan volumes, loan rates and riskless interest rates are obtained from the ECB Statistical Data Warehouse.[21] All series are adjusted for seasonality

**Table 1:** *Calibration targets and model fit (macroeconomic)*

| | $\sigma_{x_t}/\sigma_{\Delta y_t}$ (Y: $\sigma_{\Delta y_t}$) | | $\rho(x_t, \Delta y_t)$ | |
|---|---|---|---|---|
| | Data | Model | Data | Model |
| $\Delta Y$ | 1.186 | 1.246 | 1 | 1 |
| $\Delta C$ | 0.746 | 0.789 | 0.915 | 0.513 |
| $\Delta I$ | 2.594 | 2.833 | 0.93 | 0.638 |
| $\Pi$ | 0.229 | 0.451 | 0.326 | 0.263 |
| $\Delta w$ | 0.478 | 0.403 | -0.164 | -0.093 |
| $R$ | 0.308 | 0.235 | 0.489 | 0.372 |
| $H$ | 1.828 | 3.03 | 0.217 | 0.596 |
| | $\rho(x_t, x_{t-1})$ | | $\rho(x_t, x_{t-2})$ | |
| $\Delta Y$ | 0.905 | 0.768 | 0.705 | 0.546 |
| $\Delta C$ | 0.888 | 0.918 | 0.702 | 0.747 |
| $\Delta I$ | 0.872 | 0.948 | 0.754 | 0.826 |
| $\Pi$ | 0.437 | 0.798 | 0.372 | 0.671 |
| $\Delta w$ | 0.868 | 0.831 | 0.787 | 0.585 |
| $R$ | 0.971 | 0.912 | 0.922 | 0.774 |
| $H$ | 0.915 | 0.952 | 0.837 | 0.899 |

Notes: All series are seasonally adjusted and all variables except $\Pi$ and $R$ are in logs. $\Delta^{HP}$ indicates the Hodrick-Prescott filter with HP parameter 1600. Data sources and variable definitions are described in Appendix B.

and those series that exhibit trends are detrended using the Hodrick-Prescott filter.[22] The

[21]The loan volume series include all available maturities. The loan spread is constructed as a volume weighted average over maturities, where the riskless rate is taken as the short term rate published by the ECB for maturities less than 1 year, the 2-year yield on triple A euro-area government bonds (published by the ECB) for maturities between 1 and 5 years, and the corresponding 5-year yield for maturities over 5 years.

[22]Given that our data is quarterly, following Ravn and Uhlig (2002), we set the HP parameter to 1600. For those series that are not directly available with seasonal adjustment, such as loans, seasonal adjustment is done using X13-ARIMA using the R package seasonal.

**Table 2:** *Calibration targets and model fit (financial)*

| Moment | Description | Data | Model |
|---|---|---|---|
| $100\mathbb{E}_t\left[\int_0^\infty F_{jt+1}(\bar{\omega}_{Ft+1}(\omega_k))d\omega_k\right]$ | Mean Firm Default | 0.662 | 0.657 |
| $100\mathbb{E}F_{kt+1}(\bar{\omega}_{bt+1})$ | Mean Bank Default | 0.166 | 0.176 |
| $\rho\left[\int_0^\infty F_{jt+1}(\bar{\omega}_{Ft+1}(\omega_k))d\omega_k, F_{kt+1}(\bar{\omega}_{bt+1})\right]$ | Corr(Firm D., Bank D.) | 0.642 | 0.642 |
| $100\sigma\left[\int_0^\infty F_{jt+1}(\bar{\omega}_{Ft+1}(\omega_k))d\omega_k\right]$ | Std Firm Def. | 0.549 | 0.287 |
| $100\sigma\left[F_{kt+1}(\bar{\omega}_{bt+1})\right]$ | Std Bank Def. | 0.422 | 0.261 |
| $100\sigma_{\rho_t^B}$ | Std ROE Banks | 2.06 | 2.76 |
| $100(\mathbb{E}\rho_t^B - 1)$ | Mean ROE Banks | 1.6 | 2.52 |
| $\mathbb{E}\frac{L_t}{Y_t}$ | Mean L/Y | 2.35 | 2.4 |
| $100\mathbb{E}(R_{Lt} - R_t)$ | Mean Loan spread | 0.549 | 0.57 |
| $\sigma_{(R_{Lt}-R_t)}/\sigma_{\Delta Y_t}$ | Sd Loan spread | 0.137 | 0.193 |
| $\mathbb{E}R_t$ | Mean Policy Rate | 1 | 1 |
| $\mathbb{E}(L_t/S_t^L)$ | Loan-to-Bond Ratio | 3.6 | 3.73 |
| $400\mathbb{E}(K_{Ht}/K_t)$ | HH Capital Share | 0.22 | 0.22 |
| $\mathbb{E}(R_t - R_{Dt})$ | Deposit Spread | 1 | 1 |
| $\mathbb{E}\frac{\Delta_4\log(Y_{t+4})}{\Delta_4\log(EQ_t)} \mid p_1(\Delta_4\log(EQ_t))$ | GDP Loss From Large Equity Loss | -0.133 | -0.144 |
| $\beta_D$ | Deposit beta | 0.67 | 0.709 |

Notes: All series are seasonally adjusted. $\Delta^{HP}$ indicates the Hodrick-Prescott filter with HP parameter 1600. $\Delta_4 x_t$ indicates the fourth difference (that is, one-year difference) $x_t - x_{t-4}$, and $p_1(x)$ indicates that $x$ is below it's first percentile. Data sources and variable definitions are described in Appendix B.

moments for the mean and standard deviation of firm and bank defaults, the correlation between firm and bank defaults, and the mean and standard deviation of the rate of return on bank equity are taken from Mendicino et al. (forthcoming).[23] Appendix B contains further details on the data sources and construction, and the calibration strategy.

The model fits the data well. It struggles to match the relative volatility of hours worked, which is not surprising given that the model contains no labor market frictions.

[23]The moments are for the euro area and almost the same time period: Mendicino et al. (forthcoming) use data from 1992Q1:2016Q4

## 3.3 Model Validation

In this section, we validate the performance of our model by assessing it against the empirical literature on loan pricing implications of realized and unrealized bank losses.

In a recent study, Volk (2024) finds that "banks with 1 pp higher share of unrealized losses in their risk-weighted assets charge on average 8 bps higher corporate lending rate in Slovenia. These unrealized losses have a lower impact compared to actual changes in capital, for which the literature establishes the impact of around 10-25 bps." We simulate our baseline model economy, i.e. the model in which banks are subject to amortized cost requirements, for 100,000 periods and define banks' unrealized losses as the percentage difference between amortized-cost value equity and fair value equity:

$$Unrealized_t = 100\frac{B_t^{AC} - B_t}{mean(B^{AC})}. \tag{47}$$

The actually realized losses in capital are defined as the shortfall of bank equity below its average:

$$Realized_t = 100\frac{mean(B^{AC}) - B_t^{AC}}{mean(B^{AC})} \tag{48}$$

We then investigate the loan pricing implications of realized and unrealized bank losses using linear regressions of the following form:

$$spread_t = \beta_0 + \beta_1 Unrealized_t + \beta_2 Realized_t + \beta_3 K_t + \beta_4 Q_t + \beta_5 E_t + \beta_6 \Omega_t^D, \tag{49}$$

where the dependent variable is the *spread* between the loan rate and the policy rate (defined in annualized percentage points, i.e., $spread_t = 400(R_{Lt} - R_t)$, and where we control for aggregate physical capital and its price, as well as firm equity and profits from deposit taking $\Omega_t^D = (R_t - R_{Dt})D_t$.

The results are depicted in Figure 1. In line with the literature (although somewhat lower)

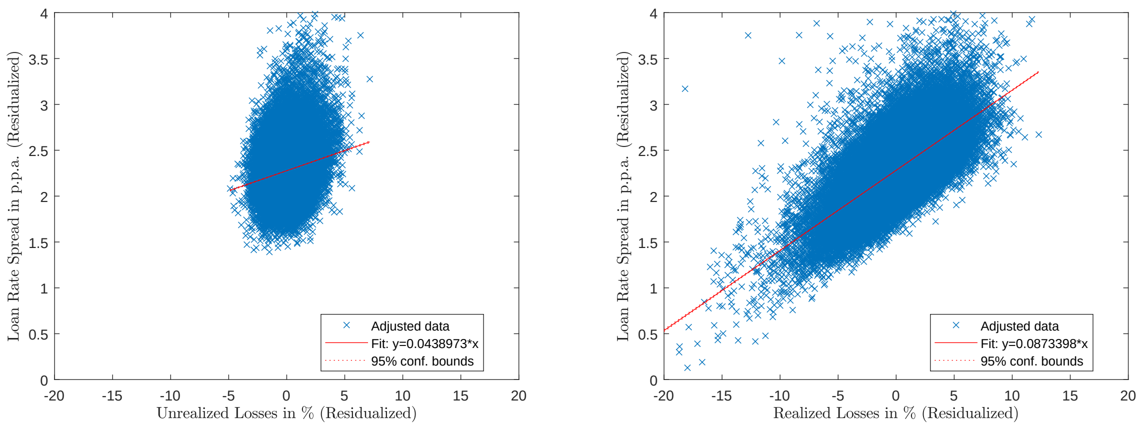



**Figure 1:** *Loan pricing effects: realized vs. unrealized losses*

Notes: The figure presents coefficients from the linear regression in Equation (49). Variables are residualized with respect to all other regressors using a Frisch–Waugh–Lovell decomposition. The regression is estimated on simulated data from the baseline model.

we find that unrealized losses on banks' balance sheet have a significant positive impact on loan pricing ($\beta_1 \approx 0.04$, corresponding to an approximately 4 bps increase in the annualized loan rate), and that this response is weaker than the one associated with actual changes in bank capital ($\beta_2 \approx 0.09$, corresponding to an approximately 9 bps increase in the annualized loan rate).

The intuition is that realized losses reduce a bank's equity and therefore its lending capacity: a contraction in loan supply that increases the equilibrium loan rate. On the other hand, unrealized losses affect loan supply via the shadow value of equity, given by (5), as equity is expected to be scarcer in the future in the presence of such unrealized losses which the bank expects to realize with a non-zero probability.

# 4 Regulatory Accounting, Credit Supply and Financial Stability

In this section, we analyze the performance of the economy under alternative regulatory accounting frameworks, identifying the approach that maximizes social welfare. Throughout the analysis, we compare endogenous responses in the baseline economy with an economy in which banks' regulatory capital is defined on the basis of the fair value of the bonds, using an identical sequence of exogenous shocks.

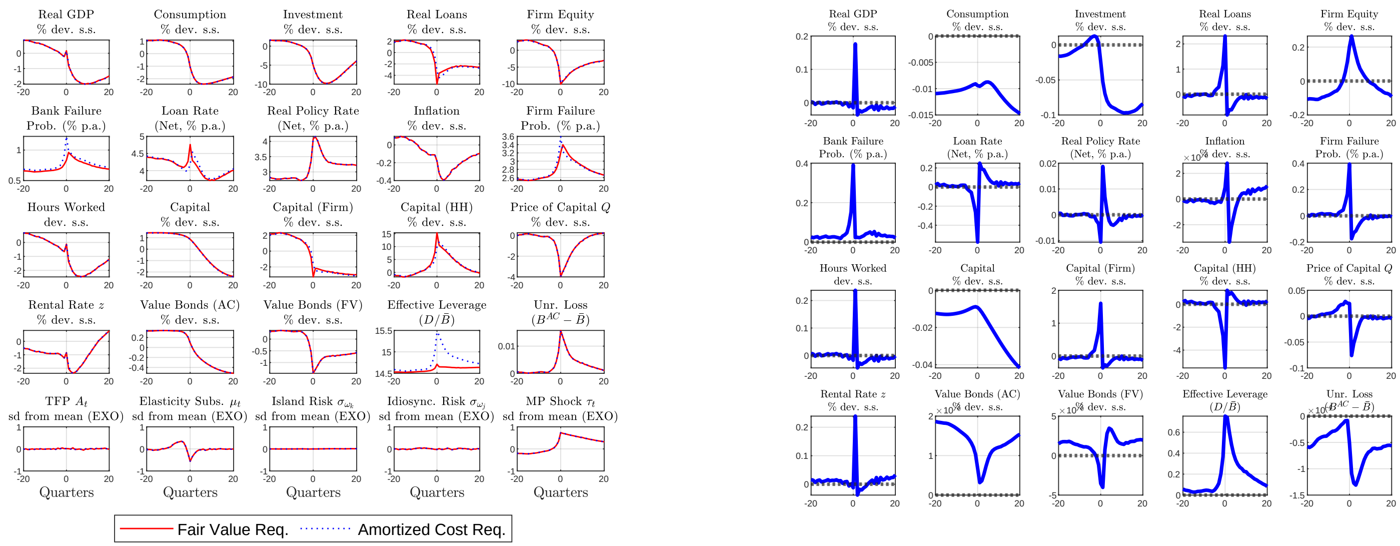
## 4.1 Dynamics Around Episodes with Large Unrealized Losses

Differences between fair-value accounting and amortized-cost accounting become particularly salient when banks have accumulated large unrealized gains or losses on their bond portfolios. These valuation changes are primarily driven by movements in interest rates: increases in policy rates reduce the market value of long-term bonds held by banks, generating unrealized losses.

To study the dynamics of the economy around such episodes, we conduct an event-study exercise based on long simulations of the model. We simulate the baseline economy for 100,000 periods under amortized-cost accounting and construct a parallel simulation under fair-value accounting using the identical sequence of exogenous shocks. Any differences in macroeconomic outcomes between the two economies therefore arise exclusively from the regulatory treatment of unrealized gains and losses.

Episodes are identified based on the accumulation of unrealized losses on banks' balance sheets. Let accumulated losses be defined as

$$AL_t \equiv B_t^{AC} - B_t,$$




**(a)** *Levels* **(b)** *Differences (Amortized Cost - Fair Value)*

**Figure 2:** *Anatomy: Episodes with large accumulated unrealized losses*

Notes: Time 0 denotes the start of a spell in which banks' balance sheet contain large accumulated unrealized losses, such that $AL_{-1} < p_{90}(AL)$ and $AL_0 \geq p_{90}(AL)$, where $AL_t \equiv B_t^{AC} - B_t$. Exogenous variables are labeled as EXO.

the difference between the amortized-cost and fair value definition of regulatory equity. We focus on episodes in which accumulated losses exceed their 90th percentile, denoted by $p_{90}(AL)$. Let $t = 0$ denote the first period of such an episode, i.e.,

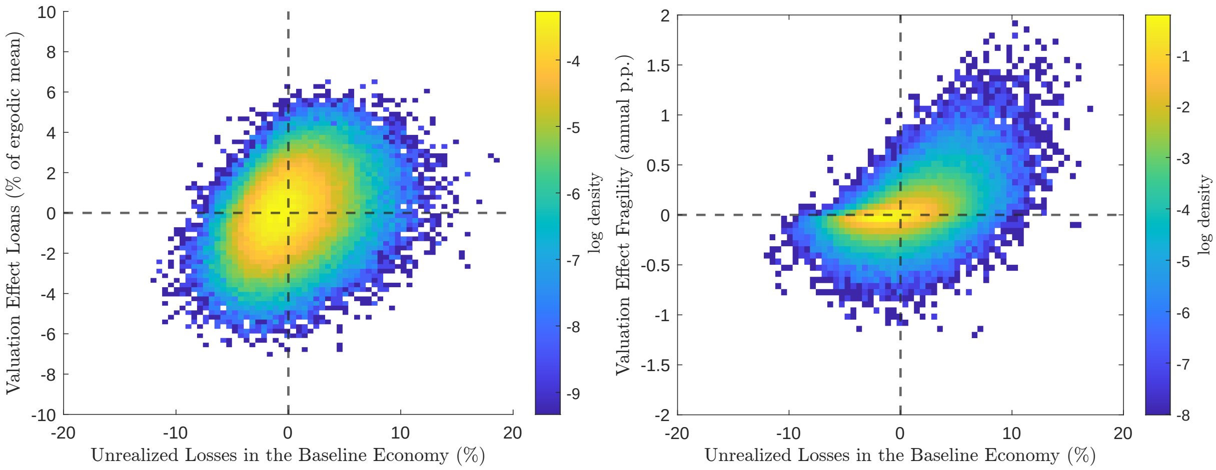
$$AL_{-1} < p_{90}(AL), \qquad AL_0 \geq p_{90}(AL).$$

Figure 2 plots the average dynamics of key variables around these events, including both endogenous outcomes and exogenous shocks (labeled EXO). Episodes with large accumulated unrealized losses are typically preceded by a period of monetary easing, which raises bond valuations. Over the same period, a temporary increase in the elasticity of substitution across intermediate-goods producers – that is, a decline in cost-push pressures – builds gradually and peaks ahead of the event, contributing to low inflation and low real interest rates.

Shortly before the event, both forces begin to reverse. The unwinding of monetary accommodation, reinforced by rising cost-push pressures, generates a sharp increase in the real policy rate, which peaks at the event. This abrupt tightening leads to a large decline in bond valuations. The resulting dynamics are broadly reminiscent of the post-COVID tightening cycle, characterized by sharp tightening, partly in response to cost-push pressures.

The evolution of loan supply and financial stability during these episodes depends on the regulatory accounting framework. Under the amortized-cost regime, banks are able to maintain a higher supply of loans while bond prices are falling. Because unrealized losses are not reflected in regulatory capital, banks effectively operate with higher leverage. As a result, bank default probabilities gradually rise relative to the fair-value regime during the monetary tightening phase.

During the subsequent normalization of monetary policy, when bond prices begin to increase again, loan supply becomes higher under fair-value accounting despite the continued presence of unrealized losses. Two mechanisms contribute to this pattern. First, the fair value of bank equity responds more quickly to changes in bond prices than its amortized-cost counterpart, allowing regulatory capital to recover sooner under fair-value accounting.




**(a)** *Loans* **(b)** *Bank Defaults*

**Figure 3:** *Valuation Effects*

Notes: The left panel of this figure shows the Valuation Effect on Loans, defined as the difference in bank loans between the baseline economy (amortized-cost regime) and the alternate economy (fair-value regime) for different levels of unrealized losses or gains. The difference in bank loans is reported as a percentage of the ergodic mean of loans under the amortized-cost regime. The right panel of this figure shows the Valuation Effect on Fragility, defined as the difference in the annualized bank default probability between the baseline economy (amortized-cost regime) and the alternate economy (fair-value regime) for different levels of unrealized losses or gains. The color scale indicates the log-density of observations in the simulated data.

Second, the sustained increase in bank default probabilities observed under amortized-cost accounting lead to larger realized equity losses in that regime and decrease lending vis-a-vis the fair-value regime even as bond prices recover.

## 4.2 Valuation Effects on Lending and Bank Defaults

We now examine how the prudential treatment of unrealized gains and losses affects credit supply and bank fragility. To do so, we exploit the two parallel simulations described above—one under amortized-cost accounting and one under fair-value accounting—constructed using the same sequence of exogenous shocks. In the baseline simulation we compute unrealized valuation gains or losses on banks' balance sheets as the percentage deviation of the fair

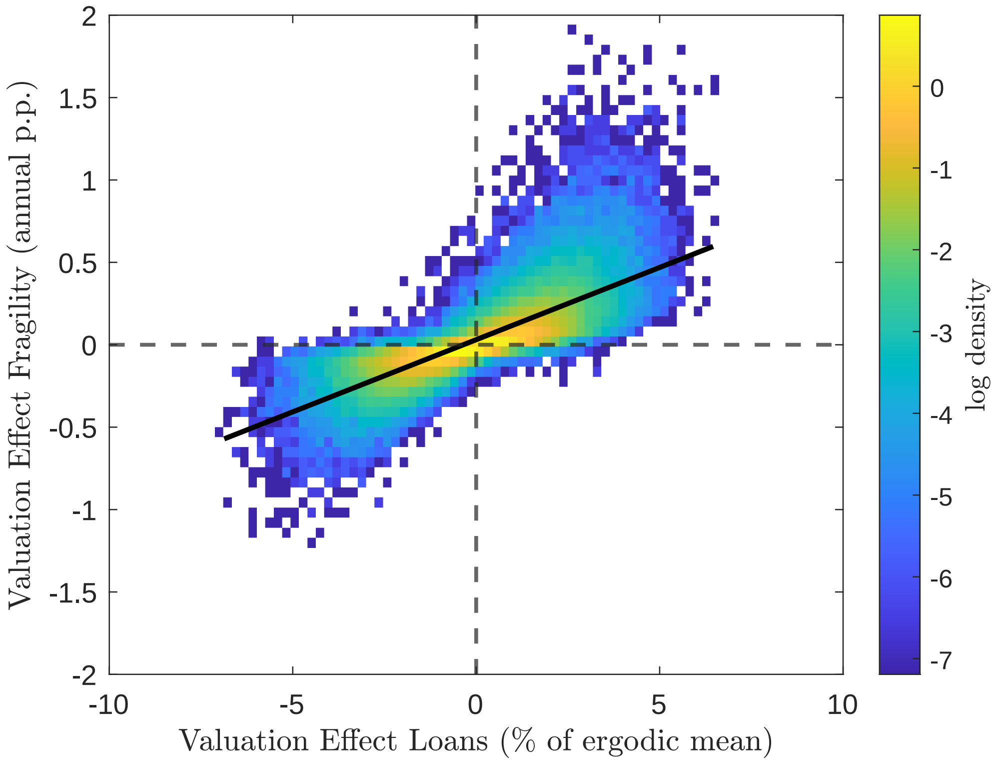



**Figure 4:** *Valuation Effects on Lending and Bank Defaults: Correlation*

Notes: The heatmap shows the log-density of simulated observations. The solid line represents a linear fit across all points. The Valuation Effect on Loans is defined as the difference in bank loans between the baseline economy (amortized-cost regime) and the alternate economy (fair-value regime) for different levels of unrealized losses or gains. The difference in bank loans is reported as a percentage of the ergodic mean of loans under the amortized-cost regime. The Valuation Effect on Fragility is defined as the difference in the annualized bank default probability between the baseline economy (amortized-cost regime) and the alternate economy (fair-value regime) for different levels of unrealized losses or gains.

value of equity from its amortized-cost value, $(B_t^{AC} - B_t)/B_t^{AC}$. For each period in the two simulations we then evaluate loan quantities and bank failure probabilities as a function of the unrealized gains or losses that would be observed under amortized-cost valuation. This allows us to compare the two regulatory regimes at identical realizations of the underlying shocks.

We summarize the effects of the regulatory valuation regime using two measures. The left panel of Figure 3 reports the *Valuation Effect on Loans*, defined as the difference in bank lending between the baseline economy (amortized-cost regime) and the alternative economy (fair-value regime) for different levels of unrealized gains or losses on banks' bond portfolios. The difference in lending is expressed as a percentage of the ergodic mean of loans under the amortized-cost regime. The right panel reports the *Valuation Effect on Fragility*, defined as the difference in the annualized probability of bank default between the two regimes.

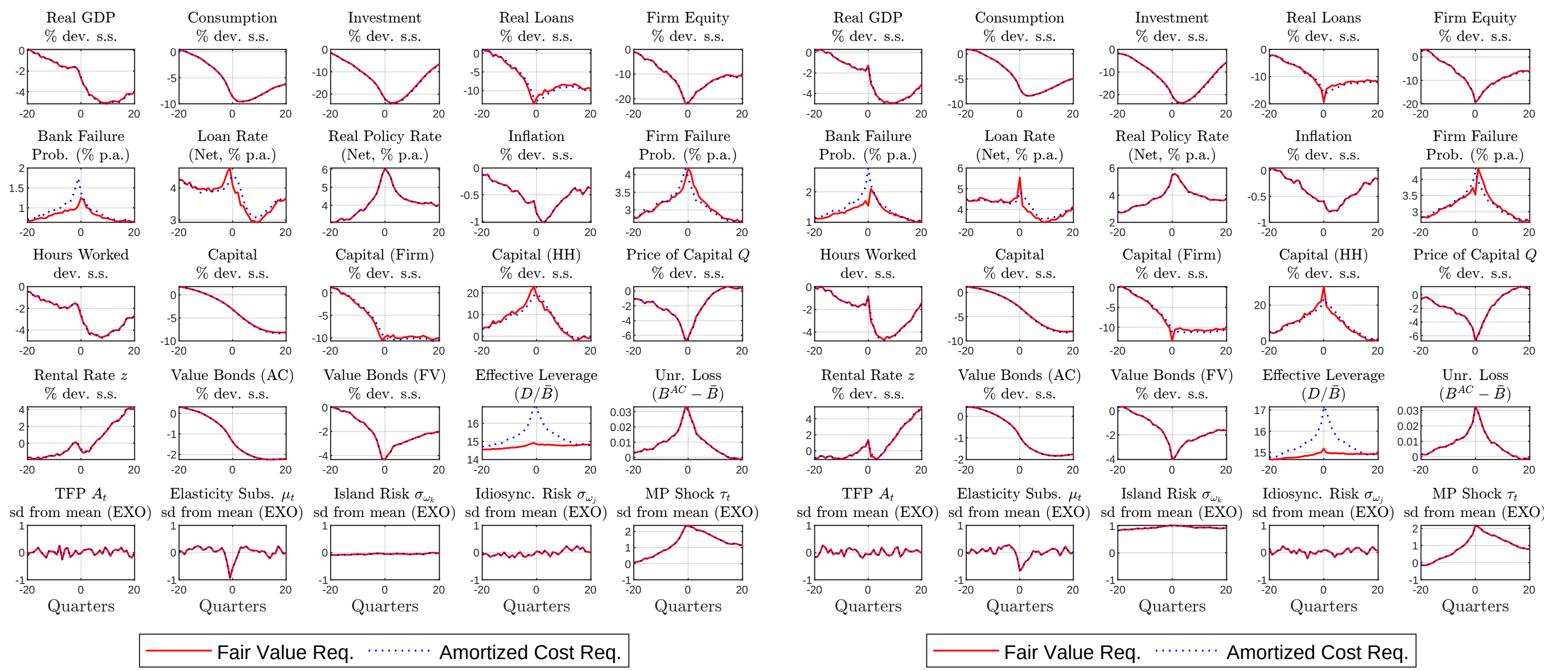
The figure shows that when unrealized losses accumulate on banks' balance sheets, both lending and bank default probabilities tend to be higher under amortized-cost accounting.

Figure 4 highlights the close, but imperfect, relationship between the two effects. Periods in which lending expands more under the amortized-cost regime also tend to be periods in which bank default probabilities increase the most. The mechanism behind this relationship is straightforward: because unrealized losses do not reduce regulatory capital under amortized-cost accounting, banks face a looser capital constraint and are able to extend more loans. The resulting increase in effective leverage raises the probability of bank insolvency.

The average valuation effect on fragility is positive and the effect on lending is negative: the amortized cost regime exhibits on average less lending and a higher bank default probability. These effects are economically meaningful. The average annual bank failure probability in the amortized-cost model is 0.7%. For unrealized losses equal to 4% of regulatory equity (losses at least this large occur in 10 % of periods), the median valuation effect on fragility amounts to about 0.11 percentage points.

At the same time, the valuation effects exhibit substantial dispersion. Even for similar levels of accumulated unrealized losses, the impact on lending and bank fragility varies widely across observations. This dispersion reflects differences in underlying macroeconomic and financial conditions, particularly in the level of credit risk.

In the next subsection we show that variation in credit risk is a key determinant of these differences and helps explain why the valuation effects on lending and bank fragility are only imperfectly correlated.




**(a)** *Low valuation effect on fragility* **(b)** *High valuation effect on fragility*

**Figure 5:** *Anatomy: The role of credit risk*

Notes: The Valuation Effect on Fragility is defined as the difference in the annualized bank default probability between the baseline economy (amortized-cost regime) and the alternate economy (fair-value regime). The effect is labeled low (high) when it is in its first (fourth) quartile. Time 0 denotes the start of a spell in which banks' balance sheet contain large accumulated unrealized losses, such that the fair value of equity is between 10 and 30% below the amortized cost value. Exogenous variables are labeled as EXO.

## 4.3 The Role of Credit Risk

To understand the source of the substantial dispersion in valuation effects documented in the previous subsection, we first examine event windows around episodes with large accumulated unrealized losses, conditioning on the magnitude of the valuation effect on fragility. The left (right) panel of Figure 5 shows the evolution of the economy when the valuation effect lies in the first (fourth) quartile of its distribution.

The differences across these episodes are largely driven by variation in credit risk. In the model, credit risk arises from island-specific shocks that banks cannot diversify away. When the variance of these shocks is high, bank default probabilities increase substantially regardless of the accounting regime. In such high-risk environments, however, the higher effective leverage permitted under amortized-cost accounting becomes particularly detrimental to bank solvency. As a result, the increase in bank fragility relative to the fair-value regime is especially pronounced during these episodes.

To summarize these patterns more systematically, Table 3 reports average outcomes conditional on the monetary policy stance (tightening vs. easing) and the level of credit risk (high vs. low). Specifically, we classify periods as monetary tightening or easing episodes based on the sign of the monetary policy shock. Periods are further classified as high- or low-risk states based on the distribution of island risk.

Three patterns emerge. First, monetary policy is transmitted more effectively under fair-value accounting: lending expands more during easing episodes and contracts more during tightening episodes relative to the amortized-cost regime. This pattern is consistent with empirical evidence on how bank balance sheet valuation affects the strength of credit supply responses to monetary policy (see, for example, Greenwald et al. 2024).

Second, the table confirms that credit risk acts as an important amplifier of the valuation effect on bank fragility: when underlying credit risk is high, the impact of the accounting regime on bank default probabilities becomes markedly larger. For the same reason, the

**Table 3:** *Average Outcomes by Accounting Regime, Monetary Policy, and Credit Risk*

| | Tightening | Easing | Tightening_HighRisk | Tightening_LowRisk | Easing_HighRisk | Easing_LowRisk |
|---|---|---|---|---|---|---|
| Loans (FV) | 3.8258 | 4.322 | 3.5346 | 4.0062 | 3.9837 | 4.5168 |
| Loans (AC) | 3.8287 | 4.3156 | 3.5358 | 4.0099 | 3.977 | 4.511 |
| Loans (AC - FV) | 0.0028 | -0.0064 | 0.0012 | 0.0037 | -0.0066 | -0.0058 |
| Bank Defaults (FV) | 0.8529 | 0.4394 | 1.6321 | 0.4152 | 0.9724 | 0.1771 |
| Bank Defaults (AC) | 0.8961 | 0.4381 | 1.7017 | 0.4428 | 0.9632 | 0.1792 |
| Bank Defaults (AC - FV) | 0.0432 | -0.0013 | 0.0696 | 0.0276 | -0.0093 | 0.0021 |
| Firm Defaults (FV) | 3.171 | 2.0635 | 3.4382 | 3.0324 | 2.3989 | 1.8965 |
| Firm Defaults (AC) | 3.1697 | 2.0814 | 3.4429 | 3.0274 | 2.4144 | 1.9154 |
| Firm Defaults (AC - FV) | -0.0013 | 0.0179 | 0.0047 | -0.005 | 0.0155 | 0.0189 |
| Real Loan Spread p.p.a (FV) | 2.5579 | 1.9927 | 2.8491 | 2.3953 | 2.2108 | 1.895 |
| Real Loan Spread p.p.a (AC) | 2.5537 | 2.0277 | 2.8527 | 2.3879 | 2.2438 | 1.9293 |
| Real Loan Spread p.p.a (AC - FV) | -0.0042 | 0.035 | 0.0036 | -0.0073 | 0.0329 | 0.0343 |
| Policy Rate p.p.a. dev. (FV) | 0.7663 | -0.762 | 0.8072 | 0.7414 | -0.7254 | -0.7748 |
| Policy Rate p.p.a. dev. (AC) | 0.7659 | -0.7616 | 0.807 | 0.7408 | -0.725 | -0.7744 |
| Policy Rate p.p.a. dev (AC - FV) | -0.0004 | 0.0004 | -0.0003 | -0.0006 | 0.0004 | 0.0004 |
| Unrealized Losses (FV) | 0.0047 | -0.0039 | 0.0049 | 0.0045 | -0.0038 | -0.0038 |
| Unrealized Losses (AC) | 0.0046 | -0.0039 | 0.0048 | 0.0045 | -0.0038 | -0.0039 |
| Unrealized Losses (AC - FV) | -0.0001 | -0.0001 | -0.0001 | 0 | 0 | -0.0001 |
| Frequency Unr. Losses > 0 (%) | 68.5305 | 29.3365 | 69.1439 | 68.1601 | 29.7578 | 29.9393 |
| Frequency Regime (%) | 49.8584 | 50.1406 | 12.677 | 24.4048 | 12.3227 | 25.5947 |

*Note: This table reports averages over a simulation of 100,000 periods. Tightening episodes are defined as those in which the policy rate is above the one implied by the Taylor Rule, i.e.* $\tau_t > 1$*, and easing episodes as those in which* $\tau_t < 1$*. Stability episodes are those in which the variance of the island-specific shock* $\sigma_{\omega_k}$ *is particularly low (below its median), and instability episodes those with* $\sigma_{\omega_k}$ *above its 75th percentile.*

impact of the accounting regime on bank fragility is substantially larger during tightening episodes. The higher policy rate in these episodes contributes to higher firm default probabilities, which translates into higher bank default probabilities. This elevated risk amplifies the impact of accounting rules on bank default probabilities.

Third, the implications of credit risk for the impact of the accounting regime on loan rates and lending are different than those for the bank default probability. During tightening episodes, the valuation effect on lending is actually *smaller* when credit risk is high, as the increased bank default probability and resulting losses in bank equity under amortized-cost accounting partially offset the looser regulatory constraint implied by that regime. For the same reason, the impact of the accounting regime on lending is somewhat larger during easing episodes than during tightening episodes. Consequently, the impact on loan spreads is also larger during easing episodes – this difference is more pronounced than the difference in lending, amplified by relatively inelastic aggregate loan demand.[24]

These mechanisms help explain the imperfect relationship between the valuation effect on lending and the valuation effect on fragility shown in Figure 4. Figure 6 illustrates this more directly: it shows a scatter plot of both effects by monetary policy regime and credit risk. For illustrative purposes, we use a stricter definition of easing and tightening here. Both unrealized losses and gains occur in both monetary policy regimes, as the second-to-last row of Table 3 shows – this is due to the effect of previous shocks. For the same reason, the real policy rate may be decreasing or increasing in both the "tightening" and the "easing" regime – with the corresponding effect on unrealized gains or losses. Figure 6 thus focuses on "strict tightening" and "strict easing" episodes, in which in addition to the sign of the monetary policy shock we require that the real policy rate is rising (strict tightening) or falling (strict easing).

The relationship between the two valuation effects is particularly flat when strict easing episodes coincide with low credit risk: in such environments, the recognition of unrealized gains in regulatory equity has a strong impact on lending, while its effect on bank fragility remains limited. The relationship becomes steeper when strict easing episodes coincide with high credit risk, when banks simultaneously become safer and restrict lending vis-a-vis the fair-value scenario as unrealized gains mount. On the other hand, during strict tightening episodes with high risk the relationship between the two valuation effects becomes particularly weak (note the much larger dispersion in the valuation effect on fragility for a given effect on lending), as large increases in bank default probabilities under amortized-cost accounting generate equity losses that dampen lending. For completeness, Figure 8 in the Appendix shows the graph for monetary policy regimes that are purely based on the sign of the monetary policy shock.

[24] As discussed in the model section, aggregate credit supply is perfectly inelastic as long as the loan rate is high enough for banks to prefer lending up to the regulatory constraint: it is fixed by the scarcity of (regulatory) bank equity. Hence, differences in loan rates reflect movements along (and shifts of) the aggregate loan demand curve.

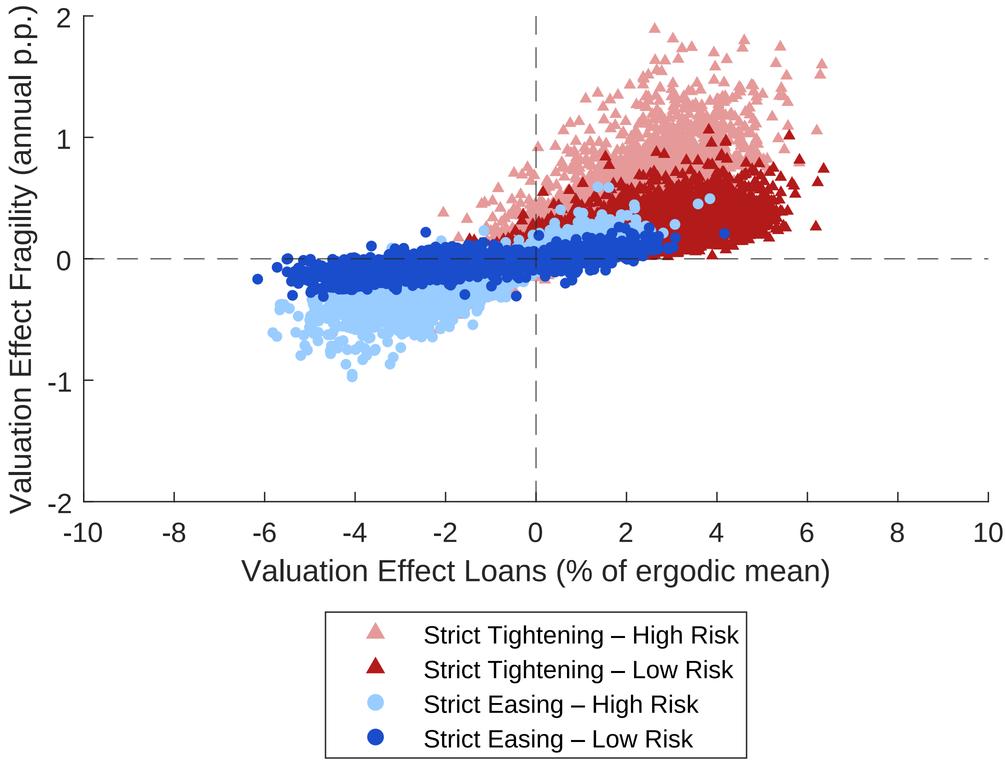



**Figure 6:** *Valuation Effects on Lending and Fragility: Correlation by Regime*

Notes: Strict tightening episodes are defined as those in which the real policy rate is above the one implied by the Taylor Rule, i.e. $\tau_t > 1$ and *increasing*, while strict easing episodes as those in which $\tau_t < 1$ and the real policy rate is *decreasing*. Stability episodes are those in which the variance of the island-specific shock $\sigma_{\omega_k}$ is particularly low (below its median), and instability episodes those with $\sigma_{\omega_k}$ above its 75th percentile. The Valuation Effect on Loans is defined as the difference in bank loans between the baseline economy (amortized-cost regime) and the alternate economy (fair-value regime) for different levels of unrealized losses or gains. The difference in bank loans is reported as a percentage of the ergodic mean of loans under the amortized-cost regime. The Valuation Effect on Fragility is defined as the difference in the annualized bank default probability between the baseline economy (amortized-cost regime) and the alternate economy (fair-value regime) for different levels of unrealized losses or gains.

An important implication of these patterns is that the effect of the accounting regime on bank defaults is highly asymmetric across monetary policy regimes: fair-value accounting substantially reduces bank failures during tightening episodes, while the corresponding increase during easing episodes is much smaller. As we show in the next subsection, this asymmetry plays a central role in determining consumption and the welfare comparison between the two regulatory regimes.

## 4.4 Welfare-Maximizing Regulatory Accounting Approach

The previous subsections show that regulatory accounting affects credit supply and financial stability in a state-dependent manner. In particular, fair-value accounting changes both the response of lending to monetary policy and the frequency of bank failures. These mechanisms translate into differences in aggregate consumption through two channels: lending affects capital accumulation and production, while bank defaults generate deadweight losses that reduce resources available for consumption.

We now evaluate how these mechanisms affect social welfare and identify the regulatory accounting framework that maximizes welfare in our model. We assess both whether regulatory capital should be defined on the basis of the amortized-cost or fair value of equity, and how high the capital requirements should be. We find that regulatory capital defined on the basis of the fair-value of the bonds is overall superior in terms of welfare to defining it on the basis of their amortized-cost.

**Table 4:** *Summary Statistics by Accounting Regime*

| Variable | Mean | | SD | |
|---|---|---|---|---|
| | FV | AC | FV | AC |
| Loans ($L_t$) | 4.0746 | 4.0728 | 0.4075 | 0.4065 |
| Real Loan Spread p.p.a $\left[400 \times \frac{(R_{Lt}-R_t)}{\Pi_{t+1}}\right]$ | 2.2745 | 2.29 | 0.9671 | 0.9069 |
| Bank Defaults p.a. $[400 \times F_{kt}(\bar{\omega}_{bt})]$ | 0.6455 | 0.6664 | 0.6281 | 0.6646 |
| Firm Defaults p.a $[400 \times \int_0^\infty F_{jt}(\bar{\omega}_{jt}(\omega_k))dF_{kt}]$ | 2.6157 | 2.624 | 0.9417 | 0.9536 |
| Consumption ($C_t$) | 1.0499 | 1.0497 | 0.047 | 0.047 |
| Total Production ($Y_t$) | 1.6958 | 1.6958 | 0.0645 | 0.0646 |
| Utility Difference (% CE) | 0.0147 | | | |

*Note: The table reports the means and standard deviations (SD) of selected variables under the fair-value (FV) and amortized-cost (AC) accounting regime. The utility difference is expressed in consumption equivalent terms, see Appendix C.*

Table 4 reports means and standard deviations of important financial and real economy variables by accounting regime. Additionally, Figure 7 shows how selected variables change with the level of the capital requirement in each of the regimes.

On average, banks supply slightly higher loan volumes at slightly lower spreads under fair value requirements. The default probability of both banks and firms is also reduced.

These average outcomes reflect the state-dependent mechanisms documented in the previous subsection and their relative size. In particular, the effect of the accounting regime on bank defaults is much stronger during monetary tightening episodes, when policy rate increases generate unrealized losses on banks' bond portfolios. At the same time, the effect on lending is larger during easing episodes. This asymmetry implies that bank default probabilities are on average lower and lending is higher under fair-value accounting. The lower firm default probability under fair-value accounting is then a consequence of lower aggregate loan rates. This effect is reinforced by the feedback loop between lower loan rates, lower firm default probabilities and lower bank default probabilities inherent in the model.

The on average lower default probabilities of firms and banks under fair-value accounting reduce reduce deadweight default costs, generating consumption gains. At the same time, on average larger credit supply under fair-value accounting supports investment and production, also generating consumption gains. Thus, consumption is overall higher under fair-value accounting, which translates into welfare gains.

Our results differ from those in Acharya et al. (2021), who analyze accounting regimes in a setting with asymmetric information about loan quality and creditor runs. In their framework, fair-value accounting improves ex-ante investment efficiency by revealing information about project quality but may increase financial fragility through belief dispersion and run incentives. In contrast, our model abstracts from asymmetric information and focuses on the regulatory treatment of unrealized valuation changes on relatively safe liquid assets. In this environment, recognizing unrealized losses primarily affects bank leverage and the incidence of costly bank failures rather than investors' information about asset quality. As a result, fair-value accounting in our framework tends to reduce bank failures in states where valuation losses are large, which contributes to the welfare gains we document.

The quantitative welfare differences between the two accounting regimes are modest. For an 8% capital requirement, the welfare gains from fair-value accounting amount to approximately 1.5 basis points in consumption-equivalent terms.

Finally, we also evaluate the optimal level of capital requirements. Figure 7 shows that welfare is maximized at a capital ratio of approximately 12%, which is substantially higher than the Basel II minimum but below the 16% level found in Mendicino et al. (forthcoming). Optimal fair-value capital requirements of 12% correspond to an increase in welfare equivalent to a roughly 13.6 bps increase in consumption equivalent utility terms.

Taken together, these results highlight the importance of the regulatory treatment of unrealized gains and losses for both financial stability and credit supply. While fair-value accounting tightens regulatory constraints during periods of monetary tightening, it substantially reduces bank failures in precisely those states in which credit risk is elevated. Because the reduction in costly defaults during tightening episodes dominates the increase during easing episodes—and because lending expands more strongly under fair-value accounting when monetary policy eases—the overall effect is higher average consumption and welfare under fair-value regulatory capital. The welfare-maximizing policy in our model therefore combines the recognition of unrealized gains and losses in regulatory capital with capital requirements that are higher than those prevailing under Basel II.

# 5 Conclusion

This paper examines how the regulatory capital treatment of unrealized capital gains and losses on banks' debt securities, related to the impact of interest rate risk, affects financial stability and credit supply. To this purpose, it develops a dynamic general equilibrium model in which banks are exposed to both interest rate risk and credit risk.

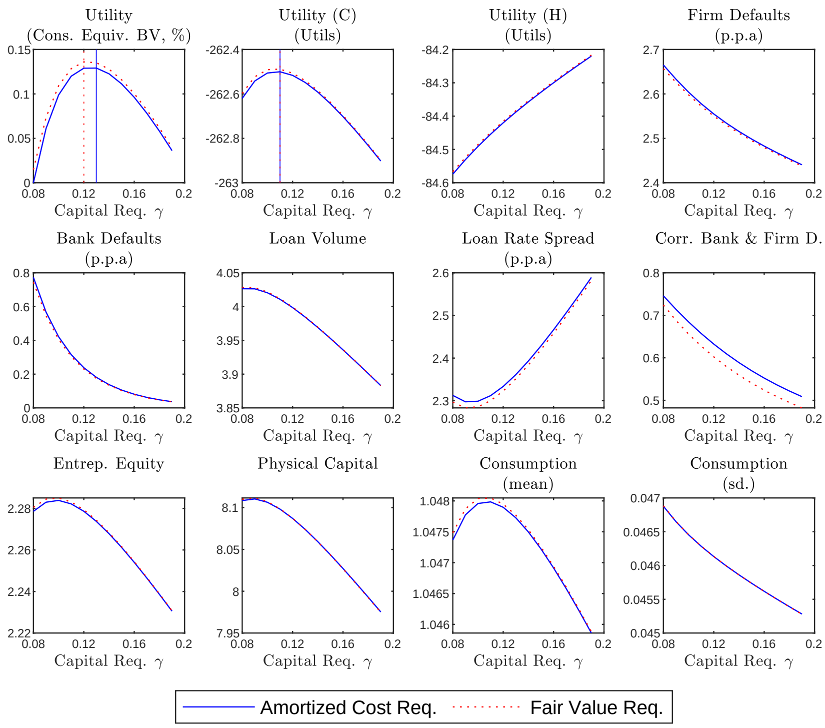



**Figure 7:** *Optimal capital requirements*

Notes: Utility is household utility, which is the relevant welfare benchmark as all banks and firms are owned by household. Utility (C) and Utility (H) are the parts attributed to consumption and labor, respectively. The benchmark for computing consumption equivalents is the baseline model with a capital requirement of 8%. All parameters other than the capital requirement $\gamma$ are kept fixed.

Our results highlight that the effects of regulatory capital accounting are inherently state-dependent, giving rise to pronounced asymmetries over the monetary policy cycle. The key mechanism is that credit risk amplifies the impact of accounting rules on bank solvency. When underlying credit risk is elevated, differences across accounting regimes translate into much larger differences in bank default probabilities. As a result, amortized-cost accounting is particularly detrimental to bank solvency during monetary tightening, when higher interest rates both reduce bond valuations and increase borrower default risk. During easing episodes, the same forces operate in reverse, and the implications of the accounting regime for bank solvency are correspondingly more muted.

These asymmetries in solvency outcomes also shape the response of lending. In tightening episodes, the higher incidence of bank distress under amortized-cost accounting erodes bank equity and partially offsets the looser regulatory constraints implied by that regime, limiting its relative effect on credit supply. By contrast, in easing periods, when solvency concerns are less acute, differences in regulatory constraints translate more directly into lending outcomes.

Thus, on average, fair-value accounting involves a lower bank default probability and more lending. Having regulatory capital defined on the basis of the fair-value of the bonds (as proposed in Basel III) is overall slightly superior in terms of welfare to having regulatory capital defined on the basis of their amortized-cost value.

# References


Abad, J., D. Martinez-Miera, and J. Suarez (2024): "A Macroeconomic Model of Banks' Systemic Risk Taking," *Banco de España Working Paper No. 2441, Available at SSRN: https://ssrn.com/abstract=5030220.*

Acharya, V. V., S. Mukherjee, and R. K. Sundaram (2021): "Investment and Contagion Tradeoffs between Fair Value and Historical Cost Accounting," .

Agarwal, S., S. Chomsisengphet, C. Liu, C. Song, and N. S. Souleles (2018): "Benefits of relationship banking: Evidence from consumer credit markets," *Journal of Monetary Economics*, 96, 16–32.

Alderson, M. J. and B. L. Betker (1995): "Liquidation Costs and Capital Structure," *Journal of Financial Economics*, 39, 45–69.

Allen, F. and E. Carletti (2008): "Mark-to-market accounting and liquidity pricing," *Journal of Accounting and Economics*, 45, 358–378.

An, S. and F. Schorfheide (2007): "Bayesian Analysis of DSGE Models," *Econometric Reviews*, 26, 113–172.

Angeloni, I. and E. Faia (2013): "Capital regulation and monetary policy with fragile banks," *Journal of Monetary Economics*, 60, 311–324.

Argimón, I., M. Dietsch, and Á. Estrada (2018): "Prudential filters, portfolio composition at fair value and capital ratios in European banks," *Journal of Financial Stability*, 39, 187–208.

Baron, M., E. Verner, and W. Xiong (2021): "Banking Crises Without Panics," *The Quarterly Journal of Economics*, 136, 51–113.

Barr, M. (2023): "Review of the Federal Reserve's Supervision and Regulation of Silicon Valley Bank," *Board of Governors of Federal Reserve System*.

Barth, M. E., W. R. Landsman, and J. M. Wahlen (1995): "Fair value accounting: Effects on banks' earnings volatility, regulatory capital, and value of contractual cash flows," *Journal of Banking & Finance*, 19, 577–605.

Basel Committee on Banking Supervision (2017): "The Interplay of Accounting and Regulation and Its Impact on Bank Behaviour," BCBS Working Paper No. 31, Bank for International Settlements.

Begenau, J. (2020): "Capital Requirements, Risk Choice, and Liquidity Provision in a Business-Cycle Model," *Journal of Financial Economics*, 136, 355–378.

Begenau, J., S. Bigio, J. Majerovitz, and M. Vieyra (2025): "A q-theory of banks," *Review of Economic Studies*, rdaf035.

Begenau, J. and T. Landvoigt (2022): "Financial Regulation in a Quantitative Model of the Modern Banking System," *Review of Economic Studies*, 89, 1748–1784.

Begenau, J., T. Landvoigt, and V. Elenev (2024): "Interest Rate Risk and Cross-Sectional Effects of Micro-Prudential Regulation," *Available at SSRN: https://ssrn.com/abstract=4950528*.

Bernanke, B. S., M. Gertler, and S. Gilchrist (1999): "The Financial Accelerator in a Quantitative Business Cycle Framework," *Handbook of Macroeconomics*, 1, 1341–1393.

Beutler, T., R. Bichsel, A. Bruhin, and J. Danton (2020): "The Impact of Interest Rate Risk on Bank Lending," *Journal of Banking & Finance*, 115, 105797.

Bonfim, D. and L. Queiró (2024): "Deposit interest rates and monetary policy transmission," *Economic Bulletin and Financial Stability Report Articles and Banco de Portugal Economic Studies*.

Boot, A. W. (2000): "Relationship Lending: What Do We Know," *Journal of Financial Intermediation*, 9, 7–25.

Born, B. and J. Pfeifer (2014): "Policy Risk and the Business Cycle," *Journal of Monetary Economics*, 68, 68–85.

Chatterjee, S. and B. Eyigungor (2012): "Maturity, Indebtedness, and Default Risk," *American Economic Review*, 102, 2674–2699.

Christiano, L. J., M. Eichenbaum, and C. L. Evans (2005): "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy," *Journal of Political Economy*, 113, 1–45.

Christiano, L. J., R. Motto, and M. Rostagno (2014): "Risk Shocks," *American Economic Review*, 104, 27–65.

Christopoulou, R. and P. Vermeulen (2012): "Markups in the Euro Area and the US over the Period 1981–2004: A Comparison of 50 Sectors," *Empirical Economics*, 42, 53–77.

Collard, F., H. Dellas, B. Diba, and O. Loisel (2017): "Optimal Monetary and Prudential Policies," *American Economic Journal: Macroeconomics*, 9, 40–87.

Corbae, D. and P. D'Erasmo (2021): "Capital Buffers in a Quantitative Model of Banking Industry Dynamics," *Econometrica*, 89, 2975–3023.

D'Andrea, A. and E. Stivella (2025): "Bankers on the Move: Relationship Capital in Credit Markets," Tech. rep., Bocconi University.

Davydiuk, T. (2017): "Dynamic Bank Capital Requirements," *Available at SSRN: https://ssrn.com/abstract=3110800.*

DeMarzo, P. M., A. Krishnamurthy, and S. Nagel (2024): "Interest Rate Risk in Banking," *NBER Working Paper No. w33308, Available at SSRN: https://ssrn.com/abstract=5076011.*

Djankov, S., O. Hart, C. McLiesh, and A. Shleifer (2008): "Debt Enforcement Around The World," *Journal of Political Economy*, 116, 1105–1149.

Drechsler, I., A. Savov, and P. Schnabl (2021): "Banking on Deposits: Maturity Transformation Without Interest Rate Risk," *Journal of Finance*, 76, 1091–1143.

Drechsler, I., A. Savov, P. Schnabl, and O. Wang (2023): "Deposit Franchise Runs," *Available at SSRN: https://ssrn.com/abstract=4411127.*

Elenev, V., T. Landvoigt, and S. Van Nieuwerburgh (2021): "A Macroeconomic Model with Financially Constrained Producers and Intermediaries," *Econometrica*, 89, 1361–1418.

Ellul, A., C. Jotikasthira, C. T. Lundblad, and Y. Wang (2015): "Is Historical Cost Accounting a Panacea? Market Stress, Incentive Distortions, and Gains Trading," *Journal of Finance*, 70, 2489–2538.

Fernández-Villaverde, J., P. Guerrón-Quintana, J. F. Rubio-Ramirez, and M. Uribe (2011): "Risk Matters: The Real Effects of Volatility Shocks," *American Economic Review*, 101, 2530–2561.

Flannery, M. J. and S. M. Sorescu (2023): "Partial Effects of Fed Tightening on US Banks' Capital," *Available at SSRN: https://ssrn.com/abstract=4424139*.

Freixas, X. and D. P. Tsomocos (2004): "Book vs. fair value accounting in banking, and intertemporal smoothing," *UPF Economics and Business Working Paper*, 771.

Galí, J. (2015): *Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework and its Applications*, Princeton University Press.

Gerali, A., S. Neri, L. Sessa, and F. M. Signoretti (2010): "Credit and Banking in a DSGE Model of the Euro Area," *Journal of Money, Credit and Banking*, 42, 107–141.

Gertler, M. and P. Karadi (2011): "A model of unconventional monetary policy," *Journal of monetary Economics*, 58, 17–34.

Gertler, M. and N. Kiyotaki (2010): "Financial Intermediation and Credit Policy in Business Cycle Analysis," in *Handbook of Monetary Economics*, Elsevier, vol. 3, 547–599.

Gomez, M., A. Landier, D. Sraer, and D. Thesmar (2021): "Banks' Exposure to Interest Rate Risk and the Transmission of Monetary Policy," *Journal of Monetary Economics*, 117, 543–570.

Granja, J., G. Matvos, and A. Seru (2017): "Selling Failed Banks," *Journal of Finance*, 72, 1723–1784.

Greenwald, D., J. Krainer, and P. Paul (2024): "Monetary Transmission Through Bank Securities Portfolios," *NBER Working Paper*.

Haddad, V., B. Hartman-Glaser, and T. Muir (2023): "Bank Fragility When Depositors are the Asset," *Available at SSRN: https://ssrn.com/abstract=4412256*.

Hatchondo, J. C. and L. Martinez (2009): "Long-Duration Bonds and Sovereign Defaults," *Journal of International Economics*, 79, 117–125.

Hoffmann, P., S. Langfield, F. Pierobon, and G. Vuillemey (2019): "Who Bears Interest Rate Risk?" *The Review of Financial Studies*, 32, 2921–2954.

Hristov, N. and O. Hülsewig (2017): "Unexpected Loan Losses and Bank Capital in an Estimated DSGE model of the Euro Area," *Journal of Macroeconomics*, 54, 161–186.

Jermann, U. J. (1998): "Asset Pricing in Production Economies," *Journal of Monetary Economics*, 41, 257–275.

Jiang, E. X., G. Matvos, T. Piskorski, and A. Seru (2024): "Monetary Tightening and US Bank Fragility in 2023: Mark-to-Market Losses and Uninsured Depositor Runs?" *Journal of Financial Economics*, 159, 103899.

Kim, S., S. Kim, and S. G. Ryan (2019): "Economic consequences of the AOCI filter removal for advanced approaches banks," *Accounting Review*, 94, 309–335.

Laux, C. and C. Leuz (2010): "Did Fair-Value Accounting Contribute to the Financial Crisis?" *Journal of Economic Perspectives*, 24, 93–118.

Malherbe, F. (2020): "Optimal Capital Requirements Over the Business and Financial Cycles," *American Economic Journal: Macroeconomics*, 12, 139–174.

Marsh, W. B. and B. Laliberte (2023): "The Implications of Unrealized Losses for Banks." *Economic Review (01612387)*, 108.

Orame, A., R. Ramcharan, and R. Robatto (2025): "Macroprudential regulation, quantitative easing, and bank lending," *Review of Financial Studies*, 38, 1545–1593.

Plantin, G., H. Sapra, and H. S. Shin (2008): "Marking-to-market: panacea or Pandora's box?" *Journal of Accounting Research*, 46, 435–460.

Ravn, M. O. and H. Uhlig (2002): "On Adjusting the Hodrick-Prescott Filter for the Frequency of Observations," *Review of Economics and Statistics*, 84, 371–376.

Rotemberg, J. J. (1982): "Sticky Prices in the United States," *Journal of Political Economy*, 90, 1187–1211.

Ruge-Murcia, F. (2012): "Estimating Nonlinear DSGE Models by the Simulated Method of Moments: With an Application to Business Cycles," *Journal of Economic Dynamics and Control*, 36, 914–938.

Smets, F. and R. Wouters (2003): "An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area," *Journal of the European Economic Association*, 1, 1123–1175.

——— (2007): "Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach," *American Economic Review*, 97, 586–606.

Stähler, N. and C. Thomas (2012): "FiMod—A DSGE Model for Fiscal Policy Simulations," *Economic Modelling*, 29, 239–261.

Van den Heuvel, S. J. (2008): "The Welfare Cost of Bank Capital Requirements," *Journal of Monetary Economics*, 55, 298–320.

Varraso, P. (2024): "Banks and the Macroeconomic Transmission of Interest-Rate Risk," *mimeo.*

Volk, M. (2024): "Do Unrealized Bank Losses Affect Loan Pricing?" *Applied Economics Letters*, 1–5.

# Internet Appendices

## A Model Details

This Appendix describes elements of the standard New Keynesian models omitted in Section 2 of the main text, and presents the details of the equilibrium.

### A.1 Household Problem

Households maximize Equation (1) subject to the budget constraint Equation (2). We begin by providing details of the components of household's cash flows, summarized by $\Sigma_t$ in Equation (2). Households:

- receive net payoffs $(1-\theta_B)(1-\xi_B)\rho_t^B P_{t-1}B_{t-1}$ from bankers,
- receive net payoffs $(1-\theta_E)(1-\xi_E)\rho_t^E P_{t-1}E_{t-1}$ from entrepreneurs,
- receive $(P_t - P_t^m)Y_t - \frac{\theta_R}{2}(\Pi_t - 1)^2 P_t Y_t$ from final good producers (see Section A.3),
- receive profits $P_t\Pi_t^C$ from capital producers and $P_t(\varsigma_t K_t^H - \frac{\kappa_H}{2}(K_t^H)^2)$ from capital managers (see Section A.4),
- are charged a lump sum fee $\frac{\theta_W}{2}\left(\Pi_t^W - 1\right)^2 W_t$ from a labor union that negotiates wages (explained in the next subsection),
- are charged lump sum taxes $LT_t$ by the government.

Therefore:

$$\begin{aligned}\Sigma_t = {} & (1-\theta_B)(1-\xi_B)\rho_t^B P_{t-1}B_{t-1} + (1-\theta_E)(1-\xi_E)\rho_t^E P_{t-1}E_{t-1} + P_t(\varsigma_t K_t^H - \frac{\kappa_H}{2}(K_t^H)^2) \\ & + P_t\Pi_t^C + (P_t - P_t^m)Y_t - \frac{\theta_R}{2}(\Pi_t - 1)^2 P_t Y_t - \frac{\theta_W}{2}\left(\Pi_t^W - 1\right)^2 W_t - LT_t. \end{aligned} \tag{A.1}$$

The multiplier on the budget constraint Equation (2) (which is expressed in nominal terms) is $\tilde{\lambda}_t$. We can then define the multiplier on the real budget constraint as $\lambda_t = P_t\tilde{\lambda}_t$ and express the real stochastic discount factor as

$$\Lambda_{t,t+1} = \beta\frac{\lambda_{t+1}}{\lambda_t}. \tag{A.2}$$

We obtain the first order conditions for consumption, capital, deposits, and riskless one-period bonds, as follows:

$$(C_t - bC_{t-1})^{-\sigma} - \beta b\mathbb{E}_t(C_{t+1} - bC_t)^{-\sigma} = \lambda_t, \tag{A.3}$$

$$\mathbb{E}_t\Lambda_{t,t+1}\left[z_{t+1} + (1-\delta)Q_{t+1}\right] = Q_t + \varsigma_t, \tag{A.4}$$

$$\mathbb{E}_t\Lambda_{t,t+1}\frac{R_{Dt}}{\Pi_{t+1}} = 1. \tag{A.5}$$

As explained in the main text, the labor supply decision is relegated to a labor union, whose problem is described in continuation.

## A.2 Wage Setting

Wage setting is subject to Rotemberg (1982) adjustment costs governed by parameter $\theta_W$ which the labor union finances by charging households a lump-sum fee. No costs arise from adjusting wages according to the steady-state inflation $\bar{\Pi}$.[25] The labor packer's demand for variety $h$ is:

$$H_{ht} = \left(\frac{W_{ht}}{W_t}\right)^{-\epsilon_W} H_t. \tag{A.6}$$

The labor union maximizes household utility subject to labor demand (Equation A.6 with Lagrange multiplier $mrs_t$) and the nominal household budget constraint (Eq. 2 with multi-

[25] This may be thought of as wages being fully indexed to steady-state inflation: If the union does not actively adjust nominal wages, they grow by the steady-state inflation rate.

plier $\lambda_t/P_t$):

$$\max_{H_{ht},W_{ht}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[ \lambda_t \left( \frac{W_{ht}}{P_t} H_{ht} - \frac{\theta_W}{2} \left( \frac{W_{ht}}{\bar{\Pi} W_{ht-1}} - 1 \right)^2 \frac{W_t}{P_t} \right) \right.$$
$$\left. - \frac{\xi_H H_{ht}^{1+\varphi_H}}{1+\varphi_H} - mrs_t \left( H_{ht} - \left( \frac{W_{ht}}{W_t} \right)^{-\epsilon_W} H_t \right) \right]. \tag{A.7}$$

We obtain the first order conditions for hours worked and wages as follows:

$$mrs_t = \lambda_t \frac{W_{ht}}{P_t} - \xi_H H_{ht}^{\varphi_H}, \tag{A.8}$$

$$\theta_W \lambda_t \left( \frac{W_{ht}}{\bar{\Pi} W_{ht-1}} - 1 \right) \frac{W_t}{P_t} \frac{1}{\bar{\Pi} W_{ht-1}} = \lambda_t \frac{H_{ht}}{P_t} - \epsilon_W mrs_t \left( \frac{W_{ht}}{W_t} \right)^{-\epsilon_W - 1} \frac{H_t}{W_t}$$
$$- \beta \mathbb{E}_t \left[ \lambda_{t+1} \theta_W \left( \frac{W_{ht+1}}{\bar{\Pi} W_{ht}} - 1 \right) \frac{W_{t+1}}{P_{t+1}} \frac{W_{ht+1}}{\bar{\Pi} W_{ht}^2} \right]. \tag{A.9}$$

Since the problem is identical for each variety $h$, there is no price dispersion and hence $W_{ht} = W_t$. Define the nominal wage inflation as $\Pi_t^W = \frac{W_t}{W_{t-1}}$. Then, the first order conditions can be combined to obtain the New Keynesian Wage Phillips Curve:

$$\theta_W \left( \frac{\Pi_t^W}{\bar{\Pi}} - 1 \right) \frac{\Pi_t^W}{\bar{\Pi}} = \theta_W \mathbb{E}_t \left[ \Lambda_{t,t+1} \left( \frac{\Pi_{t+1}^W}{\bar{\Pi}} - 1 \right) \frac{\left( \Pi_{t+1}^W \right)^2}{\Pi_{t+1} \bar{\Pi}} \right] + (1 - \epsilon_W) H_t + \epsilon_W \frac{\xi_H H_t^{1+\varphi_H}}{\lambda_t w_t}, \tag{A.10}$$

where

$$w_t = \frac{w_{t-1} \Pi_t^W}{\Pi_t} \tag{A.11}$$

is the law of motion of real wages.

## A.3 Production

A representative competitive intermediate good producer has access to Cobb-Douglas production technology:

$$Y_t^m = \theta_t K_{t-1}^{\alpha} H_t^{1-\alpha}, \tag{A.12}$$

where $\alpha \in [0,1]$, and $\theta_t$ is an aggregate productivity shock that evolves according to an AR(1) process:

$$log(\theta_t) = \rho_\theta log(\theta_{t-1}) + \sigma_\theta \epsilon_{\theta t}, \tag{A.13}$$

with $\epsilon_{\theta t} \sim N(0,1)$. Denote the price of the intermediate good by $P_t^m$. The profit maximization problem of the representative intermediate good producer is then:

$$\max_{H_t, K_{t-1}} P_t^m \theta_t K_{t-1}^{\alpha} H_t^{1-\alpha} - P_t z_t K_{t-1} - P_t w_t H_t. \tag{A.14}$$

Further, define the real price of the intermediate good. as $\frac{P_t^m}{P_t} = mc_t$. Then, the profit maximization problem yields the following FOCs:

$$mc_t \alpha \frac{Y_t^m}{K_{t-1}} = z_t \tag{A.15}$$

$$mc_t (1-\alpha) \frac{Y_t^m}{H_t} = w_t \tag{A.16}$$

To incorporate nominal price rigidities, we model a unit continuum of monopolistic final good producers, each producing a differentiated variety $i$ using a linear technology with the intermediate good as the only input:

$$Y_{it} = Y_t^m(i). \tag{A.17}$$

The final good composite is the CES aggregate:

$$Y_t = \left( \int_0^1 Y_{it}^{\frac{\mu_t - 1}{\mu_t}} di \right)^{\frac{\mu_t}{\mu_t - 1}}, \tag{A.18}$$

where $\mu_t$ is a stochastic elasticity of substitution that follows an AR(1) process:

$$ln(\mu_t) = (1 - \rho_\mu) ln(\mu) + \rho_\mu ln(\mu_{t-1}) + \sigma_\mu \epsilon_{\mu t}, \tag{A.19}$$

where $\epsilon_{\mu t} \sim N(0,1)$ is an exogenous markup shock. Final good producers are subject to Rotemberg adjustment costs, governed by parameter $\theta_R$, from steady state inflation $\bar{\Pi}$. They discount real payoffs by the household's real discount factor $\beta^t \lambda_t$. Their maximization problem in real terms is then:

$$\max_{P_t(i)} \mathbb{E}_t \sum_{n=0}^{\infty} \beta^n \frac{\lambda_{t+n}}{\lambda_t} \left[ \frac{P_{t+n}(i)}{P_{t+n}} Y_{it+n} - mc_{t+n} Y_{it+n} - \frac{\theta_R}{2} \left( \frac{P_{t+n}(i)}{\bar{\Pi} P_{t+n-1}(i)} - 1 \right)^2 Y_{t+n} \right] \tag{A.20}$$

$$\text{s.t. } Y_{it} = \left( \frac{P_t(i)}{P_t} \right)^{-\mu_t} Y_t \tag{A.21}$$

The first order condition is:

$$\begin{aligned} &(1 - \mu_t) \left( \frac{P_t(i)}{P_t} \right)^{-\mu_t} \frac{Y_t}{P_t} + mc_t \mu_t \left( \frac{P_t(i)}{P_t} \right)^{-\mu_t - 1} \frac{Y_t}{P_t} - \theta_R \left( \frac{P_t(i)}{\bar{\Pi} P_{t-1}(i)} - 1 \right) \frac{Y_t}{\bar{\Pi} P_{t-1}(i)} \\ &+ \beta \mathbb{E}_t \frac{\lambda_{t+1}}{\lambda_t} \theta_R \left( \frac{P_{t+1}(i)}{\bar{\Pi} P_t(i)} - 1 \right) \frac{P_{t+1}}{\bar{\Pi} P_t^2} Y_{t+1} \overset{!}{=} 0. \end{aligned} \tag{A.22}$$

Since all final good producers face identical marginal costs, all charge the same price. Therefore the $i$ index can be dropped and one obtains the New Keynesian Phillips Curve:

$$\theta_R \left( \frac{\Pi_t}{\bar{\Pi}} - 1 \right) \frac{\Pi_t}{\bar{\Pi}} = \mathbb{E}_t \Lambda_{t,t+1} \theta_R \left( \frac{\Pi_{t+1}}{\bar{\Pi}} - 1 \right) \frac{\Pi_{t+1}}{\bar{\Pi}} \frac{Y_{t+1}}{Y_t} + mc_t \mu_t + (1 - \mu_t) \tag{A.23}$$

Symmetry and the fact that there is a unit continuum of final good producers and intermediate good producers also implies that $Y_{it} = Y_t = \theta_t K_{t-1}^{\alpha} H_t^{1-\alpha}$.

## A.4 Capital Producers

Aggregate capital in the economy is the sum of entrepreneurial and household capital:

$$K_t = K_t^E + K_t^H. \tag{A.24}$$

Perfectly competitive capital producers produce new capital by purchasing the final output good (this investment is denoted $I$) and combining it with undepreciated capital from last period, according to the following law of motion:

$$K_t = I_t + (1-\delta)K_{t-1}. \tag{A.25}$$

They face investment adjustment costs as in Christiano et al. (2005). Their period profits (in real terms) are:

$$\Omega_t^C = Q_t K_t - I_t - Q_t(1-\delta)K_{t-1} - \frac{\kappa}{2}\left(\frac{I_t}{I_{t-1}} - 1\right)^2 I_t \tag{A.26}$$

$$= I_t\left(Q_t - 1\right) - \frac{\kappa}{2}\left(\frac{I_t}{I_{t-1}} - 1\right)^2 I_t. \tag{A.27}$$

Since they discount real payoffs using the household's real discount factor $\beta^t \lambda_t$, their maximization problem is:

$$\max_{I_t} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \lambda_t \Omega_t^C. \tag{A.28}$$

And the first order condition simplifies to:

$$Q_t = 1 - \frac{\kappa}{2}\left(\frac{I_t}{I_{t-1}} - 1\right)^2 - \kappa\left(\frac{I_t}{I_{t-1}} - 1\right)\frac{I_t}{I_{t-1}} + \Lambda_{t,t+1}\kappa\left(\frac{I_{t+1}}{I_t} - 1\right)\left(\frac{I_{t+1}}{I_t}\right)^2. \tag{A.29}$$

## A.5 Market Clearing

Good market clearing implies that:

$$Y_t = C_t + I_t + G_t + \frac{\theta_R}{2}\left(\frac{\Pi_t}{\bar{\Pi}} - 1\right)^2 Y_t + \frac{\theta_W}{2}\left(\frac{\Pi_t^W}{\bar{\Pi}} - 1\right)^2 w_t + \frac{\kappa}{2}\left(\frac{I_t}{I_{t-1}} - 1\right)^2 I_t$$

$$+ \Sigma_{ft} + \Sigma_{bt} + \frac{\kappa_H}{2}(K_t^H)^2 + \frac{C_{ft}}{\Pi_t} + \frac{\kappa_D}{2}\left(\frac{R_{Dt}}{R_{Dt-1}} - 1\right)^2 R_{Dt} D_t, \tag{A.30}$$

where $\Sigma_{ft}$ and $\Sigma_{bt}$ are default costs of entrepreneurial firms and banks, respectively. Real repossession costs of defaulting firms are given by

$$\Sigma_{ft} = \delta_M \left[Q_t(1-\delta)K_{t-1}^E + z_t K_{t-1}^E\right] \int_0^\infty \int_0^{\bar{\omega}_{Ft}(\omega_k)} \omega_k \omega_j dF_{jt}(\omega_j) dF_{kt}(\omega_k), \tag{A.31}$$

while the real repossession costs of defaulting banks are given by

$$\Sigma_{bt} = \frac{1}{\Pi_t}\delta_B \left[\int_0^{\bar{\omega}_{kt}} \tilde{R}_{Lt}(\omega_k) L_{t-1} dF_{kt}(\omega_k)\right]. \tag{A.32}$$

## A.6 Proofs

### A.6.1 Bank's Optimality Conditions

*Deposits.* Using the balance sheet constraint (26), deposit demand (27) and the default cutoff (23) in the bank's objective function (25) yields:

$$\mathbb{E}_t \frac{\Lambda_{t,t+1}^B}{\Pi_{t+1}} \left[c_R L_{kt} + \int_{\bar{\omega}_{bkt+1}}^\infty \left( (\tilde{R}_{Lkt+1}(\omega) - R_t) L_{kt} + \left[R_t - R_{Dkt} - \frac{\kappa_D}{2}\left(\frac{R_{Dkt}}{R_{Dkt-1}} - 1\right)^2 R_{Dkt}\right] \left(\frac{R_{Dkt}}{R_{Dt}}\right)^{-\epsilon_D} D_t \right.\right.$$

$$\left.\left. + (R_{t+1}^S - R_t) S_t^L + R_t \bar{B}_{kt} - C_{ft}\right) dF_{kt+1}(\omega)\right]. \tag{A.33}$$

By the Leibniz rule, the derivative with respect to the bank's deposit rate $R_{Dkt}$ is:

$$\mathbb{E}_t \frac{\Lambda^B_{t,t+1}}{\Pi_{t+1}} \left[ -1 + \epsilon_D - \epsilon_D (R_t - R_{Dkt}) - \kappa_D \left( \frac{R_{Dkt}}{R_{Dkt-1}} - 1 \right) \frac{R_{Dkt}}{R_{Dkt-1}} \right] (1 - F_{kt+1}(\bar{\omega}_{kt+1})). \tag{A.34}$$

The term $\frac{\Lambda^B_{t,t+1}}{\Pi_{t+1}}[1 - F_{kt+1}(\bar{\omega}_{bkt+1})]$ can never be zero (unless the bank fails with certainty), hence the optimal deposit rate is characterized by:

$$-1 + \epsilon_D - \epsilon_D (R_t - R_{Dkt}) - \kappa_D \left( \frac{R_{Dkt}}{R_{Dkt-1}} - 1 \right) \frac{R_{Dkt}}{R_{Dkt-1}} = 0 \tag{A.35}$$

which is independent of all other choice variables of the bank. □

*Loan Supply.* It has just been shown that the optimal choice for the deposit rate $R^*_{Dt}$ is independent of $L_{kt}$. Using this result, it is shown below that the bank's objective is convex in the loan volume for any given level of long-maturity bonds $S^L_t$ (including the optimal level). Using the optimal deposit rate (31), the balance sheet constraint (26) and the default cutoff (23) in the bank's objective function (25), the latter can be stated as a function of the loan volume for any given level of $S^L_t$:

$$f(L_{kt}) = \mathbb{E}_t \frac{\Lambda^B_{t,t+1}}{\Pi_{t+1}} [c_R L_{kt} +$$
$$\int_{\bar{\omega}_{bkt+1}}^{\infty} \left( (\tilde{R}_{Lkt+1}(\omega) - R_t) L_{kt} - (R^*_{Dt} + \frac{\kappa_D}{2} \left( \frac{R^*_{Dt}}{R^*_{Dt-1}} - 1 \right)^2 - R_t) D_t + (R^S_{t+1} - R_t) S^L_t + R_t \bar{B}_{kt} - c_f \right) dF_{kt+1}(\omega) \Bigg] \tag{A.36}$$

By the Leibniz rule, we have:

$$f'(L_{kt}) = \mathbb{E}_t \frac{\Lambda^B_{t,t+1}}{\Pi_{t+1}} \left[ c_R + \int_{\bar{\omega}_{bkt+1}}^{\infty} \left[ \tilde{R}_{Lkt+1}(\omega) - R_t \right] dF_{kt+1}(\omega) \right], \tag{A.37}$$

and, as long as the bank's default threshold $\bar{\omega}_{bkt+1}$ exists (i.e. for a given amount of lending, there are states of the world in which the bank fails and other states of the world in which it is solvent):

$$f''(L_{kt}) = \mathbb{E}_t \frac{\Lambda^B_{t,t+1}}{\Pi_{t+1}} \left[ -\frac{\partial \bar{\omega}_{bkt+1}}{\partial L_{kt}} \left[ \tilde{R}_{Lkt+1}(\bar{\omega}_{bkt+1}) - R_t \right] f_{kt+1}(\bar{\omega}_{bkt+1}) \right], \tag{A.38}$$

where by definition of the default threshold $\omega_b$ and the implicit function theorem:

$$\frac{\partial \bar{\omega}_{bkt+1}}{\partial L_{kt}} = -\frac{\tilde{R}_L(\bar{\omega}_{bkt+1}) - R_t}{\frac{\partial \tilde{R}_L(\bar{\omega}_{bkt+1})}{\partial \bar{\omega}_{bkt+1}} L_{kt}}. \tag{A.39}$$

Before turning to the case in which the bank's default threshold exists (as will be the case in equilibrium), let us briefly discuss the case in which this threshold does not exist. First, the threshold may not exist because the bank makes losses from non-lending activities that exceed (with certainty) any possible payoff from lending (for a given loan rate, which is taken as given) for all levels of lending consistent with the capital requirement, i.e. $\forall L_{kt} \in [0, \bar{L}_{kt}]$. In this case, the bank fails with certainty and is obviously indifferent between any level of lending $L_{kt} \in [0, \bar{L}_{kt}]$. Second, the threshold may not exist because the payoff from non-lending activities is so high that it always exceeds any possible losses from lending $\forall L_{kt} \in [0, \bar{L}_{kt}]$. In this case, the lower bound of the integral in Eq. (A.37) becomes zero. The bank is then indifferent between any $L_{kt} \in [0, \bar{L}_{kt}]$ if:

$$\mathbb{E}_t \frac{\Lambda^B_{t,t+1}}{\Pi_{t+1}} \left[ c_R + \int_0^\infty \left[ \tilde{R}_{Lkt+1}(\omega) - R_t \right] dF_{kt+1}(\omega) \right] = 0. \tag{A.40}$$

and strictly prefers lending either $\bar{L}_{kt}$ (when the LHS of (A.40) is above zero) or 0 (when the LHS of (A.40) is below zero).

We now turn to the case in which the bank's default threshold exists. To shorten notation, let the realized return on physical capital for entrepreneurs (net of shocks $\omega$) be denoted by $R_{Kt}$:

$$R_{Kt} = \frac{\Pi_t [Q_t(1-\delta) + z_t]}{Q_{t-1}}, \tag{A.41}$$

and let the leverage of entrepreneurial firms be denoted:

$$\Theta_t = \frac{E_t}{Q_t K_t^E}. \tag{A.42}$$

The bank does not internalize any effects of changes in the bank's default cutoff on the return on physical capital or firm leverage. Then by definition of the ex-post return on loans, we have:

$$\begin{aligned}
&\frac{\partial \tilde{R}_L(\bar{\omega}_{bkt+1})}{\partial \bar{\omega}_{bkt+1}} = -\frac{\partial \bar{\omega}_{Ft+1}(\bar{\omega}_{bkt+1})}{\partial \bar{\omega}_{bkt+1}} R_{Lkt} f_{jt+1}(\bar{\omega}_{Ft+1}(\bar{\omega}_{bkt+1})) \\
&+ (1-\mu_F)\frac{R_{Kt+1}}{1-\Theta_t}\int_0^{\bar{\omega}_{Ft+1}(\bar{\omega}_{bkt+1})} \omega dF_{jt+1}(\omega) \\
&+ (1-\mu_F)\bar{\omega}_{bkt+1}\frac{R_{Kt+1}}{1-\Theta_t}\bar{\omega}_{Ft+1}(\bar{\omega}_{bkt+1}) f_{jt+1}(\bar{\omega}_{Ft+1}(\bar{\omega}_{bkt+1})) \qquad \text{(A.43)} \\
&= [R_{Lkt} - (1-\mu_F)R_{Lkt}]\left(-\frac{\partial \bar{\omega}_{Ft+1}(\bar{\omega}_{bkt+1})}{\partial \bar{\omega}_{bkt+1}}\right) + (1-\mu_F)\frac{R_{Kt+1}}{1-\Theta_t}\int_0^{\bar{\omega}_{Ft+1}(\bar{\omega}_{bkt+1})} \omega dF_{jt+1}(\omega) > 0. \qquad \text{(A.44)}
\end{aligned}$$

The second equation follows since by definition of $\bar{\omega}_{Ft+1}(\bar{\omega}_{bkt+1})$:

$$\frac{\partial \bar{\omega}_{Ft+1}(\bar{\omega}_{bkt+1})}{\partial \bar{\omega}_{bkt+1}} = -\frac{\bar{\omega}_{Ft+1}(\bar{\omega}_{bkt+1})}{\bar{\omega}_{bkt+1}} < 0. \tag{A.45}$$

Hence $f''(L_{kt})$ simplifies to:

$$f''(L_{kt}) = \mathbb{E}_t \Lambda_{t,t+1} \frac{(\tilde{R}_L(\bar{\omega}_{bkt+1}) - R_t)^2}{\frac{\partial \tilde{R}_L(\bar{\omega}_{bkt+1})}{\partial \bar{\omega}_{bkt+1}} L_t} f_{kt+1}(\bar{\omega}_{bkt+1}) \geq 0. \tag{A.46}$$

Summarizing the above discussion, it follows that:

$$f''(L_{kt}) \begin{cases} = 0 \text{ if } \nexists \ \bar{\omega}_{bkt+1} \text{ or } \tilde{R}_L(\bar{\omega}_{bkt+1}) = R_t, \\ > 0 \text{ else.} \end{cases} \tag{A.47}$$

The objective function is thus convex in in $L_{kt}$ (but not strictly convex). Hence, when $f(L)$ is linear in $[0, \bar{L}_{kt}]$, the optimal lending decision is determined by the sign of $f'(L)$, which depends on the loan rate. Note that this implies that any equilibrium with $\tilde{R}_L(\bar{\omega}_{bkt+1}) = R_t$ involves $f'(L) > 0$ and hence $L_{kt} = \bar{L}_{kt}$. On the other hand, whenever $f(L)$ has a strictly convex region in $[0, \bar{L}_{kt}]$, the Karush-Kuhn-Tucker conditions characterize a *minimum* for a given loan rate.[26] Hence, the optimal loan supply follows a corner solution and either $L_{kt} = 0$ or $L_{kt} = \bar{L}_{kt}$ depending on the loan rate. □

## A.7 Contracting Problem Between Banks & Entrepreneurial Firms

Let $\lambda_t^F$ denote the multiplier on the firm's financing constraint Eq. (7) and $\lambda_t^{PC}$ the multiplier on the bank's participation constraint Eq. (36). Since the (atomistic) firm takes the total loan volume intermediated by the bank as given, the first order conditions of the

[26] To see this, note that the constraint $\gamma L_{kt} \leq \bar{L}_{kt}$ – where $\bar{L}_{kt} = \frac{\bar{B}_t}{\gamma}$ under fair-value capital requirements and $\bar{L}_{kt} = \frac{B_t^{AC}}{\gamma}$ under amortized-cost capital requirements – is clearly linear in $L_{kt}$.

contracting problem are given by:

$$(K_t^E): \mathbb{E}_t \Lambda_{t,t+1}^E \int_0^\infty \int_{\bar{\omega}_{Ft+1}(\omega_k)}^\infty \omega_j \omega_k [Q_{t+1}(1-\delta) + z_{t+1}] dF_k(\omega_j) dF_j(\omega_j) - Q_t \lambda_t^F -$$

$$\lambda_t^{PC} \mathbb{E}_t \frac{\Lambda_{t,t+1}^B}{\Pi_{t+1}} \left[ \int_{\bar{\omega}_{bt+1}}^\infty \frac{\partial \tilde{R}_{Lt+1}(\omega)}{\partial K_t^E} L_t dF_k(\omega) \right] = 0 \tag{A.48}$$

$$(L_{jt}): \mathbb{E}_t \frac{\Lambda_{t,t+1}^E}{\Pi_{t+1}} \int_0^\infty \int_{\bar{\omega}_{Ft+1}(\omega_k)}^\infty (-R_{Lt}) dF_k(\omega_j) dF_j(\omega_j) + \lambda_t^F -$$

$$\lambda_t^{PC} \mathbb{E}_t \frac{\Lambda_{t,t+1}^B}{\Pi_{t+1}} \left[ \int_{\bar{\omega}_{bt+1}}^\infty \frac{\partial \tilde{R}_{Lt+1}(\omega)}{\partial L_t} L_t dF_k(\omega) \right] = 0 \tag{A.49}$$

$$(R_{Lt}): \mathbb{E}_t \frac{\Lambda_{t,t+1}^E}{\Pi_{t+1}} \int_0^\infty \int_{\bar{\omega}_{Ft+1}(\omega_k)}^\infty (-L_t) dF_k(\omega_j) dF_j(\omega_j) -$$

$$\lambda_t^{PC} \mathbb{E}_t \frac{\Lambda_{t,t+1}^B}{\Pi_{t+1}} \left[ \int_{\bar{\omega}_{bt+1}}^\infty \frac{\partial \tilde{R}_{Lt+1}(\omega)}{\partial R_{Lt}} L_t dF_k(\omega) \right] = 0 \tag{A.50}$$

Using that $\bar{\omega}_{Ft+1}(\omega_k) = \frac{R_{Lt} L_j}{\omega_k \Pi_{t+1}[Q_{t+1}(1-\delta)K_{Et} + z_{t+1} K_{Et}]}$, these derivatives are given by:

$$\frac{\partial \tilde{R}_{Lt+1}(\omega_k)}{\partial K_{Et}} = \frac{\omega_k (1-\delta_M) \Pi_{t+1} [Q_{t+1}(1-\delta) + z_{t+1}]}{L_t} \Phi \left( \frac{log(\bar{\omega}_{Ft+1}(\omega_k)) - \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}} \right)$$

$$+ \delta_M \frac{R_{Lt}}{K_{Et}} \frac{1}{\sigma_{jt+1}} \phi \left( \frac{ln(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}} \right) \tag{A.51}$$

$$\frac{\partial \tilde{R}_{Lt+1}(\omega_k)}{\partial L_t} = -\frac{\omega_k (1-\delta_M) \Pi_{t+1} [Q_{t+1}(1-\delta) + z_{t+1}] K_{Et}}{L_t^2} \Phi \left( \frac{log(\bar{\omega}_{Ft+1}(\omega_k)) - \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}} \right)$$

$$- \delta_M \frac{R_{Lt}}{L_t} \frac{1}{\sigma_{jt+1}} \phi \left( \frac{ln(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}} \right) \tag{A.52}$$

$$\frac{\partial \tilde{R}_{Lt+1}(\omega_k)}{\partial R_{Lt}} = (1 - F_{kt+1}(\bar{\omega}_{Ft+1}(\omega_k))) - \delta_M \frac{1}{\sigma_{jt+1}} \phi \left( \frac{ln(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}} \right) \tag{A.53}$$

### A.7.1 Taylor Approximation

The expectation of the ex-post realized loan rate and it's derivatives are highly non-linear functions of $\omega_k$. Therefore, to solve the model in Dynare at third order, it is necessary to manually compute a third order approximation.[27] The procedure follows Mendicino et al. (forthcoming). We need the approximation of just three terms involving $\omega_k$:

$$A \equiv \Phi\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right), \tag{A.54}$$

$$\frac{\partial A}{\partial \omega_k} = -\phi\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right)\frac{1}{\sigma_{jt+1}\omega_k}, \tag{A.55}$$

$$\begin{aligned}\frac{\partial^2 A}{\partial \omega_k^2} = &-\phi\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right)\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right)\left(\frac{1}{\sigma_{jt+1}\omega_k}\right)^2 \\ &+ \phi\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right)\frac{1}{\sigma_{jt+1}\omega_k^2}.\end{aligned} \tag{A.56}$$

$$B \equiv \omega_k \Phi\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) - \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right), \tag{A.57}$$

$$\frac{\partial B}{\partial \omega_k} = -\phi\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) - \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right)\frac{1}{\sigma_{jt+1}} + \Phi\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) - \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right), \tag{A.58}$$

$$\frac{\partial^2 B}{\partial \omega_k^2} = -\phi\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) - \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right)\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) - \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right)\frac{1}{\sigma_{jt+1}^2\omega_k} \tag{A.59}$$

$$-\phi\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) - \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right)\frac{1}{\sigma_{jt+1}\omega_k}. \tag{A.60}$$

[27]Derivatives of external functions are currently only implemented in Dynare up to second order.

$$C \equiv \frac{1}{\sigma_{jt+1}}\phi\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right), \tag{A.61}$$

$$\frac{\partial C}{\partial \omega_k} = \frac{1}{\sigma_{jt+1}^2\omega_k}\phi\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right)\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right), \tag{A.62}$$

$$\frac{\partial^2 C}{\partial \omega_k^2} = -\frac{1}{\sigma_{jt+1}^2\omega_k^2}\phi\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right)\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right) \tag{A.63}$$

$$+\frac{1}{\sigma_{jt+1}^3\omega_k^2}\phi\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right)\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right)^2 \tag{A.64}$$

$$-\frac{1}{\sigma_{jt+1}^3\omega_k^2}\phi\left(\frac{log(\bar{\omega}_{Ft+1}(\omega_k)) + \frac{\sigma_{jt+1}^2}{2}}{\sigma_{jt+1}}\right). \tag{A.65}$$

Then, as in Mendicino et al. (forthcoming), the expected ex-post realized loan rate can be approximated as:

$$\mathbb{E}_t\tilde{R}_{t+1}^L \approx \sum_{i=1}^{N}\left(\int_{x_i}^{x_{i+1}} T\left(\tilde{R}_{t+1}^L\right)(\omega_k)dF_{kt+1}(\omega_k)\right) + [1 - F_{kt+1}(x_{N+1})]R_t^L. \tag{A.66}$$

where the Taylor Approximation of the ex-post realized loan rate around a point $\bar{x}_i = \frac{x_i + x_{i+1}}{2}$ is given by:

$$T\left(\tilde{R}_{t+1}^L\right)(\omega_k) = \tilde{R}_{t+1}^L(\bar{x}_i) + \frac{\partial \tilde{R}_{t+1}^L}{\partial \omega_k}(\omega_k - \bar{x}_i) + \frac{1}{2}\frac{\partial^2 \tilde{R}_{t+1}^L}{\partial \omega_k^2}(\omega_k - \bar{x}_i)^2. \tag{A.67}$$

Using the expressions just derived:

$$T\left(\tilde{R}_t^L\right)(\omega_k) = \frac{(1-\delta_M)\Pi_{t+1}[Q_{t+1}(1-\delta) + z_{t+1}]K_t^E}{L_t}T(B) + R_t^L(1 - T(A)). \tag{A.68}$$

Then:

$$\int_{x_i}^{x_{i+1}} T\left(\tilde{R}^L_{t+1}\right)(\omega_k)dF_{kt+1}(\omega_k) = Q_0(\bar{x}_i) + Q_1(\bar{x}_i)\int_{x_i}^{x_{i+1}} \omega_k dF_{kt+1}(\omega_k)$$
$$+Q_2(\bar{x}_i)\int_{x_i}^{x_{i+1}} \omega_k^2 dF_{kt+1}(\omega_k), \tag{A.69}$$

where

$$Q_0(\bar{x}_i) = [F_{kt+1}(\omega_{i+1}) - F_{kt+1}(\omega_i)]\left[\tilde{R}^L_{t+1}(\bar{x}_k) - \bar{x}_i\frac{\partial \tilde{R}^L_{t+1}}{\partial \omega_k} + \frac{1}{2}\bar{x}_i^2\frac{\partial^2 \tilde{R}^L_{t+1}}{\partial \omega_k^2}\right], \tag{A.70}$$

$$Q_1(\bar{x}_i) = \left[\frac{\partial \tilde{R}^L_{t+1}}{\partial \omega_k} - \bar{x}_i\frac{\partial^2 \tilde{R}^L_{t+1}}{\partial \omega_k^2}\right], \tag{A.71}$$

$$Q_2(\bar{x}_i) = \frac{1}{2}\frac{\partial^2 \tilde{R}^L_{t+1}}{\partial \omega_k^2}. \tag{A.72}$$

We proceed similarly for the derivatives of the ex-post loan rate.

# B Calibration

This Appendix presents additional details on the calibration strategy, and provides full details of the date sources.

where $\epsilon_{mw} \sim N(0,1)$. The length of the simulation is 1700 quarters after a burn-in of 1500 periods. The burn-in period ensures that the ergodic distribution is reached.[28] We specify priors on some parameters due to SMM's known tendency to pick parameters not supported by micro data (see An and Schorfheide, 2007 and Ruge-Murcia, 2012).[29]

[28] We follow Born and Pfeifer (2014) who use the same burn-in length.
[29] As discussed in Born and Pfeifer (2014), these priors are relatively flat.

| Parameter | Description | Prior | Variance |
|---|---|---|---|
| $\phi_\Pi$ | Taylor Rule Weight Inflation | 1.5 | 6 |
| $\phi_Y$ | Taylor Rule Weight Inflation | 0.5 | 2 |
| $\phi_R$ | Taylor Rule Smoothing | 1.5 | 2 |
| $\kappa$ | Investment Adjustment Costs | 7 | 40 |

**Table 5:** *Priors*

## B.1 Data Sources

**Gross Domestic Product (GDP) deflator** OECD Quarterly National Accounts. Euro Area (20 countries). Deflator, OECD reference year, seasonally adjusted. Millions of Euro. Index.

**Population** OECD Quarterly National Accounts. Euro Area (20 countries). Total Population. Thousands.

**GDP** OECD Quarterly National Accounts. Euro Area (20 countries). Gross domestic product - expenditure approach. National currency, current prices, quarterly levels, seasonally adjusted. Millions of Euro. *Transformation*: Divided by GDP deflator and total population.

**Consumption** Private final consumption expenditure. OECD Quarterly National Accounts. Euro Area (20 countries). National currency, current prices, quarterly levels, seasonally adjusted. Millions of Euro. *Transformation*: Divided by GDP deflator and total population.

**Investment** OECD Quarterly National Accounts. Euro Area (20 countries). Gross fixed capital formation. National currency, current prices, quarterly levels, seasonally adjusted. Millions of Euro. *Transformation*: Divided by GDP deflator and total population.

**Inflation** Log-change in GDP Deflator.

**Employment** OECD Quarterly National Accounts. Euro Area (20 countries). Employment, total (Persons). Thousands.

**Hours** OECD Quarterly National Accounts. Euro Area (20 countries). Employment, total (Hours Worked). Millions. *Transformation*: Demeaned Hours/Employment ($H = 1$ in the model corresponds to average hours worked).

**Wages** OECD Quarterly National Accounts. Euro Area (20 countries). Wages, total. Millions. *Transformation*: Wages divided by total hours worked and GDP deflator.

**Rate of return on equity (RoE), bank default probability, and firm default probability** Mendicino et al. (forthcoming).

**Loan-to-bond ratio** Hoffmann et al. (2019)

**Loans** ECB Statistical Date Warehouse. The ECB does not report values for a hypothetical constant composition Euro Area, such that care must be taken to compute relationships with the measure of GDP for the corresponding countries. For this reason, we construct data for the following countries: Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, Luxembourg, Netherlands and Portugal.

The ECB data we use is only available monthly, so for each of the variables below, population weighted averages are computed for each quarter. Let $\omega_{ct} = \frac{Population_{ct}}{\sum_c Population_{ct}}$, where countries are indexed by $c$, quarters by $t$ and month by $m$. $\omega_c$ are computed from the same OECD population data used above. Then the population-weighted averages for each quarter of variable $x$ are:

$$\bar{x}_t = \frac{1}{4} \sum_{m \in t} \sum_{c} \omega_c x_{cm} \tag{A.73}$$

(L1) : Loans vis-a-vis euro area NFCs reported by MFIs excl. ESCB. Up to 1 year maturity. Euro area (changing composition) counterpart, Non-Financial corporations (S.11) sector, denominated in Euro. Outstanding amounts at the end of the period (stocks). Monthly.
(L2) : Loans vis-a-vis euro area NFCs reported by MFIs excl. ESCB. Over 1 and up to 5 years maturity. Euro area (changing composition) counterpart, Non-Financial corporations (S.11) sector, denominated in Euro. Outstanding amounts at the end of the period (stocks). Monthly.
(L3) : Loans vis-a-vis euro area NFCs reported by MFIs excl. ESCB. Over 5 years maturity. Euro area (changing composition) counterpart, Non-Financial corporations (S.11) sector, denominated in Euro. Outstanding amounts at the end of the period (stocks). Monthly.
Sum of: (L1) + (L2) + (L3) of all countries listed above.
*Transformation*: Population weighted average for each quarters. Seasonally adjusted with X-13 ARIMA using the R package seasonal. Divided by nominal GDP and multiplied by real per capita GDP to get real per-capita loans. To compute the average loan-to-GDP ratio the sum of real per capita GDP for the same countries is used.

**Loan rate spread** ECB Statistical Data Warehouse.
(LR1): Annualised agreed rate (AAR) / Narrowly defined effective rate (NDER), Credit and other institutions (MFI except MMFs and central banks) reporting sector - Loans, Up to 1 year original maturity, Outstanding amount business coverage, Non-Financial corporations (S.11) sector, denominated in Euro. Monthly.
(SR1): Euro Interbank Offered Rate.
(LR2): Annualised agreed rate (AAR) / Narrowly defined effective rate (NDER), Credit and other institutions (MFI except MMFs and central banks) reporting sector - Loans, Over 1 and up to 5 years original maturity, Outstanding amount business coverage, Non-Financial corporations (S.11) sector, denominated in Euro. Monthly.
(SR2): Yield curve spot rate, 2 year maturity. Government bond, nominal, all issuers whose

rating is triple A - Euro area (changing composition). Monthly.

(LR3): Annualised agreed rate (AAR) / Narrowly defined effective rate (NDER), Credit and other institutions (MFI except MMFs and central banks) reporting sector - Loans, Over 5 years original maturity, Outstanding amount business coverage, Non-Financial corporations (S.11) sector, denominated in Euro. Monthly.

(SR3): Yield curve spot rate, 5 year maturity. Government bond, nominal, all issuers whose rating is triple A - Euro area (changing composition). Monthly.

*Transformation*:

$$\frac{((LR1)-(SR1))(L1)+((LR2)-(SR2))(L2)+((LR3)-(SR3))(L3)}{(L1)+(L2)+(L3)}$$

of all countries listed above. Compute population weighted average for each quarters.

**Safe Rate** ECB Statistical Data Warehouse. Using the data just described, we approximate the safe rate (the data counterpart to $R_t$) as:

$$\frac{(SR1)(L1)+(SR2)(L2)+(SR3)(L3)}{(L1)+(L2)+(L3)}$$

of all countries listed above. Then we compute the population weighted average for each quarter.

# C Details Computation Consumption Equivalents

Denote variable $x$ in model $a$ by $x_t^a$ and in model $b$ by $x_t^b$, where $a$ and $b$ will be specified below. To compute consumption equivalents (CE) $\Delta_{CE}$, we first calculate the expected lifetime utility at time $t$ under two different models:[30]

$$\mathbb{E}(U_t^a) = \mathbb{E}\left(\mathbb{E}_t \sum_{n=0}^{\infty} \beta^n \left[\frac{\{C_{t+n}^a(h) - bC_{t+n-1}^a(h)\}^{1-\sigma}}{1-\sigma} - \frac{\xi_H H_{t+n}^a(h)^{1+\varphi_H}}{1+\varphi_H}\right]\right) \tag{A.74}$$

and similarly for model $b$. Next, the expected utility in model $b$ can be related to the utility in model $a$ as follows:

$$\mathbb{E}(U_t^a) = \mathbb{E}\left(\mathbb{E}_t \sum_{n=0}^{\infty} \beta^n \left[\frac{\{(1+\Delta_{CE})(C_{t+n}^b(h) - bC_{t+n-1}^b(h))\}^{1-\sigma}}{1-\sigma} - \frac{\xi_H H_{t+n}^b(h)^{1+\varphi_H}}{1+\varphi_H}\right]\right) \tag{A.75}$$

Under log-utility ($\sigma = 1$), using Eq. (A.74) in Eq. (A.75) yields:

$$\mathbb{E}(U_t^a) = \frac{ln(1+\Delta_{CE})}{1-\beta} + \mathbb{E}(U_t^b) \tag{A.76}$$

It follows:

$$\Delta_{CE} = exp[(1-\beta)(\mathbb{E}\{U_t^a - U_t^b\})] - 1 \tag{A.77}$$

Model $a$ is for example of the model under fair value requirements, while model $b$ is the model under amortized-cost requirements. The interpretation is that households, could they choose, would require $100\Delta_{CE}\%$ of consumption in every period to remain in the economy with amortized-cost value requirements.

[30] This may be interpreted as the expected utility of a person born at an arbitrary time $t$ in the respective economy.

# D Additional Tables and Figures

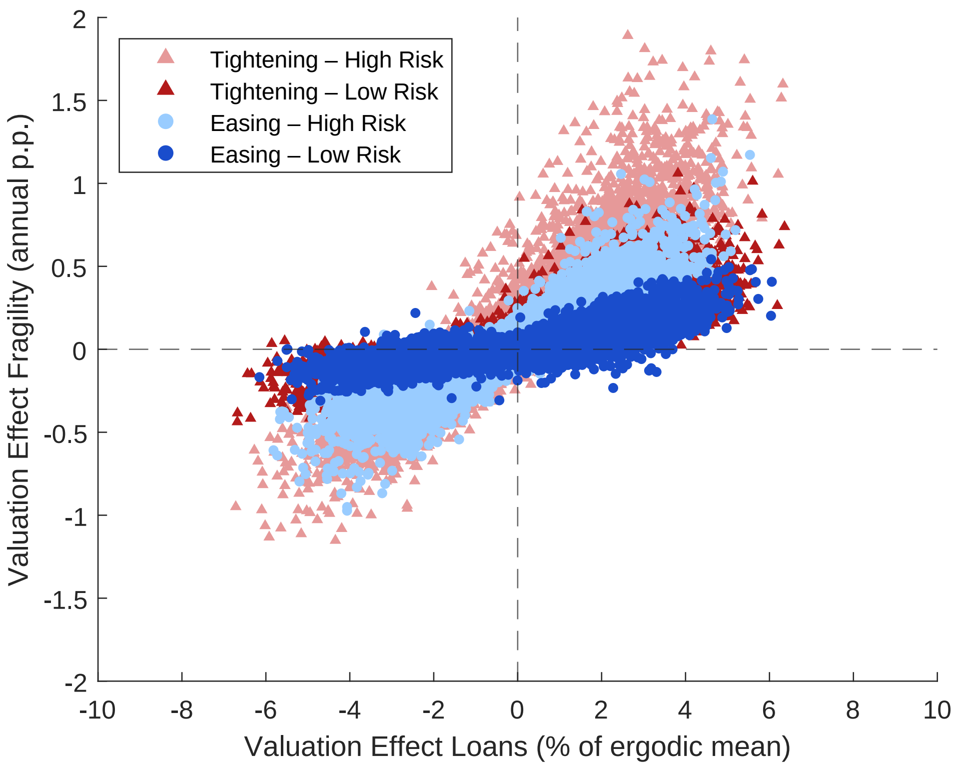



**Figure 8:** *Valuation Effects on Lending and Fragility: Correlation by Regime*

Notes: Tightening episodes are defined as those in which the real policy rate is above the one implied by the Taylor Rule, i.e. $\tau_t > 1$, and easing episodes as those in which $\tau_t < 1$. Stability episodes are those in which the variance of the island-specific shock $\sigma_{\omega_k}$ is particularly low (below its median), and instability episodes those with $\sigma_{\omega_k}$ above its 75th percentile. The Valuation Effect on Loans is defined as the difference in bank loans between the baseline economy (amortized-cost regime) and the alternate economy (fair-value regime) for different levels of unrealized losses or gains. The difference in bank loans is reported as a percentage of the ergodic mean of loans under the amortized-cost regime. The Valuation Effect on Fragility is defined as the difference in the annualized bank default probability between the baseline economy (amortized-cost regime) and the alternate economy (fair-value regime) for different levels of unrealized losses or gains.

**Table 6:** *Parameter Values*

| Symbol | Value | Description |
|---|---|---|
| $\alpha$ | 0.25 | Capital Share Production |
| $\beta$ | 0.995 | HH Discount Factor |
| $\delta$ | 0.025 | Capital Depreciation Rate |
| $\theta_R$ | 68.4 | Rotemberg Price Adjustment Cost |
| $\theta_W$ | 1.13e+03 | Rotemberg Wage Adjustment Cost |
| $\varphi_H$ | 1 | Inverse Frisch Elasticity of Labor |
| $\mu$ | 7.25 | Elasticity of Substitution Final Goods |
| $\epsilon_W$ | 5 | Elasticity of Substitution Labor |
| $\kappa$ | 7.85 | Investment Adjustment Cost |
| $\kappa_H$ | 0.00831 | Capital Management Cost |
| $\sigma$ | 1 | HH Risk Aversion (Consumption) |
| $\xi_H$ | 0.835 | Disutility of Labor |
| $\theta_B$ | 0.965 | Survival Bankers |
| $\theta_E$ | 0.969 | Survival Entrepreneurs |
| $\gamma$ | 0.08 | Regulatory Capital Requirement |
| $\phi_\Pi$ | 1.07 | Taylor Rule Weight Inflation |
| $\phi_y$ | 0.00115 | Taylor Rule Weight Output |
| $\phi_R$ | 0.648 | Taylor Rule Weight Smoothing Weight |
| $\xi_B$ | 0.5 | Endowment Bankers |
| $\xi_E$ | 8.41e-07 | Endowment Entrepreneurs |
| $b$ | 0.743 | Habit Consumption |
| $\delta_M$ | 0.3 | Loss Entrepreneurial Default |
| $\delta_B$ | 0.3 | Loss Bank Default |
| $\bar{\sigma}_{\omega_j}$ | 0.133 | Steady State Std Idiosyncratic Shock |
| $\bar{\sigma}_{\omega_k}$ | 0.112 | Steady State Std Island Shock |
| $\sigma_{\omega_j}$ | 0.000244 | Std Idiosyncratic Risk Shock |
| $\sigma_{\omega_k}$ | 0.0137 | Std Island Risk Shock |
| $\rho_{\omega_j}$ | 0.655 | Autocorr. Idiosyncratic Risk Shock |
| $\rho_{\omega_k}$ | 0.996 | Autocorr. Island Risk Shock |
| $\rho_\theta$ | 0.0158 | Autocorr. Productivity Shock |
| $\rho_p$ | 0.607 | Autocorr. Cost Push Shock |
| $\rho_g$ | 0.83 | Autocorr. Gov. Spending Shock |
| $\rho_\tau$ | 0.961 | Autocorr. Monetary Policy Shock |
| $\sigma_\theta$ | 0.000254 | Std. Productivity Shock |
| $\sigma_p$ | 0.128 | Std. Cost Push Shock |
| $\sigma_g$ | 0.00382 | Std. Gov. Spending Shock |
| $\sigma_\tau$ | 0.000281 | Std. Monetary Policy Shock |
| $S^L$ | 1.09 | Real Supply Central Bank Asset |
| $m$ | 13.6 | Gov. Bond Maturity |
| $\phi_{lc}$ | 0 | Bank Liquidity Management Cost |
| $c_f$ | 0.00491 | Bank Fixed Cost |
| $c_R$ | 0.00274 | Bank Relationship Lending Benefit |
| $\epsilon_D$ | -400 | Deposits Elasticity of Substitution |
| $\kappa_D$ | 1184.77 | Deposits Adjustment Cost |