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Stabilizing credit when nonperforming loans surge: the role of asset management companies

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Abstract

When default losses elevate borrowing costs, expanding credit cannot stabilize the economy because default rates feed back to lending rates through bank balance sheets. Asset management companies (AMCs) break this loop by purchasing nonperforming loans at their long-run recovery values, thereby fixing the effective default rate that banks face. Government purchases of performing loans expand credit but leave this feedback intact. In a model calibrated to the eurozone, the AMC reduces quarterly default rates by 0.8 percentage points, lowers lending rates by 1.6 percentage points, and raises welfare by 0.2%. Government purchases crowd out bank deposits, contracting credit; default rates rise by 1.8 percentage points, lending rates increase by 1.2 percentage points, and welfare falls by 0.3%.

Keywords: Nonperforming Loans, Asset Management Companies, Credit Stabilization, Bank Balance Sheets, Endogenous Default

JEL Classification: E44, G01, G21, G28

Non-Technical Summary

Between 2014 and 2018, nearly 10% of loans held by European banks were nonperforming. Supervisory evidence indicates that these elevated ratios constrained bank profitability and lending growth, even after central bank operations had restored funding. The underlying problem was not liquidity but a feedback loop: high default rates forced banks to increase the cost of lending, higher rates increased debt burdens on borrowers, and heavier burdens led to more defaults. Several European governments responded by establishing Asset Management Companies. An AMC purchases nonperforming loans from banks at prices reflecting long-run recovery values, removes these assets from bank balance sheets, and holds them until markets recover. Ireland's National Asset Management Agency accumulated assets equal to approximately 44% of GDP. Spain and Slovenia created AMCs managing 10% to 16% of GDP. South Korea's AMC eventually recovered about 60% of acquired assets. Despite their widespread use, little quantitative research has examined how AMCs affect the broader economy.

AMCs perform many functions in practice, from managing workouts, to preventing fire sales, to catalyzing private markets for distressed debt. This paper focuses on one channel. In practice, AMCs purchase nonperforming loans above distressed market prices, compensating banks for losses they would otherwise absorb. The model captures this by assuming the AMC fixes the effective default rate that banks face when pricing new loans. Banks expecting stable returns can offer lower interest rates because the AMC absorbs losses exceeding normal levels. Lower rates reduce debt servicing burdens, fewer borrowers default, and the vicious cycle reverses. Government purchases of performing loans operate differently. For high-grade instruments such as commercial paper and agency debt, such purchases work well because intermediation costs are modest and default risk is negligible. Risky corporate loans present a different problem. Financing these purchases diverts household resources from bank deposits, forcing banks to contract lending by more than the government expands credit. Because banks continue to face full default risk on remaining portfolios, the feedback between default and lending rates persists.

A static model characterizes these mechanisms analytically. Firms borrow to finance working capital and can default at a cost depending on aggregate credit conditions. Banks price loans to break even given expected defaults. Two inefficiencies arise: individual firms do not internalize how their default affects borrowing costs for all firms, and deteriorating conditions reduce the marginal cost of default, inducing more of it. Output sensitivity to shocks rises with the default rate, so economies with high default are less efficient and more volatile. An AMC that fixes the effective default rate eliminates this amplification. Alternative policies cannot replicate this outcome: direct government lending displaces bank lending without altering default pricing, and equity transfers stabilize profits but not lending rates because default still varies with borrowing.

The dynamic model embeds these mechanisms in a real business cycle framework calibrated to eurozone data. Banks face an agency friction where bankers can divert assets, so depositors impose an incentive constraint tying lending capacity to net worth. This creates a financial accelerator: adverse shocks erode capital, tighten credit, and amplify disturbances. Firms finance labor costs through working capital loans and choose default optimally. Credit conditions depend on both firm equity and bank balance sheet stress, so each sector's troubles feed back to the other.

Monte Carlo simulations compare three regimes: no policy, an active AMC, and government purchases of performing loans. When the AMC absorbs half of excess default losses, quarterly default rates decline by 0.8 percentage points, and lending rates fall by 1.6 percentage points. Bank net wealth rises by 5.7%. Welfare increases by 0.2% of permanent consumption. Government purchases produce the opposite outcome. Although purchases average 2.2% of GDP, bank loan supply contracts by 3.8% as financing crowds out deposits. Bank net wealth falls by 8.3%, default rates rise by 1.8 percentage points, and lending rates increase by 1.2 percentage points. Welfare falls by 0.3% of permanent consumption. This does not imply all asset purchases are counterproductive; purchases of safe assets with negligible default risk can relax balance sheet constraints without these crowding-out dynamics.

Private markets for nonperforming loans failed because banks possessed superior information about loan quality, few specialized investors dominated pricing, and legal barriers impeded enforcement. Government-backed AMCs can address all three frictions. Beyond quantified welfare gains, AMCs may preserve fiscal space, prevent fire sales, and improve credit allocation.

When elevated nonperforming loan ratios rather than funding shortages drive tight credit conditions, policies must target default directly. Expanding credit without addressing default leaves the feedback loop intact and can worsen bank balance sheets. For high-grade assets, government purchases remain effective. For nonperforming loans, AMCs offer a distinct advantage and belong in the policy toolkit alongside capital regulations and lender-of-last-resort facilities.

1 Introduction

Following the Global Financial Crisis, borrowing costs for eurozone firms remained elevated despite the European Central Bank's (ECB) long-term refinancing operations restoring bank funding. The problem was not bank liquidity but the feedback between expected default rates and lending rates operating through firm balance sheets. Across EU banks, the average nonperforming-loan (NPL) ratio was close to 10% in 2014–18 according to the IMF Financial Soundness Indicators, and supervisory evidence indicates that NPL levels remained "high by historic standards" and continued to constrain profitability and lending growth (European Banking Authority, 2018, pp. 82–83). Andrea Enria, chair of the Supervisory Board of the ECB, noted in 2019 that "inflows of new NPLs are still on the high side" and "some banks with high NPLs are still reporting increasing default rates."[1] In models such as Gertler and Kiyotaki (2010), the key friction is a bank balance sheet constraint; government asset purchases work by relaxing this constraint. But when default rates are determined by borrower conditions and feed back to lending rates, expanding the credit supply leaves the default channel intact. This motivates our focus on asset management companies (AMCs), which target default directly.

AMCs purchase NPLs from banks at long-run recovery values, fixing the effective default rate that banks face and enabling lower lending rates. This breaks the feedback loop, which government asset purchases leave intact. The critical difference is timing: Government purchases target performing loans before default occurs, while AMCs intervene after loans become impaired. This timing reflects the types of assets involved. For high-grade instruments such as commercial paper and agency debt, government purchases work well because the costs of intermediation are modest. For assets that require extensive evaluation and monitoring, such as commercial and industrial loans, equity injections that enhance private banks' capacity to intermediate may be preferable. NPLs constitute a third category. These assets have already been defaulted on, so the question is what recovery value can be achieved. AMCs specialize in answering this question, and they acquire impaired loans at prices that stabilize bank balance sheets while managing the workout process. Large AMCs in Ireland (whose balance sheet was approximately 44% of GDP) and in Spain and Slovenia (10%–16% of GDP) compensated for the absence of private secondary markets for distressed assets (Medina Cas and Peresa, 2016).

Why did private secondary markets for NPLs fail to emerge? Wide bid-ask spreads and thin trading volumes point to significant market frictions (Fell et al., 2016). Fell et al. (2017) identify three classic failures: (i) information asymmetry, whereby banks possessed superior information about asset quality, creating a lemons problem in which rational investors assumed all assets were of low quality; (ii) oligopsonistic market structure, in which a few large investors dominated the market and set prices while excluding smaller participants who lacked expertise in

[1] "Non-performing loans in the euro area — where do we stand?," Speech by Andrea Enria, Chair of the Supervisory Board of the European Central Bank, at the Conference "EDIS, NPLs, Sovereign Debt and Safe Assets" organized by the Institute for Law and Finance, Frankfurt, 14 June 2019.

loan valuation; and (iii) nontransferability and imperfect excludability, whereby investors faced difficulties enforcing claims, coordinating with other creditors, or acquiring loans that were legally required to remain with banking entities. AMCs with appropriate legal frameworks can mitigate all three frictions by requiring standardized data and independent valuations to reduce adverse selection, acting as credible price setters that crowd in private investors, and exercising special legal powers to enforce claims outside the banking system. Furthermore, by relying on external service providers, AMCs can catalyze an ecosystem for impaired-asset management that fosters private market development, as observed in Ireland and Spain following the establishment of their AMCs.

This paper analyzes how AMCs reduce lending margins, increase lending, and improve macro-financial outcomes. We embed working-capital financing with endogenous default into both a two-period static model and a calibrated real business cycle model with balance sheet-constrained banks. In our framework, loan rates rise when defaults increase, which depresses labor demand, investment, and output, consistent with empirical findings in the eurozone (Huljak et al., 2022). We compare AMC purchases of NPLs with government purchases of performing loans.

In the static model, we show analytically that an AMC reduces the elasticity of output with respect to both productivity and discount-factor shocks by breaking the feedback loop between firm default and bank lending rates. In the dynamic model — calibrated to eurozone data — Monte Carlo simulations reveal substantial differences between the two policies. When active, the AMC reduces mean quarterly default rates by 0.8 percentage points, lowers loan rates by 1.6 percentage points, and increases firm equity by 1.2%. We show that government purchases of performing loans, by contrast, crowd out bank deposits and contract credit supply rather than expanding it (which erodes bank capital): Default rates rise by 1.8 percentage points and loan rates increase by 1.2 percentage points when this policy is active. Welfare analysis reveals that the AMC generates gains equivalent to 0.2% of permanent consumption, while government asset purchases reduce welfare by 0.3%.

A substantial literature emphasizes interventions that alleviate financial-intermediary constraints by improving net worth and liquidity positions (Gertler and Kiyotaki, 2010; Gertler and Karadi, 2011, 2013; Adrian and Shin, 2010; Kiley and Sim, 2014; Onofri et al., 2023). In these frameworks, central bank purchases typically target safe or near-safe assets, relaxing bank balance sheet constraints without materially altering default risk. We model intervention in an environment in which lending conditions remain tight because of endogenous borrower-side risks. When the same style of intervention is applied to risky corporate loans and is activated precisely when spreads are elevated and macroeconomic conditions are weak, the financing required crowds out bank deposits, forcing banks to contract lending by more than the policy expands credit. The consequences are elevated average default rates and an erosion of bank net worth, which keeps credit spreads persistently wide. In our calibration, the intended credit expansion never materializes; instead, balance sheets weaken and default losses increase, which explains why the welfare effect is negative. The AMC operates differently: By purchasing NPLs at prices exceeding their market value, it directly increases banks' ex post returns and enables lower ex ante lending rates. Lower borrowing costs reduce firms' debt servicing burden, lowering default rates and further improving bank returns in a self-reinforcing feedback loop.

Our analysis also connects to the literature on public support for nonfinancial firms, including the Troubled Asset Relief Program (TARP) automotive loans, and related work on broad-based transfers (Bianchi, 2016), quasi-equity facilities (Elenev et al., 2020), and liquidity assistance (Faria-e Castro, 2021; Segura and Villacorta, 2023; Hirakata et al., 2013). While these programs attenuate pecuniary externalities by raising borrower net worth, an AMC acts on bank pricing decisions through their balance sheets: Overpaying for NPLs raises realized bank returns, allowing banks to lend at tighter spreads since their required loss buffer is effectively reduced. Equity support and AMC-style purchases are thus *complements*. The former is most powerful when borrower net worth is exhausted, while the latter is especially effective when pecuniary externalities arising from default drive the credit crunch. Our framework abstracts from several amplification channels that would further increase AMC benefits, including product-market links (Chen et al., 2023a; Dou et al., 2025), self-fulfilling credit freezes (Bebchuk and Goldstein, 2011), and fire-sale spirals (Allen and Gale, 2000; Elliott et al., 2014; Cespa and Foucault, 2014). By acquiring distressed loans at supportive prices, an AMC can interrupt these feedback loops, suggesting that our estimates represent a lower bound on the system-wide gains from such interventions.

The paper proceeds as follows. Section 2 provides background on AMCs and their use in practice. Section 3 develops a static two-period model that characterizes how the AMC breaks the feedback loop between default and lending rates, and it allows us to compare AMC intervention with alternative policies including government lending and equity injections. Section 4 embeds these mechanisms in a real business cycle model calibrated to the eurozone with balance sheet-constrained banks. We present first-order impulse responses and evaluate welfare using a second-order approximation, both of which account for occasionally binding constraints. Section 5 concludes.

2 A Primer on Asset Management Companies

AMCs play a vital role in achieving financial stability by removing impaired assets from troubled banks, thereby improving balance sheet quality and facilitating economic recovery. Although the terms are often used interchangeably, AMCs and bad banks differ significantly. An AMC typically acquires impaired assets from multiple banks as part of a systemic approach to resolving banking crises (see, for example, Hryckiewicz et al., 2023). A bad bank is created from a single troubled bank and holds impaired assets for eventual liquidation, as exemplified by the European Union's 2014 Bank Recovery and Resolution Directive, which split troubled banks into viable entities and liquidated remaining impaired assets. Figure 5 in the Appendix illustrates various mechanisms for resolving NPLs and highlights the distinct role of AMCs. AMCs primarily function by addressing the intertemporal pricing gap that arises when market prices for distressed assets become artificially depressed because of liquidity shortages or heightened risk aversion. By acquiring and managing these assets over time, AMCs prevent destructive fire sales, thus allowing assets to appreciate as markets recover and maximizing value recovery (Fell et al., 2017).

Over the past three decades, systemic (or public) AMCs have been deployed in Europe and Asia, addressing large NPL accumulations resulting from crises such as the 1997 Asian financial crisis and the eurozone sovereign debt crisis (Fell et al., 2021, 2017). Empirical analyses underscore AMCs' effectiveness in stabilizing financial systems. Using data from the *Building Better Bad Banks* project, Park et al. (2021) analyze 139 AMCs in 62 countries between 1996 and 2016. Controlling for macroeconomic conditions (GDP growth, inflation, exchange rate fluctuations, volatility index), bailouts (Bova et al., 2016), and macroprudential policies (Cerutti et al., 2017), they identify a significant negative impact of AMCs on NPL ratios. Balgova et al. (2016) highlight the enhanced effectiveness of AMCs when they operate alongside public bailout funds.

The Global Financial Crisis further illustrates government intervention's critical role. In the United States, TARP initially aimed at purchasing illiquid mortgage-backed securities but shifted to capital injections, thus directly affecting bank risk-taking and enhancing bank lending capabilities (Duchin and Sosyura, 2014; Dávila and Walther, 2020). European countries successfully employed public AMCs, such as Ireland's National Asset Management Agency (NAMA), created in 2009, to stabilize banks (while returning substantial funds to the government by 2016) by acquiring toxic loans (Medina Cas and Peresa, 2016). Various case studies further illustrate AMCs' varied degrees of success globally. South Korea's Korea Asset Management Corporation (KAMCO), established during the Asian crisis, acquired around 75% of all Korean distressed assets, recovering about 60% of the acquired assets by 2004 (He, 2006). Malaysia's Danaharta similarly recovered 58% of its acquired NPLs by 2005 (Fell et al., 2021). Sweden's AMC, during the country's crisis in the 1990s, represents a benchmark for successful bank stabilization (Jonung, 2009). In contrast, Spain's Sareb and Indonesia's AMC (under the Indonesian Bank Restructuring Agency, IBRA) faced notable challenges, and achieved only modest recovery rates due to institutional and valuation shortcomings (Medina Cas and Peresa, 2016; He, 2006). Thus, the effectiveness of AMCs hinges critically on having a robust regulatory framework, accurate valuation of assets, sufficient liquidity management, and adequate capitalization. Their integration with broader macroeconomic policies significantly enhances their effectiveness, as seen in Ireland and South Korea, whereas weaker institutional environments limit AMC success, as seen in Indonesia and Spain.

3 Static Model

We now introduce our static model to illustrate the mechanisms by which our AMC can mitigate pecuniary externalities originating from the nonfinancial sector when the banking sector is not balance sheet constrained. We then compare the effectiveness of the AMC with other government policies including government lending to banks or firms, as well as equity injections to firms. Finally, we modify our banks by introducing balance sheet constraints and compare the effectiveness of the AMC to previously studied crisis policies. All proofs are in the Appendix.

3.1 Agents and Institutions

Households

Households live for two periods, ($t \in \{0, 1\}$) and have linear preferences over consumption (c_0 and c_1) and a quadratic cost of labor (n_0^2). These preferences allow the real interest rate to depend on the discount factor β. Utility is $U = c_0 - \frac{1}{2}n_0^2 + \beta c_1$. In the first period, households sell labor for wage rate w_0, and hold deposits d_1, which earn net interest $i_{d,0}$ in that period; they receive the principal in the second period. In addition, households can trade riskless bonds b_1 at an interest rate of i_{b_0}. Households receive profits from firms (Π_{F_0}) and banks (Π_{b_0}), transfers from the government in the two periods Υ_0 and Υ_1, and an endowment y_1 in the second period. The budget constraints for the first and second periods, respectively, are,

$$c_0 + d_1(1 - i_{d,0}) + \frac{b_1}{1 + i_{b_0}} = \Pi_{F_0} + \Pi_{b_0} + w_0 n_0 + \Upsilon_0, \quad \textit{and}$$
$$c_1 + \Upsilon_1 = d_1 + b_1 + y_1.$$

Optimality implies

$$w_0 = n_0, \tag{1}$$
$$(1 - i_{d,0})(1 + i_{b_0}) = 1, \tag{2}$$
$$1 + i_{b_0} = \frac{1}{\beta}, \tag{3}$$

which means bond rates and deposit rates move in the same direction.

Firms

Firms must pay for labor through working capital loans $l_0 \geq w_0 n_0$ in advance of production, and production is given by a linear production function $y_0 = a_0 n_0$ that depends on total factor productivity (TFP) a_0. Loans net of defaults δ_0 and interest $i_{l,0}$ are repaid in the same period.

Firms maximize profits $\pi_{f,0}$ by choosing labor n_0, working capital loans l_0, and defaults δ_0, according to the profit function

$$\pi_{f,0} = y_0 - (1 - \delta_0)(1 + i_{l,0})l_0 - \frac{\Omega_0}{2}[\delta_0 l_0(1 + i_{l,0})]^2. \tag{4}$$

The credit-conditions variable $\Omega_0 = \kappa\Pi_{f,0}$, composed of the aggregate value of equity $\Pi_{f,0}$ and parameter κ, which helps scale Ω_0. The marginal cost of defaulting equals the marginal cost of repayment:

$$\Omega_0[\delta_0 l_0(1 + i_{l,0})] = 1. \tag{5}$$

The left-hand side of (5) represents the marginal pecuniary cost of renegotiating debt, while the right-hand side represents the marginal pecuniary benefit, which is constant. As a result, when aggregate conditions improve and industry equity values increase, the marginal pecuniary cost of renegotiating debt increases. In turn, individual firms choose a lower haircut δ_0. Similarly, higher industry indebtedness reduces profits and equity values, and haircuts on debt are higher.

The optimality condition for labor gives $y_0 = l_0(1 + i_{l,0})$, or

$$a_0 = w_0(1 + i_{l,0}). \tag{6}$$

That is, the marginal cost of labor increases with the gross lending rate. Although the firm repays net of defaults, $(1 - \delta_0)(1 + i_{l,0})l_1$, it is the gross lending rate $i_{l,0}$ that affects the real economy. As we will see directly below, a higher default rate raises the gross lending rate, and from (6) we see that this reduces the demand for labor and consequently reduces output.

Banks

Following Goodfriend and McCallum (2007) and Jaccard (2024), banks can transform only a share η (with $\eta < 1$) of their deposits into loans, so that $l_0 \leq \eta d_1$. The parameter η captures the efficiency of this intermediation by linking the loans extended to nonfinancial borrowers with the deposits raised at the start of the period. Because banks choose deposits and loans to maximize profits, they earn zero profit. Their profit function is

$$\begin{aligned} \pi_{b,0} &= l_0(1 - \delta_0)(1 + i_{l,0}) - d_1(1 + i_{d,0}) - l_0 + d_1 \\ &= \eta d_1((1 - \delta_0)(1 + i_{l,0}) - 1) - d_1 i_{d,0}, \end{aligned} \tag{7}$$

with aggregate profits of the banking sector being $\pi_{b,0}$. The optimality condition of banks is given by the lending-rate schedule

$$i_{l,0} = \frac{\frac{1}{\eta} i_{d,0} + 1}{(1 - \delta_0)} - 1. \tag{8}$$

Equation (8) shows the positive relationship between the default rate and the lending rate. Importantly, lowering banks' borrowing costs $i_{d,0}$ only affects the total repayment rate $(1-\delta_0)(1+i_{l,0})$, not the lending rate or default rate separately. Banks are not balance-sheet constrained. That is, they are not constrained in their lending ability by insufficient net worth and can freely raise debt to meet their purchases of loans. Our focus is on how anticipated firm default rates affect the ex ante lending rate through the banking sector, so we abstract from bank balance sheet constraints. In Section 3.5 we allow banks to be balance sheet constrained in a similar manner to Gertler and Kiyotaki (2010) and study how equity injections by the government compare with the role of an AMC.

Government

Υ_0 (Υ_1) is the net transfer to households in the first (second) period, and the government sets the supply of riskless debt to zero, $b_1 = 0$. In addition to potentially purchasing equity e_0 directly from banks, the government can extend loans λ_1 directly to firms at the same terms as banks. As deposits are repaid over two periods, and our model does not include cash, the government plays an additional auxiliary role in intermediating between the interperiod deposits that households purchase and the intraperiod deposits that banks sell. These transactions are in the model to replicate what would occur in the presence of fiat money; they do not have any meaning beyond ensuring accounting consistency. Formally, households make deposits with the government, which immediately deposits them with the banks. The banks then return the deposits with interest to the government. In the same period, the government transfers the net interest income $i_{d,0}d_1$ to depositors, and it transfers the principal to depositors d_1 in the second period. These transactions net out to what is described in the budget constraints and the flow-of-funds diagram in Figure 1.[2] The budget constraints in the first and second periods are $\Upsilon_0 = d_1 + \dfrac{b_1}{1 + i_{b_0}} - e_0 - \lambda_1 + (1 - \delta_0)(1 + i_{l,0})\lambda_1$, and $\Upsilon_1 = -d_1 - b_1$, respectively. Figure 1 below shows the flow of funds.

[2] In terms of net public liabilities, this approach is identical to the government issuing cash or to an economy in which banks can transfer their liabilities across periods. The choice of the latter does not affect our results. An earlier version of this paper used cash without nominal rigidities.

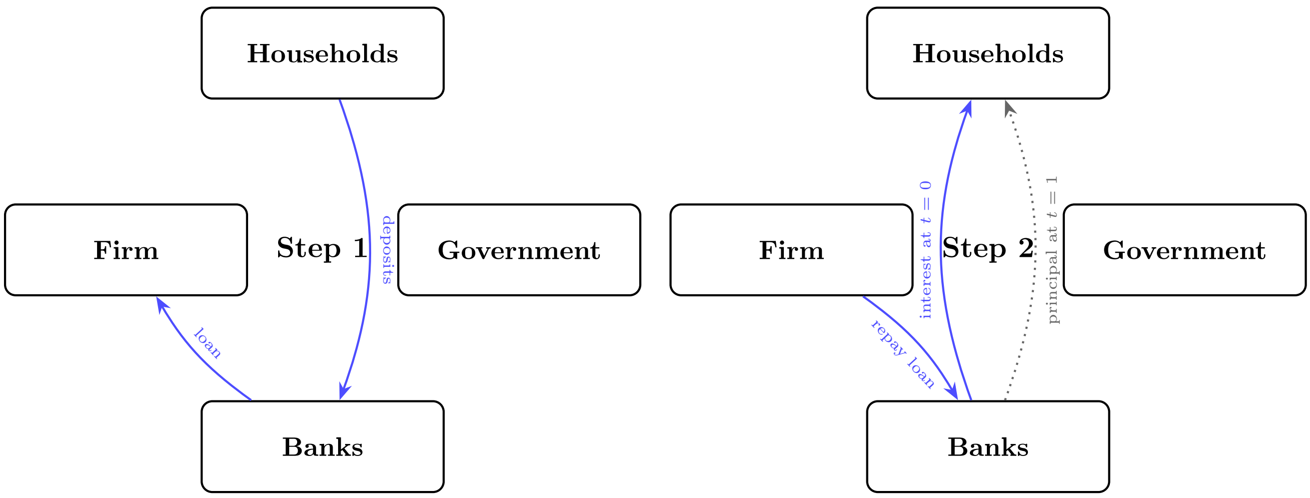

Figure 1: Flow of Funds

3.2 Equilibrium

We consider a competitive equilibrium in which the deposit, loan, and bond markets clear. Our focus in the static model is the response of endogenous variables to variations in TFP (a_0) and the discount factor, represented by the bank cost of funding ($\frac{i_{d,0}}{\eta} + 1$). We first characterize how lending rates and default rates respond to TFP and deposit-rate changes, and then we determine the elasticity of output with respect to TFP and deposit-rate changes, which serves as the measure of volatility that is stabilized through policy.

Using labor demand from firms equation (6) and households (1), together with the optimality condition for the default rate (5), we obtain $n_0 = \frac{a_0}{(1+i_{l,0})}$, so $l_0 = (\frac{a_0}{1+i_{l,0}})^2$, and $y_0 = \frac{a_0^2}{1+i_{l,0}}$. Substituting (5) into the firm profit function, equation (4), and then substituting the expression for profits into the definition of Ω_0, and finally substituting the resulting expression together with the expression for loans $l_0 = (\frac{a_0}{1+i_{l,0}})^2$ into (5) gives the firm default schedule

$$\delta_0 = \frac{(1+i_{l,0})\sqrt{2/\kappa}}{a_0^2}, \tag{9}$$

in which $\frac{\partial \delta_0}{\partial i_{l,0}} > 0$. The properties of equilibrium are summarized by Proposition 1.

Proposition 1. *In equilibrium, the following is true:*

1. *Default rates and lending rates are decreasing in TFP:* $\frac{\partial \delta_0}{\partial a_0} < 0$ *and* $\frac{\partial i_{l,0}}{\partial a_0} < 0$.
2. *The elasticity of output with respect to TFP is increasing in the default rate:* $\varepsilon_{a_0} = 2\frac{1-\delta_0}{1-2\delta_0}$,

3. *The elasticity of output with respect to the deposit rate is increasing in the deposit rate:* $\varepsilon_{i^*_{d,0}} = \dfrac{1-\delta_0}{1-2\delta_0}$.

Proposition 1 highlights that default not only reflects the economy being more inefficient, but also causes the equilibrium to change more when subject to TFP or discount-factor shocks. This means that stabilization of default has a larger effect than if the elasticity were constant. In the dynamic model, the notion of stability reflects intertemporal smoothing, but the conceptual result here holds there as well.

There are two sources of inefficiency in the economy, both stemming from firm default. The first is the pecuniary externality running from firm default rates to the lending rate, given the cost of renegotiating debt. The marginal rate of substitution between consumption and labor is $w_0 = \dfrac{a_0}{1+i_{l,0}} = n_0$. Substituting this into the bank lending-rate schedule (8), we get $w_0 = a_0 \dfrac{1-\delta_0}{\frac{1}{\eta} i_{d,0} + 1} = n_0$, with $\delta_0 = 0$ minimizing the wedge between the marginal product of labor and TFP. The constrained efficient allocation (constrained in the sense that the intermediation friction is taken as given) is then obtained when $\dfrac{1-\delta_0}{\frac{1}{\eta} i_{d,0} + 1}$ is maximized, which occurs at $\delta_0 = 0$. Any policy that reduces the default rate — or, if the rate of default, given the primitives, is $\delta_0 = \bar{\delta}$, minimizes its increase — will increase efficiency. The second source of inefficiency is the pecuniary externality running from the credit-conditions variable to default rates. Lower TFP (or higher lending rates caused by higher deposit rates) reduces firm profits, which, as we know from the firm marginal default decision (5), reduces the marginal cost of defaulting, thereby increasing the rate of default. The two policies we now consider, an AMC and equity injections to firms, work through these externalities. The AMC targets the externality from default rates to the lending rate, as it holds the lending rate fixed; equity injections work through the externality from the credit-conditions variable to default as they keep profits and hence credit conditions fixed.

3.3 Asset Management Company

The AMC purchases NPLs from banks at a fixed default rate of $\bar{\delta}$ whenever the actual firm default rate is higher than this amount. This means the AMC makes a negative profit of $\pi_{AMC,0} = l_0(\bar{\delta} - \delta_0)(1 + i_{l,0})$. However, the consolidated budget constraint of the AMC and the banking system has no fiscal impact. Take the bank profit condition (7) and add AMC profit to get

$$\begin{aligned}\pi_{AMC,0} + \pi_{b,0} &= l_0(1-\bar{\delta})(1+i_{l,0}) - d_1(1+i_{d,0}) + l_0(\bar{\delta}-\delta_0)(1+i_{l,0}) - l_0 + d_1 \\ &= l_0(1-\delta_0)(1+i_{l,0}) - d_1(1+i_{d,0}) - l_0 + d_1,\end{aligned}$$

which represents the total inflows from the nonfinancial sector and the total outflows to the household sector. The lack of net impact on aggregate flows is important because while the

AMC is a public institution, it does not affect the private sector/public sector balance. It also helps us to understand the mechanics of its funding structure. In our model (both the static and dynamic versions), the AMC does not require any initial equity or funding. Instead, it requires funding to finance its loss from purchasing loans above fair value. It gets the funding by issuing its own non-interest-bearing liability (paying interest would not affect our results), $b_{AMC,1}$. This results in the following flow constraint of the AMC:

$$l_0(1-\bar{\delta})(1+i_{l,0}) = l_0(1-\delta_0)(1+i_{l,0}) + b_{AMC,1}.$$

This constraint means the banks' assets are composed of both real resources $l_0(1-\delta_0)(1+i_{l,0})$ and the AMC liability $b_{AMC,1}$. After paying interest on deposits, the bank is required to transfer the value of its remaining assets to the government to cover the value of the principal amount of deposits. The value transferred is $d_1 = l_0(1-\delta_0)(1+i_{l,0}) + b_{AMC,1} - d_1 i_{d,0} - \pi_{b,0}$, where $\pi_{b,0} = 0$ in equilibrium. The government can now use its tax revenue to transfer resources (in an amount equal to $b_{AMC,1}$) to the AMC, which are then used as repayment for the AMC liability. This sequence of transactions, though convoluted, allows the AMC to engage in transactions *before* fiscal revenue is raised. This is in contrast with direct equity injections to banks or firms, which require either tax revenue or the issuance of debt in advance of the injections. When there is little fiscal space, the steps the AMC takes create additional space. It is important to explore the funding structure of AMCs, but we abstract from it to focus on the effect of the AMC through influencing lending margins. Figure 2 depicts the flow of funds.[3]

In the eurozone, AMCs have been used in Ireland, Spain, and Slovenia in recent decades.[4] The financing model of these AMCs is relatively straightforward. They are endowed with unissued government bonds, both senior and subordinated, which can be used to acquire impaired assets from participating banks at a price close to, but below, real economic value.[5] The banks may be able to pledge the senior bonds with the central bank to access credit operations, a particularly important ability, which is reasonable to expect in a crisis-management context. In the European context, owing to the national accounting regime, nations that established AMCs did not have to account for them in the national accounts–that is, the AMCs' balance sheets were not included in the national debt. In this way, the debts raised to help establish the AMC can be seen as external, as they are not accounted for nationally. In reality, there is a contingent liability, only realizable if the AMC fails to achieve its aims. Based on available performance criteria, the track record of these country-specific, systemic AMCs in the eurozone has been positive overall. They have contributed to repairing and unblocking the investment channel in these countries, although

[3]Because we replicate the liquidity purposes of money through the timing of transactions, there are additional transactions (not present in the diagram) that are described in the government problem.

[4]These are the National Asset Management Agency (NAMA) in Ireland, Sociedad de Gestión de Activos Procedentes de la Reestructuración Bancaria (Sareb) in Spain, and Družba za Upravljanje Terjatev Bank (DUTB) in Slovenia.

[5]For various reasons, AMCs may acquire performing and nonperforming loans, though the former are acquired in relatively small proportions relative to the latter.

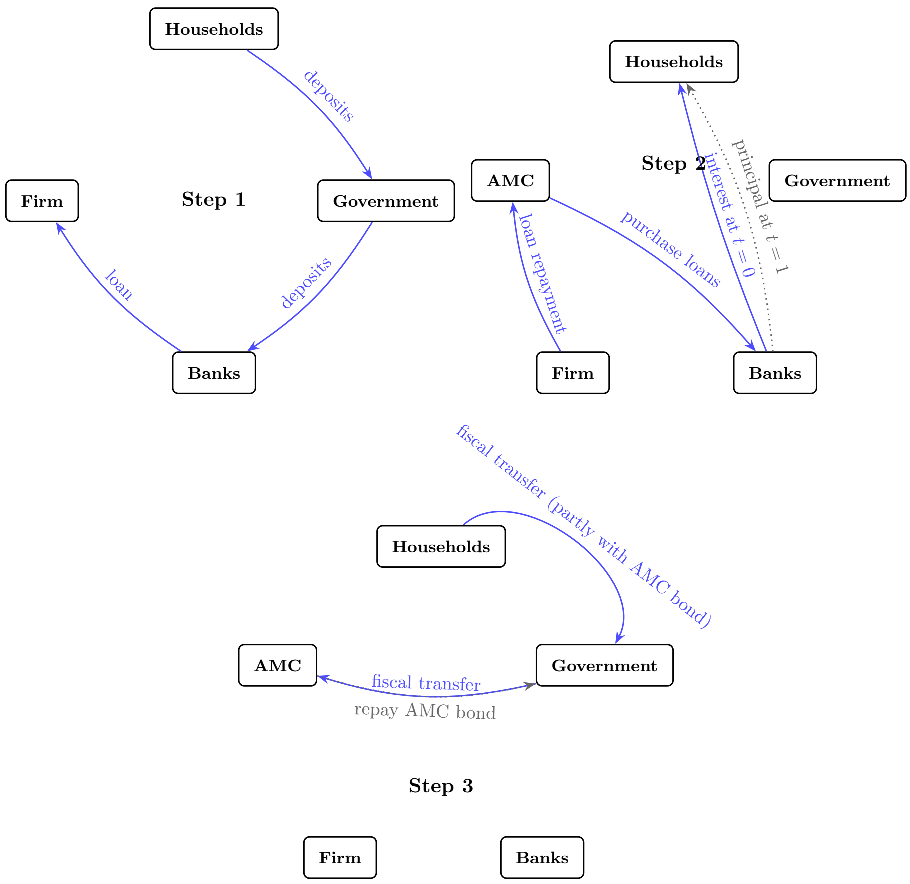

Figure 2: Flow of Funds with an Asset Management Company

the results differ across the three countries (for an overview, see Medina Cas and Peresa, 2016).

Since we simplify the financial structure of the economy to include only within-period loans, the AMC we describe necessarily takes losses when it is active (though in practice it can make profits by carrying assets until their market values increase). This means that while there is no net wealth impact on households, there is still the transfer to cover the AMC losses, which ultimately needs to be financed by households. We now show that financing this with a lump-sum transfer from households stabilizes output. In the following sections of the static model, when we mention elasticity, we mean the one-sided elasticity when TFP declines. We focus on this because we are interested in the effect of an AMC that is only operational when default rates increase (which happens when TFP declines).

The bank lending-rate-schedule equation (8) is now given by $i_{l,0} = \frac{\frac{1}{\eta} i_{d,0} + 1}{(1-\bar{\delta})} - 1$, where the bar indicates the default rate that the AMC prices in when purchasing the loan from the bank. This fixes the spread of loans over deposits and makes the loan rate acyclical. A lower $\bar{\delta}$ reduces $i_{l,0}$, and output $y_0 = \frac{(a_0)^2}{(1+i_{l,0})}$ increases. Furthermore, from equation (9) we see that the realized default rate of firms falls because the lending rate falls. This reduces the deadweight losses from defaults, and consumption increases. As the wedge between wages and the marginal product of labor is reduced, efficiency increases, and it is straightforward that welfare increases. The macrofinancial stabilization that an AMC offers is summarized in the proposition below.

Proposition 2. *In an equilibrium with an AMC, the following is true:*

1. *The elasticity of output with respect to TFP is constant:* $\varepsilon_{a_0} = 2$.
2. *The elasticity of output with respect to the deposit rate is constant:* $\varepsilon_{i^*_{d,0}} = 1$.

Proposition 2 shows that the elasticity of output is lower than in the case without an AMC, even though NPLs fluctuate over the business cycle. This is because the effective loan rate faced by banks is constant, in turn because of the AMC's pricing policy.

3.4 Alternative Government Policies

We now consider government policies that could substitute for an AMC. Because banks are not balance sheet constrained, their effectiveness is limited.

Government Lending to Banks

Subsidized bank borrowing (deposit) rates lower banks' total cost of lending to firms but do not change the cyclicality of the lending rates. However, consider a cyclical bank borrowing rate (suppose banks must borrow directly from the government, which in turn accepts deposits from households) that makes the firm lending rate acyclical with $\bar{i}_{l,0}$ fixed. From the bank lending-rate schedule in equation (8), $\frac{1}{\eta}\bar{i}_{d,0}+1 = (1+\bar{i}_{l,0})(1-\delta_0)$. The zero lower bound implies $\delta_0 < \frac{\bar{i}_{l,0}}{1+\bar{i}_{l,0}}$. In other words, while cyclical bank borrowing rates potentially stabilize firm lending rates, they are only feasible for a limited range of default rates.

Government Lending to Firms

Banks are constrained in their ability to lend only by the intermediation constraint $\eta < 1$. This generates a wedge between the borrowing (deposit) rate and the net (of default) lending rate. Government lending to firms at the market rate only displaces bank lending without moving the lending rate. If the government lends at a below-market rate, banks will not participate in the lending market.

Transfers to Firms

Under the Automotive Industry Financing Program, part of TARP, the US Treasury disbursed \$79.7 billion in loans to the automotive sector during the 2008–09 financial crisis. In subsequent bankruptcy proceedings, most loans were exchanged for equity: Through the program, the Treasury converted its claims on General Motors into 60.8% of the reorganized firm's common stock and \$2.1 billion in preferred shares, and it received 9.9% of Chrysler Group. Chrysler repaid its remaining obligations in May 2011, and Fiat purchased the Treasury's residual 6% stake for \$560 million in July 2011, leaving \$1.3 billion unrecovered from the \$12.5 billion originally provided. The larger General Motors position was liquidated through a November 2010 initial public offering and subsequent open-market sales; the final shares were sold on December 9, 2013, yielding total proceeds of \$39.7 billion on an investment of \$51 billion. Including the support extended to Ally Financial, the net fiscal cost of the automotive rescue was approximately \$9.3 billion. The program helped to save the companies and was an important part of the overall TARP rescue package. We now consider a policy in which the government makes net injections to firms to stabilize their default rates. In the dynamic version of the model, we will see how equity transfers can help to reduce the pecuniary externality emanating from default.

Suppose the government makes a unilateral transfer to firms (again financed by a lump-sum transfer from households). Suppose the transfer is such that the level of profits remains constant. The firm profit function is now $\bar{\Pi}_{f,0} = a_0 n_0 - w_0 n_0 + (1-(1-\delta_0)(1+i_{l,0}))l_0 - \frac{\Omega_0}{2}[\delta_0 l_0(1+i_{l,0})]^2 + E_0$, where $\bar{\Pi}_{f,0}$ denotes the level of profits targeted by the government and E_0 is the transfer. Using the now-targeted profit levels, equation (5) becomes $\kappa\bar{\Pi}_{f,0}[\delta_0 l_0(1+i_{l,0})] = 1$.

Proposition 3. *In an equilibrium with firm-profit-stabilizing transfers, the following is true:*

1. *The elasticity of output with respect to TFP is the same as without the transfers:* $\varepsilon_{a_0} =$

$$2\frac{1-\delta_0}{1-2\delta_0}.$$

2. *The elasticity of output with respect to the deposit rate is the same as without the transfers:* $\varepsilon_{i^*_{d,0}} = \frac{1-\delta_0}{1-2\delta_0}$.

Profit-stabilizing transfers do not lead to an acyclical elasticity of output with respect to either TFP or the deposit rate because even though the price of total default Ω_0 is now constant, the default rate will still vary with the amount borrowed l_0, which depends on TFP. As a result, the lending rate depends on the TFP and the deposit rate, adding additional fluctuations to the demand for labor and hence output. In our calibrated dynamic simulation in Section 4, the firm cannot borrow its entire working capital cost, so the marginal default decision with targeted profits $\kappa\bar{\Pi}_{f,0}[\delta_0 l_0(1+i_{l,0})] = 1$ has a smaller effect of the lending rate $i_{l,0}$ on default decisions. As a result, when the economy is subject to TFP shocks, profit-stabilizing transfers can help to stabilize the economy. Unlike a TFP shock, which directly enters the firm default decision, a discount-factor shock operates indirectly through channels outside the default mechanism, making profit-stabilizing policies less effective than an AMC.

3.5 Balance Sheet-Constrained Banks

Thus far in our analysis, banks have not faced balance sheet constraints, allowing them to lend and raise funds without restriction. We now demonstrate that when banks face bank balance sheet constraints *à la* Gertler and Kiyotaki (2010) and the economy is hit by a negative TFP shock, banks' net wealth influences their lending margins. Under these circumstances, government interventions such as equity injections and direct lending can mitigate increases in lending rates, moving them closer to pre-shock levels and thus limiting the shocks' adverse effects on economic output.

However, these policy measures suffer limitations. Equity injections require accurate information about the realized TFP shock in advance, which might not be feasible if the injections precede observations of output. Additionally, the size of the injections is constrained by the need to satisfy bankers' incentive-compatibility (IC) constraints, which require that bankers' expected profits remain non-negative. Meanwhile direct government lending at rates below market-level bank lending rates risks reducing net lending proceeds below the deposit interest rate, thereby discouraging bank intermediation entirely.

These limitations emerge because banks' total returns from lending depend jointly on endogenous interest rates and default rates, whereas firm-level output depends solely on the interest rate. Consequently, focusing exclusively on managing interest rates requires precise knowledge of TFP shocks and could inadvertently lead to negative bank profitability.

Banks receive an equity injection e_0 from the government which they can use to extend loans. Loan demand by banks is now $l_0 = \eta(d_1 + e_0)$. Banks are now run by bankers, who can divert $\theta(l_0 - \omega d_1 - e_0)$ in assets to themselves, with a fraction ω of deposits being divertible and government equity not being divertible. As in Gertler and Kiyotaki (2010), this generates an IC constraint of the form $\pi_{b,0} \geq \theta(l_0 - \omega d_1 - e_0)$.[6] The bank profit function is still $\pi_{b,0} = l_0(1-\delta_0)(1+i_{l,0}) - d_1(1+i_{d,0})$, and the supply of loans to firms is still $l_0 = (\frac{a_0}{1+i_{l,0}})^2$.

The question is whether equity injections or direct lending to firms by the government can replicate the outcome of an AMC that pins down the default rate that banks face when extending loans. As default is endogenous, this implies varying the interest rate so that the firm default rate equals the default rate guaranteed by the AMC.

We summarize our results in the following proposition

Proposition 4. *In an equilibrium with balance sheet-constrained banks and a policy that targets a constant elasticity of output with respect to TFP or the discount factor, the following is true:*

1. *Government direct lending to firms may not be feasible because it may result in banks ceasing intermediation if bank profits become negative.*

2. *Government equity injections to banks targeting a default rate of firms may not be feasible.*

3. *Government equity injections to banks targeting a lending rate to firms may not be feasible.*

Proposition 4 suggests that while liquidity and capitalization policies *can* bring the economy close to stability (that is, constant elasticity of output with respect to the shock), they cannot ensure it. The reason is that default endogenously varies in the economy, so policies targeting the banking system (or lending rates to firms) cannot simultaneously target both the lending rate and the default rate. As a consequence, the profitability of bank lending is affected and intermediation may cease. An AMC is not subject to these issues because it *directly* affects bank profitability and *indirectly* affects firm lending rates through bank lending decisions. When we studied the extreme case in which banks face no balance sheet limits, we found that an AMC is still an effective policy tool. Proposition 4 shows that when such balance sheet constraints are binding, an AMC can be complementary to other measures, giving policymakers more room to pursue both macroeconomic and financial-stability goals.

4 A Real Business Cycle Model with Banks and Policy Interventions

We now develop a real business cycle model with financial frictions that incorporates the household and corporate sectors, a banking sector that intermediates funds between the two, and en-

[6] This characterization skips over many of the pertinent features in Gertler and Kiyotaki (2010) regarding the microfoundations of the constraint. For the sake of brevity we use this specification because it provides a similar qualitative insight into the importance of bank net wealth.

dogenous default by firms on their loans. The model introduces two policy interventions, which differ fundamentally in their timing relative to loan performance. First, an AMC purchases loans from banks *after* they become delinquent, effectively absorbing realized default losses. Second, a government asset-purchase facility acquires loans *while they remain performing*, expanding credit supply before distress materializes. This distinction is central to understanding the differential effects of these policies.

Our banking sector builds on the financial accelerator framework of Gertler and Kiyotaki (2010) and Gertler and Karadi (2011), in which banks face an agency problem that limits their ability to intermediate. Banks can divert a fraction of assets for private benefit, and depositors anticipate this moral hazard. The resulting IC constraint ties a bank's lending capacity to its net worth, creating a financial accelerator: Adverse shocks that reduce bank capital tighten credit supply, amplifying the initial disturbance. Our contribution is to show how the timing of policy intervention, on performing versus NPLs, differentially affects this mechanism.

4.1 Agents and Institutions

Households

Households maximize the present discounted value of utility from consumption c_t and leisure z_t by choosing labor supply n_t, deposits D_t, and government bond holdings B_t. The time endowment is normalized to unity:

$$z_t + n_t = 1. \tag{10}$$

Lifetime utility is given by

$$V_0 = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_t \frac{(c_t^{\kappa}(\psi_L + z_t^{\nu}))^{1-\sigma}}{1-\sigma}, \tag{11}$$

where β_t is a time-varying discount factor. Further,

$$\log\left(\frac{\beta_t}{\bar{\beta}}\right) = \rho_\beta \log\left(\frac{\beta_{t-1}}{\bar{\beta}}\right) + \varepsilon_{\beta,t} \tag{12}$$

where $\bar{\beta}$ is the steady state discount factor, ρ_β is the persistence of the discount-factor process and $\varepsilon_{\beta,t}$ is an i.i.d. shock. The parameter σ is the coefficient of relative risk aversion, κ governs the consumption share of utility, ν determines the Frisch elasticity of labor supply, and ψ_L is a preference parameter for leisure.

The household flow budget constraint is

$$c_t + x_t + \frac{B_{t+1}}{1+i_{B,t}} + D_{t+1}\left(1 + \frac{\phi_D}{2}(D_{t+1} - \bar{D})\right) = \Pi_{f,t} + \Pi_{b,t} + \Upsilon_t + w_t n_t + D_t(1 + i_{D,t}) + B_t, \tag{13}$$

where x_t is investment, $i_{B,t}$ is the bond rate, $i_{D,t}$ is the deposit rate, ϕ_D is a deposit adjustment-cost parameter that ensures determinacy, $\Pi_{f,t}$ and $\Pi_{b,t}$ are firm and bank profits, Υ_t is the government transfer, and w_t is the wage. The net interest on deposits is returned in the same period, while the principal is returned in the next period.

The first-order conditions yield the standard optimality conditions. The marginal utility of consumption satisfies

$$\kappa c_t^{\kappa-1}(\psi_L + z_t^{\nu})\left(c_t^{\kappa}(\psi_L + z_t^{\nu})\right)^{-\sigma} = \lambda_t, \tag{14}$$

where λ_t is the marginal utility of wealth. The intratemporal condition for labor supply is

$$\nu z_t^{\nu-1} c_t^{\kappa}\left(c_t^{\kappa}(\psi_L + z_t^{\nu})\right)^{-\sigma} = \lambda_t w_t. \tag{15}$$

The Euler equations for bonds and deposits are

$$\frac{\lambda_t}{1+i_{B,t}} = \beta_t \mathbb{E}_t \lambda_{t+1}, \quad \textit{and} \tag{16}$$

$$\lambda_t\left(1 + \phi_D(D_{t+1} - \bar{D})\right) = \beta_t \mathbb{E}_t \lambda_{t+1} + \lambda_t i_{D,t}, \tag{17}$$

where the last term on the right-hand side of the deposit Euler equation represents the liquidity benefit of deposits from the net interest being returned in the same period.

Firms

Firms are infinitely lived and produce output using capital k_{t-1} and labor n_t according to

$$y_t = A_t k_{t-1}^{\alpha} n_t^{1-\alpha}, \tag{18}$$

where α is the capital share in production and TFP follows the autoregressive process

$$\log A_t = \rho_A \log A_{t-1} + \varepsilon_{A,t}, \tag{19}$$

with ρ_A denoting the persistence of productivity and $\varepsilon_{A,t}$ an i.i.d. shock.

Households elastically supply investment (x_t) to firms, which, in turn, return profits. Capital accumulation features adjustment costs:

$$k_t = (1-\tilde{d})k_{t-1} + \left(\frac{\theta_1}{1-\epsilon}\left(\frac{x_t}{k_{t-1}}\right)^{1-\epsilon} + \theta_2\right)k_{t-1}, \tag{20}$$

where $\tilde{d}$ is the depreciation rate and ϵ, θ_1, θ_2 govern investment adjustment costs.

Firms finance a fraction μ of labor costs through intraperiod loans l_t at interest rate $i_{L,t}$. This working capital constraint generates a direct link between credit conditions and production:

$$l_t = \mu(1-\alpha)\frac{y_t}{1+\mu i_{L,t}}. \tag{21}$$

The wage rate, reflecting working capital costs, is

$$w_t = \frac{(1-\alpha)y_t/n_t}{1+\mu i_{L,t}}. \tag{22}$$

Firms can strategically default on a fraction δ_t of their debt obligations. Default incurs a cost that depends on aggregate credit conditions Ω_t:

$$\text{Default Cost} = \frac{\Omega_t}{1+\xi}\left[\delta_t l_t(1+i_{L,t})\right]^{1+\xi}. \tag{23}$$

Here $\xi > 0$ governs the curvature of default costs. Credit conditions depend on both firm equity value and banking sector health:

$$\Omega_t = \bar{\Omega}\left(\frac{\nu_t}{\bar{\nu}}\right)^{\phi_\nu}\cdot\left(\frac{\bar{\psi}_b}{\psi_{b,t}}\right)^{\phi_\psi}. \tag{24}$$

Here, $\bar{\Omega}$ is the steady-state level of credit conditions, ν_t is firm equity value with steady-state value $\bar{\nu}$, $\psi_{b,t}$ is the multiplier on the bank IC constraint with steady-state value $\bar{\psi}_b$, $\phi_\nu > 0$ is the elasticity of credit conditions with respect to firm equity, and $\phi_\psi > 0$ is the elasticity with respect to the bank IC-constraint multiplier. The inclusion of banking sector conditions in the credit-conditions variable creates a channel through which bank balance sheet stress feeds back to firm default decisions.

Firm profits are given by $\Pi_{f,t} = y_t + l_t - w_t n_t - (1-\delta_t)(1+i_{L,t})l_t - \frac{\Omega_t}{1+\xi}\left[\delta_t l_t(1+i_{L,t})\right]^{1+\xi}$, and equity value ν_t satisfies the following recursive equation:

$$\nu_t = \Pi_{f,t} + \beta_t\frac{\lambda_{t+1}}{\lambda_t}\mathbb{E}_t\nu_{t+1}. \tag{25}$$

The first-order condition for optimal default equates marginal cost to marginal benefit:

$$\Omega_t \left[\delta_t l_t (1 + i_{L,t})\right]^{\xi} = 1. \tag{26}$$

The first-order conditions for capital and investment yield:

$$1 = q_t \theta_1 \left(\frac{x_t}{k_{t-1}}\right)^{-\epsilon}, \quad and \tag{27}$$

$$q_t \lambda_t = \beta_t \mathbb{E}_t \lambda_{t+1} \left[q_{t+1} \left(1 - \tilde{d} + \frac{\theta_1}{1-\epsilon} \left(\frac{x_{t+1}}{k_t}\right)^{1-\epsilon} - \theta_1 \left(\frac{x_{t+1}}{k_t}\right)^{1-\epsilon} + \theta_2 \right) + \alpha \frac{y_{t+1}}{k_t} \right], \tag{28}$$

where q_t is Tobin's q.

Banking Sector

Our banking sector follows the framework of Gertler and Kiyotaki (2010) and Gertler and Karadi (2011), in which banks face an agency problem that constrains their ability to intermediate. A representative bank collects deposits D_t from households and extends loans L_t to firms. The bank's balance sheet constraint is

$$L_t \leq D_t + \rho_b N_{b,t-1}, \tag{29}$$

where ρ_b is the probability that a banker survives to the next period. Bankers who exit (with probability $1 - \rho_b$) consume their accumulated net worth, while surviving bankers retain theirs to finance continued lending. This specification allows bank lending to be financed by both deposits and accumulated net worth.

Bank net worth (net wealth) evolves according to

$$N_{b,t} = L_t(1 + i_{L,t})(1 - \delta_t^{AMC}) - D_t(1 + i_{D,t}), \tag{30}$$

where δ_t^{AMC} is the effective default rate faced by banks after AMC intervention. When the AMC is active, $\delta_t^{AMC} = \bar{\delta}$ (the steady-state default rate); otherwise $\delta_t^{AMC} = \delta_t$ (the market default rate). This is the key channel through which the AMC affects bank balance sheets: By absorbing default losses that exceed the steady-state level, the AMC stabilizes bank net worth.

Banks can divert a fraction θ_b of available funds for private benefit. Depositors anticipate this moral hazard and will only supply funds if the bank's franchise value (the present value of future profits from continuing operations) exceeds the gain from diversion. This yields the IC constraint:

$$V_{b,t} \geq \theta_b L_t (1 + i_{L,t})(1 - \delta_t^{AMC}). \tag{31}$$

Here, $V_{b,t}$ is the bank's franchise value. The franchise value satisfies the recursion:

$$V_{b,t} = (1-\rho_b)\lambda_t N_{b,t} + \beta_t \rho_b \mathbb{E}_t V_{b,t+1}. \tag{32}$$

The first term is the value to exiting bankers, who consume their net worth valued at the household marginal utility λ_t. The second term is the continuation value for surviving bankers, discounted by both the household discount factor and the survival probability.

When the IC constraint is binding (which it is in equilibrium, given our calibration), the bank's lending capacity is limited by its net worth. Let $\psi_{b,t}$ denote the multiplier on this constraint. The bank's first-order conditions for loans and deposits are as follows:

$$\begin{aligned}
&-\lambda_{b,t} + (1+\psi_{b,t})(1-\rho_b)\lambda_t(1+i_{L,t})(1-\delta_t^{AMC}) - \psi_{b,t}\theta_b(1+i_{L,t})(1-\delta_t^{AMC}) \\
&+ \beta_t\rho_b^2(1+i_{L,t})(1-\delta_t^{AMC})\mathbb{E}_t\lambda_{b,t+1} = 0, && (33)\\
&\lambda_{b,t} - (1+\psi_{b,t})(1-\rho_b)\lambda_t(1+i_{D,t}) + \psi_{b,t}\theta_b\omega_b(1+i_{D,t}) - \beta_t\rho_b^2(1+i_{D,t})\mathbb{E}_t\lambda_{b,t+1} = 0. && (34)
\end{aligned}$$

Here, $\lambda_{b,t}$ is the shadow value of bank funds and ω_b is the weight on deposits in the IC constraint, capturing the fraction of deposit liabilities that bankers can divert.

The key insight from this structure is that bank net worth serves as the state variable linking credit supply to macroeconomic conditions. Adverse shocks that reduce $N_{b,t}$, whether through lower loan returns or higher default losses, tighten the IC constraint and reduce lending capacity. This creates a financial accelerator that amplifies business cycle fluctuations. Our two policies differ in how they affect this mechanism: The AMC directly stabilizes bank net worth by absorbing realized default losses, while government asset purchases expand credit supply without directly affecting the default rate banks face.

Government

The government issues one-period bonds and makes transfers to households. The government budget constraint is

$$\Upsilon_t + g_t^{AP} L_t \left[(1+i_{L,t})(1-\delta_t) - 1\right](1-\tau^{policy}) = D_{t+1} - D_t + \frac{B_{t+1}}{1+i_{B,t}} - B_t + \tau_t^{AMC}, \tag{35}$$

where g_t^{AP} is the government asset-purchase share, τ^{policy} is a small deadweight-cost parameter capturing administrative costs, τ_t^{AMC} is the transfer to the AMC, and government debt is held constant at its steady-state level.

Asset Management Company

The AMC purchases loans from banks *after* default is realized, paying a price that reflects the steady-state default rate $\bar{\delta}$ rather than the realized default rate δ_t. When the market default rate exceeds the steady state ($\delta_t > \bar{\delta}$), the AMC is operational and the effective default rate faced by banks becomes

$$\delta_t^{AMC} = \bar{\delta} + (1 - \phi^{AMC})(\delta_t - \bar{\delta}), \tag{36}$$

where ϕ^{AMC} is the absorption fraction. When $\phi^{AMC} = 0.5$, the AMC absorbs half of the excess default losses; when $\phi^{AMC} = 1$, the AMC fully insulates banks from default fluctuations. When $\delta_t \leq \bar{\delta}$, the AMC is inactive and $\delta_t^{AMC} = \delta_t$.

This mechanism directly stabilizes bank net worth during periods of elevated default. By absorbing the excess default losses $(\delta_t - \delta_t^{AMC})L_t(1 + i_{L,t})$, the AMC prevents the erosion of bank capital that would otherwise tighten the IC constraint and reduce credit supply. The AMC's operations are financed through a lump-sum transfer from the government:

$$\tau_t^{AMC} = L_t(1 + i_{L,t}) \left[(1 - \delta_t^{AMC}) - (1 - \delta_t)\right] (1 + \tau^{policy}). \tag{37}$$

A fraction τ^{policy} of the net financial cost of the AMC is a deadweight cost (or operating cost).

Government Asset-Purchase Facility

As an alternative, the government can directly purchase loans from firms *while they remain performing*. This corresponds to the direct lending policies analyzed by Gertler and Kiyotaki (2010) and Gertler and Karadi (2011), who show that such interventions can be effective when the costs of central bank intermediation are not too large. In their framework, direct lending makes particular sense for high-grade instruments, for which evaluation and monitoring costs are low.

The government asset-purchase rule responds to deviations in the loan-bond spread from steady state:

$$g_t^{AP,shadow} \cdot L_t = \nu^{AP} \bar{L} \left[(i_{L,t} - i_{B,t}) - (\bar{i}_L - \bar{i}_B)\right]. \tag{38}$$

Here, ν^{AP} governs the sensitivity of purchases to spread movements, $\bar{L}$ is steady-state lending, and $\bar{i}_L$ and $\bar{i}_B$ are the steady-state loan and bond rates, respectively. When the shadow value $g_t^{AP,shadow} > 0$, the policy is active with $g_t^{AP} = g_t^{AP,shadow}$; otherwise $g_t^{AP} = 0$. This rule captures the idea that government purchases expand when credit spreads widen; this injects liquidity into the loan market.

The crucial distinction between the two policies lies in their timing. Government asset purchases occur on performing loans: They expand credit supply before default materializes. The AMC intervenes on NPLs: It absorbs losses after default occurs. This timing difference has important implications for how each policy affects bank balance sheets and credit conditions.

Market Clearing and Equilibrium

Clearing in the goods market requires:

$$y_t = c_t + x_t + \frac{\Omega_t}{1+\xi}\left[\delta_t l_t(1+i_{L,t})\right]^{1+\xi} + \frac{\phi_D}{2}(D_t - \bar{D})^2 + C_t^{policy}, \tag{39}$$

where the last two terms capture deposit adjustment costs and policy deadweight costs ($C_t^{policy} = L_t(1+i_{L,t})\left[(1-\delta_t^{AMC}) - (1-\delta_t)\right] \cdot \tau^{policy} + g_t^{AP} L_t\left[(1+i_{L,t})(1-\delta_t) - 1\right] \cdot \tau^{policy}$). The loan market clears with

$$l_t = (1 + g_t^{AP}(1-\tau^{policy}))L_t, \tag{40}$$

reflecting that government purchases supplement private bank lending. A competitive equilibrium consists of prices $\{w_t, i_{L,t}, i_{D,t}, i_{B,t}, q_t\}$ and allocations $\{c_t, n_t, x_t, k_t, y_t, l_t, \delta_t, D_t, L_t, N_{b,t}\}$ such that households, firms, and banks optimize subject to given prices, markets clear, expectations are correct (Rational Expectations), and policy rules are satisfied.

4.2 Calibration

Table 1 reports the calibrated parameter values. Much of the calibration follows Jaccard (2024) for the eurozone using data from the mid-1990s with financial data extended to 2018. Calibrated parameters are found in Table 1, while the moments that are matched are in Table 2.

New moments were calculated using the following series. From the European Central Bank data portal, Nominal GDP uses "Gross domestic product at market prices," Inflation uses "HICP - Overall index," Nominal Deposits uses "Deposit liabilities vis-a-vis euro area residents reported by Credit institutions in the euro area (stocks)," and the Nominal Deposit Rate uses "Bank interest rates - deposits redeemable at notice of up to three months - euro area." Real GDP was obtained from the St. Louis FRED series "Real Gross Domestic Product (Euro/ECU Series) for Euro Area (19 Countries)".[7] The variables g_y, g_c, and g_x are year-on-year growth rates in output, consumption, and investment, and l/y and x/y are the ratios of loans to output and investment to output, all from Jaccard (2024). New moments calculated are as follows: g_D is the

[7] From the European Central Bank Data portal the following series were obtained. Nominal GDP series key: `MNA.Q.N.U2.W2.S1.S1.B.B1GQ._Z._Z._Z.EUR.V.N`, Inflation series key: `ICP.M.U2.N.000000.4.ANR`, Deposits series key: `BSI.Q.U2.N.R.L20.A.1.U2.0000.Z01.E`, Nominal deposit series key: `MIR.M.U2.B.L23.D.R.A.2250.EUR.N`. From the St. Louis FRED, real GDP key: CLVMEURSCAB1GQEA19.

year-on-year growth rate of the ratio of nominal deposits to nominal GDP; i_D is the annualized real deposit rate calculated as the nominal rate minus the actual inflation rate in the subsequent quarter; $i_L^* - i_D$ is the difference between the annualized nominal loan rate (in the model it is the loan rate after default) and the annualized nominal deposit rate minus the inflation rate in the subsequent quarter; and $\text{corr}(\Delta\delta, g_y)$ is the correlation between the change in the default rate (in the data, the NPL rate) and output (real GDP growth). In the model, all variables are calculated with respect to deviations from the steady state.

For preferences, the discount factor $\bar{\beta}$ is set to 0.9975 quarterly, the risk-aversion parameter σ to 2, and the consumption-utility weight κ to 1. Labor supply parameters are chosen so that households work approximately 20% of their time endowment in steady state, with the leisure elasticity ν set to 0.8. The leisure preference parameter ψ_L is set internally to match the steady-state labor supply target. For production, the capital share α is set to one-third, implying a labor share of two-thirds. The depreciation rate $\tilde{d}$ is set to 0.011 quarterly. The investment adjustment-cost curvature ϵ is set to 0.2, and the remaining adjustment-cost parameters θ_1 and θ_2 are derived to ensure that $q = 1$ and $x/k = \tilde{d}$ in steady state.

For the financial sector, the deposit adjustment-cost parameter ϕ_D is set to 0.1 to ensure determinacy. The working capital parameter μ is set to 0.97, implying that nearly all labor costs require loan financing. The bank retention rate (banker survival probability) ρ_b is 0.9, and the moral hazard parameter θ_b is 0.5, consistent with the calibration in Gertler and Karadi (2011). The steady-state default rate $\bar{\delta}$ is calibrated to 4% quarterly, reflecting elevated default conditions relative to the 3.5% NPL rate observed in our sample from 2014 to 2024. The credit conditions firm-equity elasticity ϕ_ν is set to 6, the credit-conditions bank IC elasticity ϕ_ψ to 1.8, and the default-cost curvature ξ to 0.5. The parameter ω_b in the bank-deposit first-order condition is set to zero, which simplifies the IC constraint to depend only on loan returns.

Shock processes are calibrated with TFP persistence $\rho_A = 0.97$ and standard deviation $\sigma_A = 0.0067$, and discount-factor persistence $\rho_\beta = 0.91$ with standard deviation $\sigma_\beta = 0.0013$. For policy parameters, the government asset-purchase sensitivity ν^{AP} is set to 0.5, and the policy deadweight cost τ^{policy} to 0.001. In the welfare analysis, we also vary the AMC absorption fraction, which determines what share of excess default losses the AMC absorbs when the market default rate exceeds steady state.

Table 1: **Calibrated Parameters**

Parameter	Description	Value
Preferences		
$\bar{\beta}$	Discount factor	0.9975
σ	Risk aversion	2
κ	Consumption-utility weight	1
ν	Leisure elasticity	0.8
ψ_L	Leisure preference parameter	Set to match $n = 0.2$
Production		
α	Capital share	0.33
$\tilde{d}$	Depreciation rate	0.011
ϵ	Investment adjustment-cost curvature	0.2
θ_1, θ_2	Investment adjustment-cost levels	Set to match $q = 1$, $x/k = \tilde{d}$
Financial Frictions		
ϕ_D	Adjustment cost on deposits	0.1
μ	Working capital requirement	0.97
ρ_b	Bank retention rate	0.9
θ_b	Bank diversion parameter	0.5
ω_b	Deposit weight in incentive constraint	0
$\bar{\delta}$	Steady-state default rate	0.04
ϕ_ν	Credit-conditions firm-equity elasticity	6
ϕ_ψ	Credit-conditions bank IC elasticity	1.8
ξ	Default-cost curvature	0.5
Shock Processes		
ρ_A	TFP persistence	0.97
σ_A	TFP shock std. dev.	0.0067
ρ_β	Discount-factor persistence	0.91
σ_β	Discount-factor shock std. dev.	0.0013
Policy Parameters		
ϕ^{AMC}	AMC default absorption fraction	0.5
ν^{AP}	Government asset-purchase sensitivity	0.5
τ^{policy}	Policy deadweight cost	0.001

4.3 Computational Approach and Simulated Moments

The AMC and government asset purchases policies are one-sided as they are triggered only when default rates or credit spreads are higher than a benchmark. In addition, we are interested in comparing the welfare effects of the policies. This means we require a solution method that can handle both occasionally binding constraints and capture the non-linearities and the premia in welfare. To achieve this, we solve the model using a second-order perturbation with pruning. Across all simulations agents form expectations using the no-policy decision rules, and then we introduce unexpected policy shocks to trigger the policies when their conditions are met. This follows the approach of Chen et al. (2023b), who note that this tends to understate the potential welfare gains, since agents do not fully internalize the possibility of future interventions.

Impulse responses, presented in Section 4.4, are computed using the same pruned second-order solution but with a single one-time shock. For each policy regime we first simulate a no-shock reference path by setting all exogenous disturbances to zero. We then introduce a one-time structural disturbance and compute the resulting path using the pruned simulation routine. The impulse responses reported in the figures are the deviations of this shocked path from the corresponding no-shock path. Policy triggers in the impulse response exercises are defined relative to this no-shock reference path, so that AMC and government purchase shocks are activated only when the shocked path default rate or credit spread is larger than the no-shock reference path.

The Monte Carlo experiments in Section 4.5 use the same pruned simulation framework but rely on long stochastic histories of 500 simulations of 10,000 periods each. Shocks are drawn from their calibrated distributions and policy interventions are activated whenever the default rate, in the case of the AMC, or the credit spread, in the case of government asset purchases, exceed their deterministic steady state values.

Baseline simulated moments in Table 2 are obtained by applying the simulation procedure of the Monte Carlo experiments to the no-policy economy and averaging statistics across replications. Table 2 compares model-generated moments using a second-order approximation with their data counterparts. The model matches well the volatilities of output, consumption, and investment growth, with all three falling within or very close to their 95% confidence intervals. The volatility of deposit growth in the model (2.42%) falls below the data range, reflecting the model's deposit adjustment costs that smooth deposit dynamics relative to the more volatile observed series. The volatility of the deposit rate (2.09%) lies within the data confidence interval as does the mean deposit rate (1.08% annualized).

The mean loan-deposit spread of 1.78 percentage points (annualized) exceeds the data confidence interval of [0.96, 1.00], reflecting the model's elevated steady-state default rate of 4%, which requires banks to charge higher lending rates to cover expected losses. This calibration choice captures crisis conditions (with elevated NPL rates) rather than normal conditions. The loan-to-output ratio (0.62) and investment-to-output ratio (0.27) both fall somewhat outside their data counterparts, reflecting the simplified production structure that abstracts from features such as inventories and government spending.

The correlation between default-rate changes and output growth is -0.39 in the model, consistent with the countercyclical nature of default observed in the data (the 95% confidence interval is $[-0.42, 0.20]$). This negative correlation is central to the financial accelerator mechanism: Adverse shocks reduce output and increase default, which erodes bank capital and amplifies the initial disturbance. The model's ability to generate this correlation endogenously, rather than imposing it through exogenous default shocks, is important for evaluating policies operating through the default channel.

Table 2: **Moments: Model vs. Data**

	Data (95% CI)	Model
std(g_y)	[1.6, 2.1]	1.58
std(g_c)	[0.9, 1.2]	1.19
std(g_x)	[5.0, 6.6]	5.32
std(g_D)	[5.2, 7.3]	2.42
std(i_D)	[1.8, 2.4]	2.09
$\mathbb{E}(i_D)$ (%, ann.)	[1.0, 1.2]	1.08
$\mathbb{E}(i_L^* - i_D)$ (%, ann.)	[0.96, 1.00]	1.78
$\mathbb{E}(l/y)$	[0.88, 0.95]	0.62
$\mathbb{E}(x/y)$	[0.21, 0.22]	0.27
corr($\Delta\delta, g_y$)	[−0.42, 0.20]	−0.39

Note: Data moments are computed from eurozone quarterly data, 1995–2018. Model moments are computed from 500 simulations of 10,000 periods each, discarding the first 30% as burn-in.

4.4 Impulse-Response Analysis

Impulse responses are computed using the same pruned second-order decision rules. For each policy regime we first simulate a no-shock reference path by setting all exogenous disturbances to zero. We then introduce a one-time structural shock at a given date and compute the resulting path of endogenous variables using the pruned simulation routine. The impulse responses reported in the figures are the deviations of this shocked path from the corresponding no-shock path over the chosen horizon.

Policy triggers in the impulse response experiments are defined relative to this no-shock baseline path. For the AMC, at each date we compare the default rate on the shocked path to the default rate on the no-shock path and activate the AMC shock when the shocked default rate lies above its no-shock counterpart. For government asset purchases, we similarly compare the credit spread on the shocked path to its value on the no-shock path and introduce a government purchase shock whenever the shocked path implies a positive gap. This contrasts with the Monte Carlo simulations in Section 4.5, where the AMC and government purchase triggers are defined relative to the steady-state default rate and credit spread. Impulse responses computed with the Occbin framework are qualitatively identical to the pruned impulse responses and are reported in the Appendix for completeness.

We analyze the dynamic effects of aggregate shocks under three policy regimes: (i) no policy intervention (baseline), (ii) an active AMC that purchases NPLs when default rates exceed the no-shock baseline, and (iii) a government asset-purchase facility that acquires performing loans when credit spreads widen compared to the no-shock baseline.

TFP Shock

Figure 3 displays impulse responses to a one-standard-deviation negative TFP shock. The baseline economy exhibits the financial accelerator dynamics central to Gertler and Kiyotaki (2010) and Gertler and Karadi (2011): lower productivity reduces output by 0.7% on impact, with the decline peaking at 0.7% in quarter 5 before gradually recovering. Investment falls 1.2% on impact and reaches a trough of 1.6% by quarter 5. Reduced firm revenues erode firm equity by 0.7%. Credit conditions initially tighten on impact, briefly reducing default rates, but as firm equity remains depressed, they weaken and default rates rise to 0.4 percentage points above the no-shock path. Higher defaults reduce bank net worth, which falls progressively to 2.2% below the no-shock path by quarter 16, tightening the bank incentive constraint and forcing banks to raise loan rates. Loan rates rise gradually, peaking at 1.7 percentage points around quarter 20. Credit spreads initially fall on impact as the bank constraint loosens, but then rise as balance sheet damage accumulates, reaching 1.7 percentage points by quarter 20. The persistence of the bank net worth decline sustains elevated spreads well beyond the direct impact of the productivity shock.

The AMC alters these dynamics by intervening on the asset side of bank balance sheets. By absorbing a fraction of default losses above the no-shock baseline rate, the AMC partially insulates bank capital. The default rate path is similar to baseline, peaking at 0.4 percentage points above the no-shock path, as the AMC absorbs losses rather than preventing defaults. The key difference emerges in bank balance sheets: bank net worth declines to only 1.5% below the no-shock path versus 2.2% in baseline, and crucially, the AMC limits the persistence of balance sheet damage. By quarter 30, bank net worth under the AMC has recovered to 1.1% below the no-shock path while baseline remains at 1.6% below. With net worth partially protected, banks raise loan rates by only 0.9 percentage points versus 1.7 percentage points in baseline. Credit spreads peak at only 0.7 percentage points versus 1.7 percentage points in baseline, approximately halving the financial amplification of the shock. The output and investment responses remain similar to baseline on impact, but the AMC accelerates recovery: by quarter 20, output is 0.5% below the no-shock path under the AMC versus 0.6% under baseline. The leverage ratio falls under AMC intervention, indicating reduced balance sheet stress. This result mirrors the analytical finding from Proposition 2 in the static model, in which the AMC reduces the financial amplification of shocks by protecting bank capital.

The contrast with government asset purchases of performing loans is instructive. Gertler and Kiyotaki (2010) argue that direct lending is most effective for high-grade instruments with low evaluation costs. In our setting, however, government lending is subject to the same endogenous firm default as bank lending, limiting its effectiveness. Government lending is financed through lump-sum transfers, which diverts household resources from bank deposits and forces banks to contract lending more sharply than in baseline. With reduced loan income, bank net worth deteriorates to 2.9% below the no-shock path by quarter 25, substantially worse than baseline's 2.2% trough. The leverage ratio falls more under government purchases than baseline, reflecting forced deleveraging as funding constraints bind. Loan rates rise 1.4 percentage points, modestly below the baseline increase of 1.7 percentage points due to government credit provision, but credit spreads converge to baseline levels and eventually exceed them as bank balance sheet deterioration offsets the direct effect of government lending. Output responses are similar to baseline throughout. Because the core problem is not a shortage of lending capacity but elevated default rates eroding bank capital, expanding credit supply addresses symptoms rather than causes. This echoes the static-model result in Proposition 3: policies that do not directly target the default channel cannot achieve the same stabilization as the AMC.

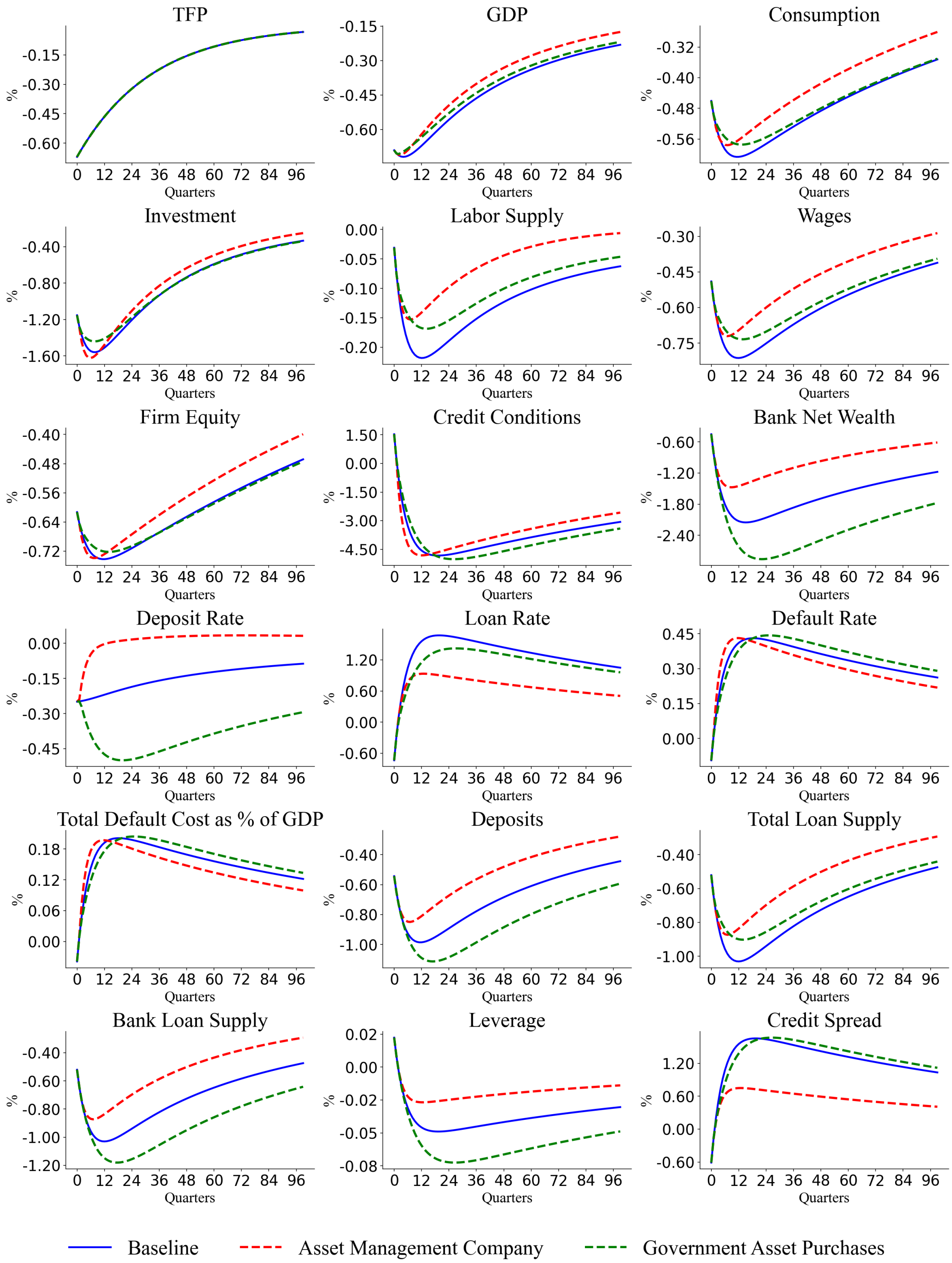

Figure 3: Impulse Responses to a One-Standard-Deviation Negative TFP Shock.

Note: Blue solid lines show the baseline (no-policy). Red dashed lines show the asset-management-company policy. Green dashed lines show the government-asset-purchase policy. Variables are expressed as percentage deviations from steady state except for interest rates (annualized percentage-point deviations) and the default rate (percentage-point deviation). Leverage is the ratio of loans to bank net worth, $L_t/N_{b,t}$.

Discount-Factor Shock

Figure 4 shows responses to a negative discount-factor shock, which increases household impatience and reduces saving. In baseline, impatient households reduce deposits by 0.9%, tightening bank funding and raising loan rates by 2.3 percentage points on impact. Output falls 0.3% on impact and investment falls 2.4%. Default rises 0.5 percentage points on impact as firms facing higher borrowing costs default more readily. Consumption initially rises 0.1% as households draw down savings, but falls below the no-shock path by quarter 9 and reaches a trough of 0.1% below by quarter 40. Bank net worth initially rises to 0.2% above the no-shock path by quarter 4 before declining, eventually reaching 0.4% below by quarter 45. Credit conditions deteriorate by 5.8% on impact before gradually recovering. Total default costs rise to 0.2% of GDP.

The AMC produces notably stronger dynamics, particularly for bank balance sheets. Default rates rise to 0.8 percentage points above the no-shock path, roughly 1.6 times the baseline increase of 0.5 percentage points. This elevated default reflects moral hazard on the firm side: when the AMC absorbs bank losses, credit conditions do not tighten as sharply, reducing the marginal cost of default and inducing firms to default more readily. Total default costs reach 0.4% of GDP versus 0.2% in baseline. The output response is similar to baseline, falling 0.3% on impact. The key distinction is the bank balance sheet response: bank net worth *rises*, peaking at 0.7% above the no-shock path by quarter 4, as the AMC absorbs default losses rather than banks. This protection persists, with bank net worth remaining positive through quarter 20 before gradually declining. Credit spreads rise to 1.7 percentage points on impact, below the baseline increase of 2.1 percentage points, and the spread differential widens over time as AMC spreads fall to 0.2 percentage points by quarter 10 while baseline spreads remain at 0.7 percentage points. Loan rates rise by 2.3 percentage points, similar to baseline, as the AMC protects bank balance sheets without directly lowering borrowing costs.

Government asset purchases of performing loans provide partial stabilization for this shock by compressing credit spreads. Output falls 0.3% on impact, similar to the AMC and baseline, but consumption responds more favorably: it rises 0.2% on impact versus 0.1% in baseline and remains above baseline throughout the first 10 quarters. Default rates rise by only 0.4 percentage points, below both baseline (0.5 percentage points) and the AMC (0.8 percentage points), as lower loan rates reduce firm debt burdens. Credit spreads rise to only 1.4 percentage points on impact, below the baseline increase of 2.1 percentage points, and remain compressed throughout. However, bank net worth declines from the outset, reaching 0.6% below the no-shock path, as government purchases displace bank lending without absorbing default losses.

These contrasting responses reflect the distinct margins targeted by each policy. Government purchases reduce default rates but do not protect bank capital, while the AMC protects bank capital but does not reduce default rates. This highlights the fundamental distinction in policy mechanisms: government purchases intervene on performing loans *before* default materializes to compress spreads, while the AMC intervenes on NPLs *after* default occurs to absorb losses. For the discount-factor shock, the spread compression channel provides meaningful stabilization, whereas for the TFP shock it does not. Conversely, the AMC's balance sheet protection is highly effective for the TFP shock but generates moral hazard costs for the discount-factor shock through elevated default. The relative welfare contribution of each policy therefore depends on the variance of each shock type: since TFP shocks exhibit substantially higher variance than discount-factor shocks in our calibration, the AMC's advantage in stabilizing TFP-driven fluctuations dominates aggregate welfare comparisons.

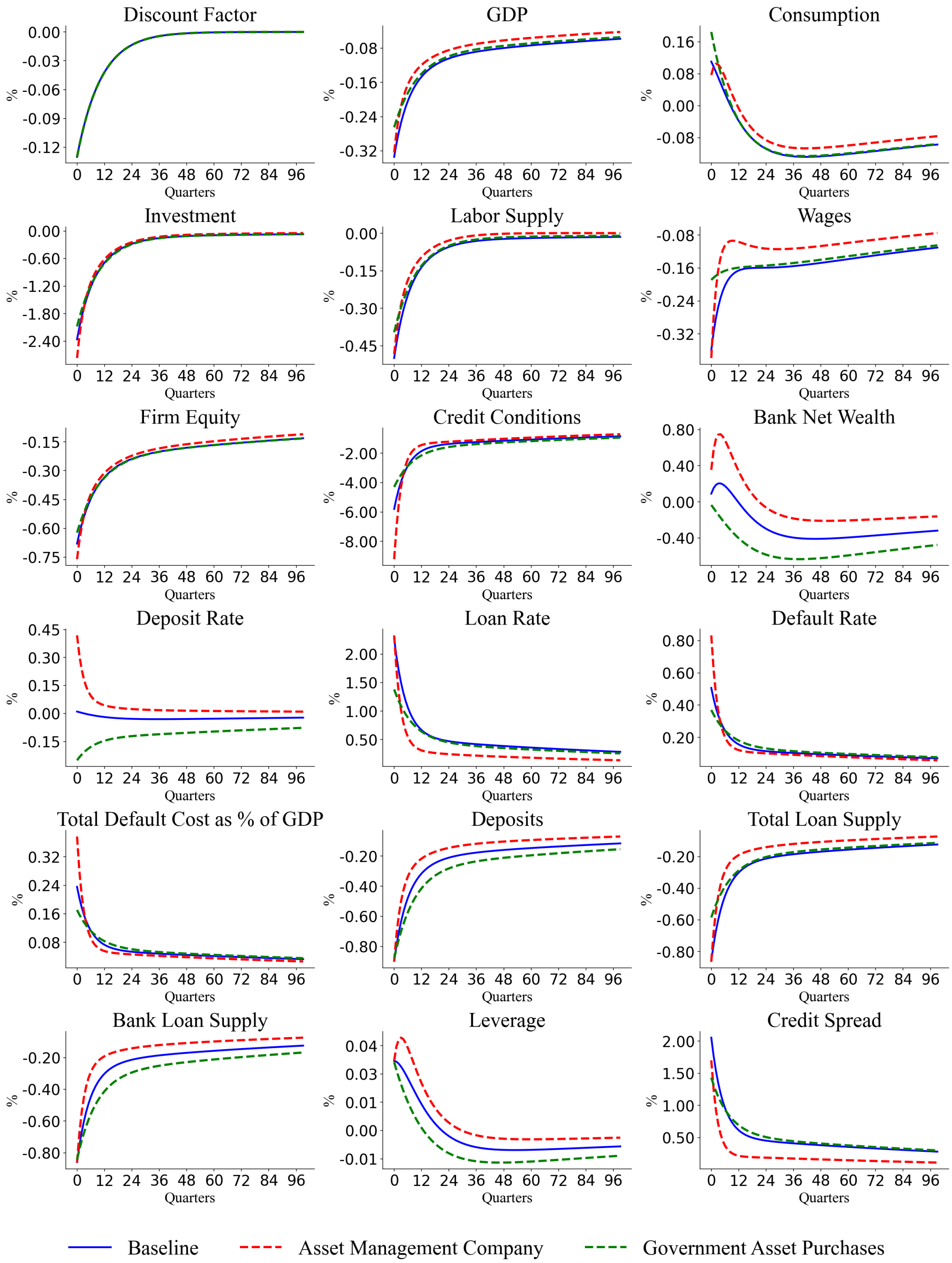

Figure 4: Impulse Responses to a One-Standard-Deviation Negative Discount Factor Shock.

Note: Blue solid lines show the baseline (no-policy). Red dashed lines show the asset-management-company policy. Green dashed lines show the government-asset-purchase policy. Variables are expressed as percentage deviations from steady state except for interest rates (annualized percentage point deviations) and the default rate (percentage point deviation).

4.5 Welfare Analysis

Welfare is measured by consumption-equivalent variation (CEV), defined as the permanent percentage change in consumption that would make households indifferent between the baseline and policy economies.[8] Formally:

$$\text{CEV} = \left(\frac{\mathbb{E}[V^{policy}]}{\mathbb{E}[V^{baseline}]} \right)^{\frac{1}{\kappa(1-\sigma)}} - 1, \tag{41}$$

where V^{policy} and $V^{baseline}$ are the value functions in the respective economies.

Table 3 reports welfare alongside key moments across different policy intensity parameters. For the AMC, the absorption fraction ϕ^{AMC} determines what share of excess default losses the AMC absorbs when the market default rate exceeds the steady-state rate. With an absorption fraction of 0.5, the AMC absorbs half of any default losses exceeding the steady-state rate. The government asset-purchase response parameter ν^{AP} governs the sensitivity of purchases to credit-spread movements as specified in equation (38). The AMC generates a consumption-equivalent gain of 0.22% while government asset purchases generate a welfare *loss* of 0.33%.

For the AMC, higher absorption fractions amplify the stabilization effects: Increasing the absorption fraction from 0.3 to 0.5 raises welfare gains from 0.16% to 0.22% of permanent consumption. For government asset purchases, higher response parameters worsen outcomes: Increasing the response parameter from 0.3 to 0.5 deepens welfare losses from 0.14% to 0.33%.

[8] The CEV is derived from the household value function $V_0 = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{(c_t^{\kappa}(\psi_L + z_t^{\nu}))^{1-\sigma}}{1-\sigma}$. Let λ denote the permanent proportional change in consumption such that $V^{baseline}((1+\lambda)c) = V^{policy}(c)$. Since utility is homogeneous of degree $\kappa(1-\sigma)$ in consumption, we have $(1+\lambda)^{\kappa(1-\sigma)} V^{baseline} = V^{policy}$, which yields $\text{CEV} = \lambda = \left(\frac{V^{policy}}{V^{baseline}} \right)^{\frac{1}{\kappa(1-\sigma)}} - 1$.

Table 3: Policy effects on simulated moments and welfare (500 replications)

	AMC: absorption ϕ^{AMC}			Gov AP: response ν_{AP}		
	0.3	0.4	0.5	0.3	0.4	0.5
GDP (%)	0.52	0.60	0.71	−0.28	−0.46	−0.67
Consumption (%)	0.79	0.91	1.09	−0.59	−0.96	−1.41
Investment (%)	0.80	0.90	1.08	−0.70	−1.13	−1.66
Labor supply (%)	0.39	0.46	0.54	−0.07	−0.13	−0.19
Real wage (%)	1.15	1.35	1.60	−0.67	−1.09	−1.59
Firm equity (%)	0.88	1.00	1.20	−0.81	−1.30	−1.90
Credit conditions (%)	6.40	7.19	8.74	−8.02	−12.72	−18.45
Bank net wealth (%)	4.01	4.87	5.68	−4.11	−6.09	−8.34
Deposit rate (ppt, ann.)	0.77	0.93	1.08	−1.36	−2.07	−2.95
Loan rate (ppt, ann.)	−4.46	−5.23	−6.19	1.95	3.21	4.74
Credit spread (ppt, ann.)	−4.91	−5.79	−6.84	2.94	4.70	6.85
Default rate (ppt)	−0.62	−0.69	−0.84	0.77	1.24	1.80
Default cost (% of GDP)	−0.30	−0.33	−0.40	0.35	0.56	0.82
Deposits (%)	1.44	1.68	1.99	−1.66	−2.58	−3.68
Total loan supply (%)	1.54	1.81	2.14	−0.74	−1.21	−1.79
Bank loan supply (%)	1.54	1.81	2.14	−1.74	−2.68	−3.80
Leverage (ppt)	0.10	0.13	0.15	−0.08	−0.11	−0.13
Gov AP share (% of GDP)	0.00	0.00	0.00	1.04	1.56	2.21
Welfare gain (%)	0.16	0.18	0.22	−0.14	−0.23	−0.33

Note: Entries report Monte Carlo mean changes relative to the no-policy baseline. For the asset-management company (AMC), the absorption fraction ϕ^{AMC} determines the share of excess defaults absorbed when the market default rate exceeds steady state; for government asset purchases (Gov AP), the response parameter ν_{AP} governs the sensitivity of purchases to credit-spread deviations. Real variables (GDP, consumption, investment, labor supply, real wages, firm equity, credit conditions, bank net wealth, deposits, total and bank loan supply) are percentage deviations from baseline means in the stochastic simulation. Interest rates (deposit rate, loan rate) and credit spreads are annualized percentage-point changes. Default rates are in percentage points; default costs are percentages of steady-state GDP. Leverage is the percentage-point change in the ratio of bank loans to deposits. The government asset-purchase share reports the average size of government loan purchases relative to GDP. The welfare gain is the consumption-equivalent variation: the permanent percentage change in consumption that would make households indifferent between the baseline and policy economies, computed from simulated value functions. All Monte Carlo standard errors are below 5% of the reported means. Results based on 500 replications of 10,000 periods with 30% burn-in. Valid replications: AMC = 494, 470, 411; Gov AP = 500, 500, 494 (replications needed to be removed due to explosive paths).

The mechanisms underlying these welfare differences are visible in the simulated moments. By absorbing excess defaults, the AMC protects bank balance sheets, raising bank net wealth by 5.7 percent. Combined with higher firm equity (up 1.2 percent), this improves credit conditions by 8.7 percent. Facing better credit conditions, firms optimally choose lower default rates. Default rates fall by 0.84 percentage points, which reduces equilibrium loan rates by 6.19 percentage points and default costs by 0.4 percent of GDP. Healthier banks offer higher deposit rates, attracting deposits that fund an expansion of total credit supply by 2.1 percent.

Government purchases generate the opposite dynamics. Although purchases average 2.2 percent of GDP, bank loan supply contracts by 3.8 percent, a crowding-out ratio exceeding one-for-one. By expanding credit precisely when conditions are adverse, government purchases increase banks' exposure to default losses. The resulting losses deplete bank net wealth by 8.3 percent. Combined with lower firm equity (down 1.9 percent), credit conditions deteriorate by 18.5 percent. Facing worse credit conditions, firms optimally choose higher default rates. Default rates rise by 1.80 percentage points, raising loan rates by 4.74 percentage points and default costs by 0.8 percent of GDP. Lower deposit rates reduce deposits, and the general equilibrium effect is a 1.8 percent contraction in total credit supply despite the policy's expansionary intent.

The results illustrate why asset-purchase programs designed for safe instruments perform poorly when applied to risky corporate loans in an environment with endogenous default. Unlike the Gertler and Kiyotaki (2010) setup, in which government purchases of bank assets relax leverage constraints because the government faces no such constraint, our environment features endogenous default that responds to aggregate conditions. The spread-contingent rule triggers government purchases precisely when spreads are elevated and conditions adverse, but these purchases crowd out private bank lending and increase the default rate. The resulting losses deplete bank net worth and sustain elevated spreads over time. The credit expansion the asset-purchase program was designed to deliver never materializes; instead, balance sheets weaken and realized default losses increase. This mechanism, whereby stimulating risky credit in bad times worsens banking sector health rather than ameliorating it, explains the negative welfare effect of 0.33% in our calibration. As shown in the impulse response analysis, government asset purchases do provide modest stabilization following discount-factor shocks, but productivity shocks, which dominate business-cycle variance in our calibration, generate crowding-out effects that overwhelm any stabilization benefits.

4.6 Discussion

The impulse responses and welfare results highlight how intervention timing shapes policy effectiveness. The AMC intervenes on NPLs, absorbing losses *after* default occurs. Government asset purchases intervene on performing loans, expanding credit *before* default materializes. This distinction has profound implications that confirm the analytical insights from the static model.

The AMC's effectiveness stems primarily from its direct effect on the lending rate. By purchasing NPLs at prices reflecting the steady-state default rate, the AMC fixes the effective default rate that banks face when pricing loans. This breaks the feedback loop between realized default and lending spreads that would otherwise amplify shocks. Lower lending rates reduce borrowing costs for firms, which in turn reduces default rates, creating a self-reinforcing mechanism that operates independently of bank balance sheet constraints. As Proposition 2 establishes analytically, this channel alone is sufficient to stabilize output: the AMC reduces the elasticity of output with respect to shocks by fixing the effective default rate in the bank lending-rate schedule.

In our quantitative model, bank balance sheet constraints amplify these effects but are not essential to them. When banks face IC constraints, the AMC provides additional stabilization by protecting bank net worth from default losses. The leverage ratio, $L_t/N_{b,t}$, rises modestly under AMC intervention as the expansion of deposits and credit proceed in tandem with protected bank capital. As our static model shows, the AMC remains effective even when banks are unconstrained. The key mechanism is the lending-rate channel, not the capital channel.

The impulse responses reveal that AMC intervention improves credit conditions (Ω_t) through multiple paths: directly through the lending-rate reduction, and indirectly through the feedback from lower default rates to firm equity values embedded in equation (24). When the effective default rate is stabilized, credit discipline tightens and firms default less — except when moral hazard dominates, as with the discount-factor shock. This quantitative result confirms the static-model finding: The AMC stabilizes output by targeting the margin that directly distorts production. Government asset purchases work through a fundamentally different channel. By acquiring performing loans, the policy expands credit supply but leaves the link between default rates and lending spreads intact. Banks continue to price default risk into their lending rates, so the feedback loop that amplifies shocks remains operative. More importantly, even if bank capital were protected, the policy would still fail to break the feedback between default rates and lending rates that drives output volatility. This mirrors Proposition 4: Policies targeting credit supply cannot simultaneously stabilize both lending rates and default rates when default is endogenous. The distinction between performing and nonperforming intervention maps onto the practical observation that purchasing defaulted loans involves loss recovery and directly affects bank returns, while purchasing performing loans expands volume without altering the pricing of default risk.

5 Conclusion

Our study fills a need for quantitative analysis of AMCs' capacity to offset the effects of downturns characterized by high NPL levels, which can restrict bank lending and dampen investment. Furthermore, the positive impacts of an AMC do not require prolonged expansions of government debt or liquidity, suggesting that AMCs offer a viable alternative, or complementary, tool for macrofinancial stability. We demonstrate that when firm defaults endogenously raise lending rates, an AMC that purchases distressed loans at a preset haircut stabilizes the economy. In both the static model and the quantitative real business cycle model, the AMC keeps loan rates and default costs from escalating, maintains labor demand, and limits the fall in output and investment after adverse shocks. Equity injections or government loans help only when banks are severely balance sheet constrained, and they require precise, state-contingent calibration; they cannot fully break the feedback loop between default rates and credit spreads. Because the AMC directly targets the gross lending rate, the margin that distorts production, it restores output and generates welfare improvements. These findings suggest that well-designed AMCs should be placed alongside capital regulations and lender-of-last-resort facilities in the policy toolkit for managing crises driven by surges in NPLs.

A central lesson is that asset-purchase programs suited for high-grade instruments can backfire when applied to risky corporate loans in an environment in which default is endogenous. In the standard Gertler and Kiyotaki (2010) and Gertler and Karadi (2011) framework, central bank purchases of near-safe assets primarily ease balance sheet constraints without materially affecting default risk. In our setting, the same policy design is directed at risky performing loans and activates when spreads widen and conditions deteriorate. The resulting expansion of credit in bad times does not reduce the default rate, nor does it protect banks from the ensuing losses. The additional credit created by such an asset-purchase program thus shows up predominantly as fragile balance sheets and larger default losses rather than as a durable improvement in credit supply, which is why the welfare effect in our calibration is negative.

An AMC also delivers benefits that lie outside our quantitative framework. First, because it swaps bad loans for state-guaranteed claims without immediate budget outlays, it preserves scarce fiscal space during crises and avoids the optimistic asset-recovery bias that recapitalized, but still impaired, banks at times can display in the absence of asset removal. By parking NPLs until collateral values recover, the AMC creates a bridge to the future that requires no upfront taxpayer money and mitigates fire-sale losses. Second, micro-level evidence shows that impaired balance sheets distort credit allocation. Following the 2011 EBA capital requirement increase, weak Portuguese banks rolled over bad borrowers and starved productive firms. This credit misallocation accounted for a fifth of Portugal's productivity drop in 2012 (Blattner et al., 2023). Early asset cleansing via an AMC curbs this misallocation and lengthens the horizon over which banks can meet liquidity standards, reducing the need for later lender-of-last-resort assistance (Santos and Suarez, 2019). Third, loan-sale studies find that transferring large, risky loans to nonbanks expands aggregate credit supply (Drucker and Puri, 2009); and cross-country evidence confirms that AMCs paired with recapitalization funds accelerate NPL resolution and credit growth (Balgova et al., 2016). Finally, by stabilizing deposit funding (banks with stronger, stickier deposits maintained lending in past crises; Cornett et al., 2011), an AMC amplifies the credit-supply channel that underpins our simulated welfare gains.

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Appendix

Nonperforming-Loan Resolution Mechanisms

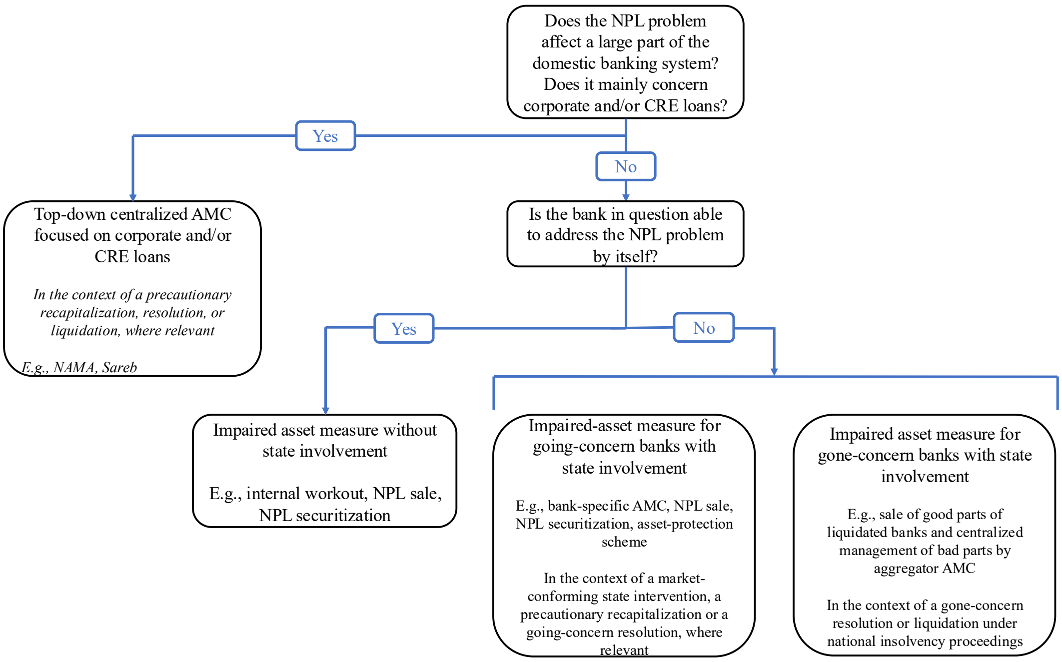

Figure 5: Nonperforming-Loan Resolution Mechanisms
Source: Grasmann et al. (2019). Note: CRE refers to commercial real estate; MPS to Monte dei Paschi di Siena; and GACS to Italy's Fondo di Garanzia sulla Cartolarizzazione delle Sofferenze; AMC to asset management companies; and NPL to nonperforming loans.

Proofs of Propositions

Proof of Proposition 1

Proof. From the bank lending-rate schedule (8), $1-\delta_0 = \dfrac{\frac{i_{d,0}}{\eta}+1}{1+i_{l,0}}$, and knowing that the deposit rate is pinned down by the household discount factor, together with the default-rate schedule $\delta_0 = \dfrac{(1+i_{l,0})\sqrt{2/\kappa}}{a_0^2}$, we obtain $1-\dfrac{(1+i_{l,0})\sqrt{2/\kappa}}{a_0^2} = \dfrac{\frac{i_{d,0}}{\eta}+1}{1+i_{l,0}}$. Setting $i^*_{d,0} = \dfrac{i_{d,0}}{\eta}+1$. and totally differentiating, we get $\left\{\dfrac{\frac{1-\beta}{\eta}+1}{(1+i_{l,0})^2} - \dfrac{\sqrt{2/\kappa}}{a_0^2}\right\}\partial(1+i_{l,0}) = -2\dfrac{(1+i_{l,0})\sqrt{2/\kappa}}{a_0^3}\partial a_0 - \dfrac{1}{1+i_{l,0}}\partial i^*_{d,0}$.

Simplifying, this becomes $\dfrac{1-2\delta_0}{(1+i_{l,0})}\partial(1+i_{l,0}) = -2\dfrac{\delta_0}{a_0}\partial a_0 - \dfrac{1}{1+i_{l,0}}\partial i^*_{d,0}$. Restricting attention to equilibria in which the default rate is less than 50%, $\delta_0 << \dfrac{1}{2}$, we can obtain the partial derivative $\dfrac{\partial(1+i_{l,0})}{\partial a_0} =$

$-2\frac{\delta_0}{\partial a_0}\frac{(1+i_{l,0})}{1-2\delta_0} < 0$. As we know from (8) that δ_0 and $i_{l,0}$ are positively related, $\frac{\partial \delta_0}{\partial a_0} < 0$.

Setting $\partial a_0 = 0$, $\frac{\partial(1+i_{l,0})}{\partial i^*_{d,0}} = -\frac{1}{1-2\delta_0} < 0$. Totally differentiating the default rate schedule and setting $\partial a_0 = 0$, we obtain $\partial \delta_0 = \frac{\delta_0}{(1+i_{l,0})}\partial(1+i_{l,0})$, and so $\frac{\partial \delta_0}{\partial i^*_{d,0}} = -\frac{\delta_0}{(1+i_{l,0})}\frac{1}{1-2\delta_0} < 0$.

Recall that $y_0 = \frac{a_0^2}{1+i_{l,0}}$. Totally differentiating gives $\partial y_0 = 2\frac{a_0}{1+i_{l,0}}\partial a_0 - \frac{a_0^2}{(1+i_{l,0})^2}\partial(1+i_{l,0})$, or $\frac{\partial y_0}{\partial a_0} = 2\frac{y_0}{a_0} - \frac{y_0}{(1+i_{l,0})}\frac{\partial(1+i_{l,0})}{\partial a_0}$, or $\frac{\partial y_0}{\partial a_0}\frac{a_0}{y_0} = 2 - \frac{a_0}{(1+i_{l,0})}\frac{\partial(1+i_{l,0})}{\partial a_0}$. Using the expression above, this simplifies to $\frac{\partial y_0}{\partial a_0}\frac{a_0}{y_0} = 2 + 2\frac{\delta_0}{1-2\delta_0}$. The (absolute value) elasticity of output $\varepsilon_{a_0} = \frac{\partial y_0}{\partial a_0}\frac{a_0}{y_0}$ is $\varepsilon_{a_0} = 2\frac{1-\delta_0}{1-2\delta_0}$, and as TFP falls and the default rate rises, output becomes more elastic.

Similarly, the (absolute value) elasticity of output with respect to the deposit rate (equivalent to the elasticity of output with respect to the discount factor) can be obtained from $\frac{\partial y_0}{\partial(1+i_{l,0})} = \frac{a_0^2}{(1+i_{l,0})^2} = \frac{y_0}{(1+i_{l,0})}$, and using $\frac{\partial(1+i_{l,0})}{\partial i^*_{d,0}} = -\frac{1}{1-2\delta_0}$, we get $\frac{\partial y_0}{\partial i^*_{d,0}} = -\frac{y_0}{(1+i_{l,0})}\frac{1}{1-2\delta_0}$. The elasticity is defined as

$\varepsilon_{i^*_{d,0}} = \frac{\partial y_0}{\partial i^*_{d,0}}\frac{i^*_{d,0}}{y_0}$, and using the bank lending-rate schedule (8), the elasticity is given by $\varepsilon_{i^*_{d,0}} = -\frac{1-\delta_0}{1-2\delta_0}$. The higher the default rate, the greater the elasticity of output when deposit rates increase. □

Proof of Proposition 2

As the bank lending-rate schedule equation is now $1+i_{l,0} = \frac{\frac{1}{\eta}i_{d,0}+1}{(1-\bar{\delta})}$, so $\partial(1+i_{l,0}) = \frac{1}{(1-\bar{\delta})}\partial i^*_{d,0}$, from $y_0 = \frac{(a_0)^2}{(1+i_{l,0})}$, $\partial y_0 = 2\frac{a_0}{(1+i_{l,0})}\partial a_0 - \frac{(a_0)^2}{(1+i_{l,0})^2}\frac{1}{(1-\bar{\delta})}\partial i^*_{d,0}$. Setting $\partial i^*_{d,0} = 0$, $\frac{\partial y_0}{\partial a_0} = 2\frac{a_0}{(1+i_{l,0})} = 2\frac{y_0}{a_0}$. Setting $\partial a_0 = 0$, $\frac{\partial y_0}{\partial i^*_{d,0}} = -\frac{(a_0)^2}{(1+i_{l,0})^2}\frac{1}{(1-\bar{\delta})} = -\frac{y_0}{i^*_{d,0}}$.

The elasticity of output with respect to TFP is then given by $\varepsilon_{a_0} = \frac{\partial y_0}{\partial a_0}\frac{a_0}{y_0} = 2$, while the elasticity of output with respect to the deposit rate is $\varepsilon_{i^*_{d,0}} = 1$.

Proof of Proposition 3

Using $l_0 = (\frac{a_0}{1+i_{l,0}})^2$, $y_0 = \frac{a_0^2}{1+i_{l,0}}$, the optimality condition of firms $\kappa\bar{\Pi}_{f,0}[\delta_0 l_0(1+i_{l,0})] = 1$, can be re-arranged as $\delta_0 = \frac{1}{\kappa\bar{\Pi}_{f,0} l_0(1+i_{l,0})} = \frac{1}{\kappa\bar{\Pi}_{f,0}}\frac{1+i_{l,0}}{a_0^2}$. This is qualitatively the same as the default rate schedule $\delta_0 = \frac{(1+i_{l,0})\sqrt{2/\kappa}}{a_0^2}$, in the case without policy in the proof of Proposition 1. As no other optimality conditions are affected, it is straightforward that we get the same elasticities as in the case without policy in Section 3.2.

Proof of Proposition 4

The IC constraint is $\pi_{b,0} \geq \theta(l_0 - \omega d_1 - e_0)$, the bank budget constraint is $\eta d_1 = l_0 - \eta e_0$, the bank profit function is $\pi_{b,0} = l_0(1-\delta_0)(1+i_{l,0}) - d_1(1+i_{d,0})$, and the supply of loans by firms is still $l_0 = (\frac{a_0}{1+i_{l,0}})^2 \leq (a_0)^2$.

As $\theta(l_0 - \omega d_1 - e_0) \geq 0$, from the IC constraint we know that $l_0\frac{\eta-\omega}{1-\omega} \geq \eta e_0$. As ηe_0 is the transformation of equity to loans, this implies that after equity exceeds $\frac{a_0^2}{\eta}\frac{\eta-\omega}{1-\omega}$, the IC constraint is not binding, the bank is not constrained, and further equity displaces deposits one for one.

While the bank is constrained, the lending-rate schedule is

$$1 + i_{l,0} = \frac{\frac{1}{\eta}(\frac{a_0}{1+i_{l,0}})^2[1+i_{d,0}+\theta(\eta-\omega)] - e_0[1+i_{d,0}+\theta(1-\omega)]}{(\frac{a_0}{1+i_{l,0}})^2(1-\delta_0)}. \tag{42}$$

When $e_0 = \theta = 0$, (42) reverts to (8), (correcting for the intermediation cost). For a given level of deposits, an increase in government purchases of bank equity expands bank loan demand and lowers the lending rate because the IC constraint is loosened.

Direct Lending to Firms

If the government lends directly to firms (and if banks have some equity), driving down the default rate to $\bar{\delta}$ or the lending rate corresponding to this, then the total return from lending for banks $(1-\delta_0)(1+i_{l,0})$ declines while the cost of deposits $(1+i_{d,0})$ stays the same, which drives down bank profits and causes equity to stabilize deposits.

This is because, from the default-rate schedule $\delta_0 = \frac{(1+i_{l,0})\sqrt{2/\kappa}}{a_0^2}$, we obtain $(1-\delta_0)(1+i_{l,0}) = (1 - \frac{(1+i_{l,0})}{a_0^2}\sqrt{2/\kappa})(1+i_{l,0}) \geq 1$, as the net return on deposits needs to be positive. The root of which, where $(1+i_{l,0})$ is close to, but higher than, 1, is $(1+i_{l,0}) = \frac{1-\sqrt{1-4\frac{\sqrt{2/\kappa}}{a_0^2}}}{2\sqrt{1-4\frac{\sqrt{2/\kappa}}{a_0^2}}}$. Lowering the lending rate $(1+i_{l,0})$ below this will result in the total return after default from loans being negative. In fact, with the required return on deposits being higher than 0, the requirement will be higher than this. Lowering the lending rate below the threshold above will result in bank profits becoming negative and banks will cease intermediating. As the equilibrium default rate still fluctuates based on either TFP or the discount factor, a direct lending policy will not be able to guarantee that lending rates are stabilized *and* banks participate in intermediation. An AMC does not have this limitation, as it allows the bank optimality condition (the bank lending-rate schedule) to determine the lending rate, given the default rate that the AMC prices in. This allows bank profitability to be maintained while still reducing the *equilibrium* lending rate by banks and default rate by firms.

Equity Injections to Banks Targeting a Default Rate

If the government injects equity to target a default rate, and since $y_0 = \frac{a_0^2}{(1+i_{l,0})}$, the default schedule (9) can be written as

$y_0 = \frac{\sqrt{2/\kappa}}{\bar{\delta}}$, and rearranging (42) gives

$$e_0 = \frac{1}{\eta a_0^2}\frac{[1+i_{d,0}+\theta(\eta-\omega)]}{[1+i_{d,0}+\theta(1-\omega)]}y_0^2 - y_0\frac{(1-\bar{\delta})}{[1+i_{d,0}+\theta(1-\omega)]}. \tag{43}$$

This says that, unlike an AMC's purchases, the equity injection must be conditioned on the realization of TFP (or discount factor). Implementation of this policy would require a rule in which equity is injected until the default rate of firms reaches a target value. This potentially large injection raises the possibility that the IC constraint may become negative. To see this, rearrange the above as

$$\eta e_0 = l_0\frac{\eta-\omega}{1-\omega}\left\{\frac{1-\omega}{\eta-\omega}\left(\frac{1+i_{d,0}+\theta(1-\omega)-\theta+\theta\eta-\eta\frac{a_0^2}{\sqrt{2/\kappa}}\bar{\delta}(1-\bar{\delta})}{[1+i_{d,0}+\theta(1-\omega)]}\right)\right\},$$

and when the term inside the brace is bigger than 1, the non-negativity of profits, and hence the IC is violated. This is particularly likely when $\bar{\delta}$ is small, in which case the policies cannot replicate what could be implemented with an AMC.

Equity Injections Targeting a Lending Rate

Let $X = \frac{\bar{a}_0}{(1+\bar{i}_{l,0})}$ and $X' = \frac{a'_0}{(1+\bar{i}_{l,0})} = X\frac{a'_0}{\bar{a}_0}$, where the bar represents the values before the shock and the prime the values after the shock with $a'_0 = \epsilon \bar{a}_0$. Then $X' = X\epsilon$. Using this equation, and substituting the default schedule (9) into the loan-rate schedule (42), we get

$$e_0 = \frac{1}{\eta}\frac{[1+i_{d,0}+\theta(\eta-\omega)]}{[1+i_{d,0}+\theta(1-\omega)]}(X\epsilon)^2 - \frac{X\bar{a}_0\epsilon^2 - \sqrt{2/\kappa}}{[1+i_{d,0}+\theta(1-\omega)]}.$$

The equity injection again needs to be conditioned on the realization of the TFP shock, unlike an AMC's purchases. Using similar arguments as before, it is easy to see parameterizations in which the IC becomes negative.

Dynamic Model Equations

This appendix collects the complete set of equilibrium conditions for the dynamic model.

Household Optimality Conditions

$$\kappa c_t^{\kappa-1}(\psi_L + z_t^{\nu})\left(c_t^{\kappa}(\psi_L + z_t^{\nu})\right)^{-\sigma} = \lambda_t \tag{44}$$

$$\nu z_t^{\nu-1} c_t^{\kappa}\left(c_t^{\kappa}(\psi_L + z_t^{\nu})\right)^{-\sigma} = \lambda_t \frac{(1-\alpha)y_t/n_t}{1+\mu i_{L,t}} \tag{45}$$

$$\frac{\lambda_t}{1+i_{B,t}} = \beta_t \mathbb{E}_t \lambda_{t+1} \tag{46}$$

$$\lambda_t\left(1+\phi_D(D_{t+1}-\bar{D})\right) = \beta_t \mathbb{E}_t \lambda_{t+1} + \lambda_t i_{D,t} \tag{47}$$

$$V_t = \frac{\left(c_t^{\kappa}(\psi_L + z_t^{\nu})\right)^{1-\sigma}}{1-\sigma} + \beta_t \mathbb{E}_t V_{t+1} \tag{48}$$

Firm Optimality Conditions

$$y_t = A_t k_{t-1}^{\alpha} n_t^{1-\alpha} \tag{49}$$

$$k_t = (1-\tilde{d})k_{t-1} + \left(\frac{\theta_1}{1-\epsilon}\left(\frac{x_t}{k_{t-1}}\right)^{1-\epsilon} + \theta_2\right)k_{t-1} \tag{50}$$

$$w_t = \frac{(1-\alpha)y_t/n_t}{1+\mu i_{L,t}} \tag{51}$$

$$1 = q_t \theta_1 \left(\frac{x_t}{k_{t-1}}\right)^{-\epsilon} \tag{52}$$

$$q_t\lambda_t = \beta_t\mathbb{E}_t\lambda_{t+1}\left[q_{t+1}\left(1-\tilde{d}+\frac{\theta_1}{1-\epsilon}\left(\frac{x_{t+1}}{k_t}\right)^{1-\epsilon}-\theta_1\left(\frac{x_{t+1}}{k_t}\right)^{1-\epsilon}+\theta_2\right)+\alpha\frac{y_{t+1}}{k_t}\right] \quad (53)$$

$$l_t = \mu(1-\alpha)\frac{y_t}{1+\mu i_{L,t}} \quad (54)$$

$$1 = \Omega_t\left[\delta_t l_t(1+i_{L,t})\right]^{\xi} \quad (55)$$

$$\nu_t = y_t + l_t - (1-\alpha)\frac{y_t}{1+\mu i_{L,t}} - (1-\delta_t)(1+i_{L,t})l_t - \frac{\Omega_t}{1+\xi}\left[\delta_t l_t(1+i_{L,t})\right]^{1+\xi} + \beta_t\frac{\lambda_{t+1}}{\lambda_t}\mathbb{E}_t\nu_{t+1} \quad (56)$$

Banking Sector Conditions

$$L_t \le D_t + \rho_b N_{b,t-1} \quad (57)$$

$$N_{b,t} = L_t(1+i_{L,t})(1-\delta_t^{AMC}) - D_t(1+i_{D,t}) \quad (58)$$

$$V_{b,t} = (1-\rho_b)\lambda_t N_{b,t} + \beta_t\rho_b\mathbb{E}_t V_{b,t+1} \quad (59)$$

$$V_{b,t} \ge \theta_b\left[L_t(1+i_{L,t})(1-\delta_t^{AMC}) - \omega_b D_t(1+i_{D,t})\right] \quad (60)$$

$$\begin{aligned} 0 = {} & -\lambda_{b,t} + (1+\psi_{b,t})(1-\rho_b)\lambda_t(1+i_{L,t})(1-\delta_t^{AMC}) \\ & - \psi_{b,t}\theta_b(1+i_{L,t})(1-\delta_t^{AMC}) + \beta_t\rho_b^2(1+i_{L,t})(1-\delta_t^{AMC})\mathbb{E}_t\lambda_{b,t+1} \end{aligned} \quad (61)$$

$$\begin{aligned} 0 = {} & \lambda_{b,t} - (1+\psi_{b,t})(1-\rho_b)\lambda_t(1+i_{D,t}) \\ & + \psi_{b,t}\theta_b\omega_b(1+i_{D,t}) - \beta_t\rho_b^2(1+i_{D,t})\mathbb{E}_t\lambda_{b,t+1} \end{aligned} \quad (62)$$

Policy and Government

$$\delta_t^{AMC} = \begin{cases} \bar{\delta} & \text{if } \delta_t > \bar{\delta} \text{ (AMC active)} \\ \delta_t & \text{otherwise} \end{cases} \quad (63)$$

$$\tau_t^{AMC} = L_t(1+i_{L,t})\left[(1-\delta_t^{AMC}) - (1-\delta_t)\right](1-\tau^{policy}) \quad (64)$$

$$g_t^{AP,shadow}\cdot L_t = \nu^{AP}\bar{L}\left[(i_{L,t}-i_{B,t}) - (\bar{i}_L - \bar{i}_B)\right] \quad (65)$$

$$g_t^{AP} = \max\{0, g_t^{AP,shadow}\} \quad (66)$$

$$\Upsilon_t + g_t^{AP}L_t\left[(1+i_{L,t})(1-\delta_t)-1\right](1-\tau^{policy}) = D_{t+1} - D_t + \frac{B_{t+1}}{1+i_{B,t}} - B_t + \tau_t^{AMC} \quad (67)$$

$$B_t = \bar{B} \quad (68)$$

Market Clearing and Aggregation

$$z_t + n_t = 1 \quad (69)$$

$$d_t = D_t \quad (70)$$

$$l_t = (1 + g_t^{AP}(1 - \tau^{policy}))L_t \tag{71}$$

$$y_t = c_t + x_t + \frac{\Omega_t}{1+\xi}\left[\delta_t l_t(1+i_{L,t})\right]^{1+\xi} + \frac{\phi_D}{2}(D_t - \bar{D})^2 + C_t^{policy} \tag{72}$$

$$\Omega_t = \bar{\Omega}\left(\frac{\nu_t}{\bar{\nu}}\right)^{\phi_\nu} \cdot \left(\frac{\bar{\psi}_b}{\psi_{b,t}}\right)^{\phi_\psi} \tag{73}$$

Exogenous Processes

$$\log(A_t/\bar{A}) = \rho_A \log(A_{t-1}/\bar{A}) + \varepsilon_{A,t} \tag{74}$$

$$\log(\beta_t/\bar{\beta}) = \rho_\beta \log(\beta_{t-1}/\bar{\beta}) + \varepsilon_{\beta,t} \tag{75}$$

Auxiliary Definitions

Total default costs:

$$TD_t = \frac{\Omega_t}{1+\xi}\left[\delta_t l_t(1+i_{L,t})\right]^{1+\xi} \tag{76}$$

Policy deadweight costs (as percentage of steady-state GDP):

$$C_t^{AMC} = L_t(1+i_{L,t})\left[(1-\delta_t^{AMC}) - (1-\delta_t)\right] \cdot \tau^{policy} \tag{77}$$

$$C_t^{AP} = g_t^{AP} L_t\left[(1+i_{L,t})(1-\delta_t) - 1\right] \cdot \tau^{policy} \tag{78}$$

$$C_t^{policy} = C_t^{AMC} + C_t^{AP} \tag{79}$$

Occbin IRFs

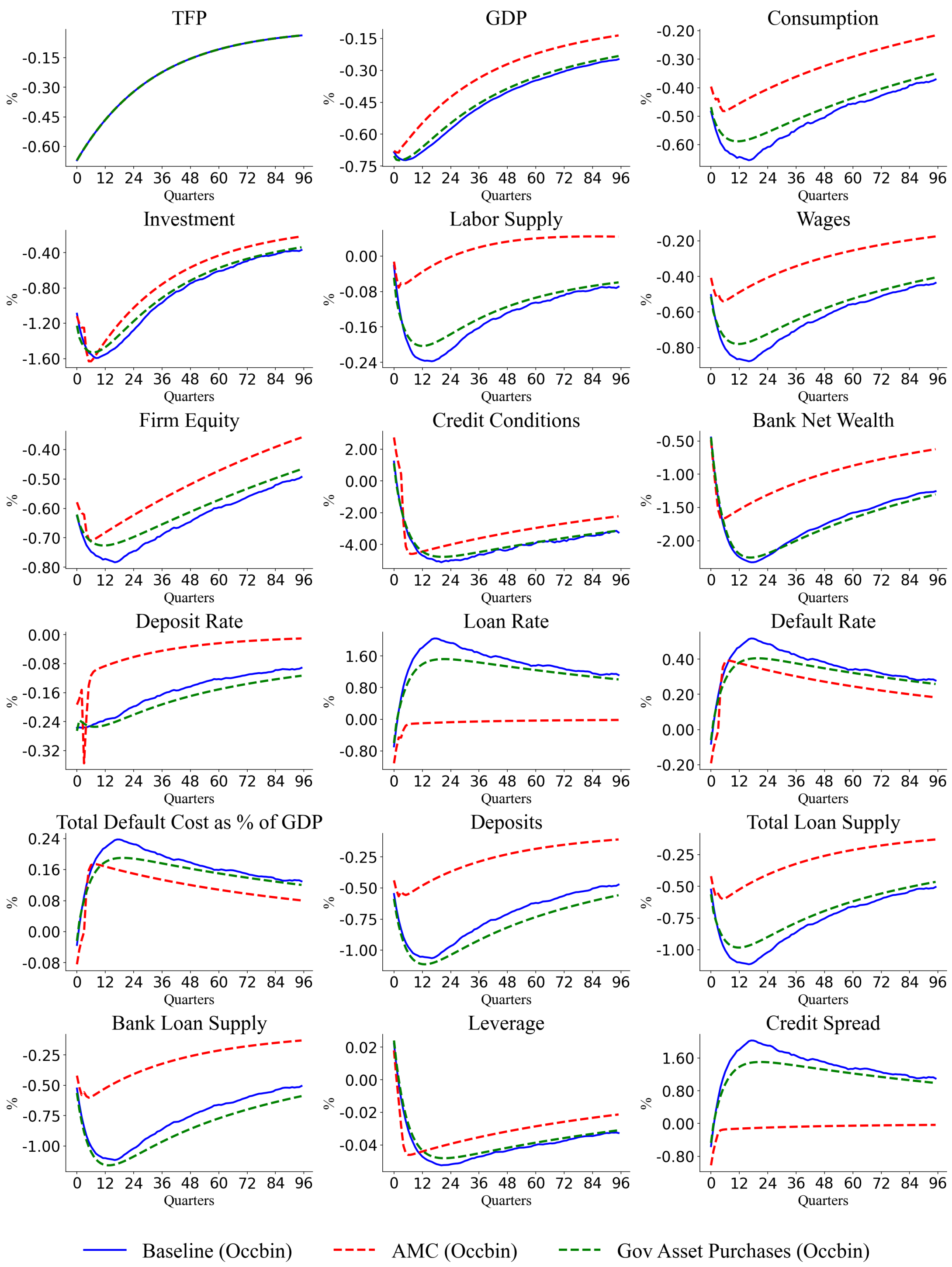

Figure 6: Impulse Responses to a One-Standard-Deviation Negative TFP Shock.

Note: Occbin simulations. Blue solid lines show the baseline (no-policy). Red dashed lines show the asset-management-company policy. Green dashed lines show the government-asset-purchase policy. Variables are expressed as percentage deviations from steady state except for interest rates (annualized percentage point deviations) and the default rate (percentage point deviation). Leverage is the ratio of loans to bank net worth, $L_t/N_{b,t}$.

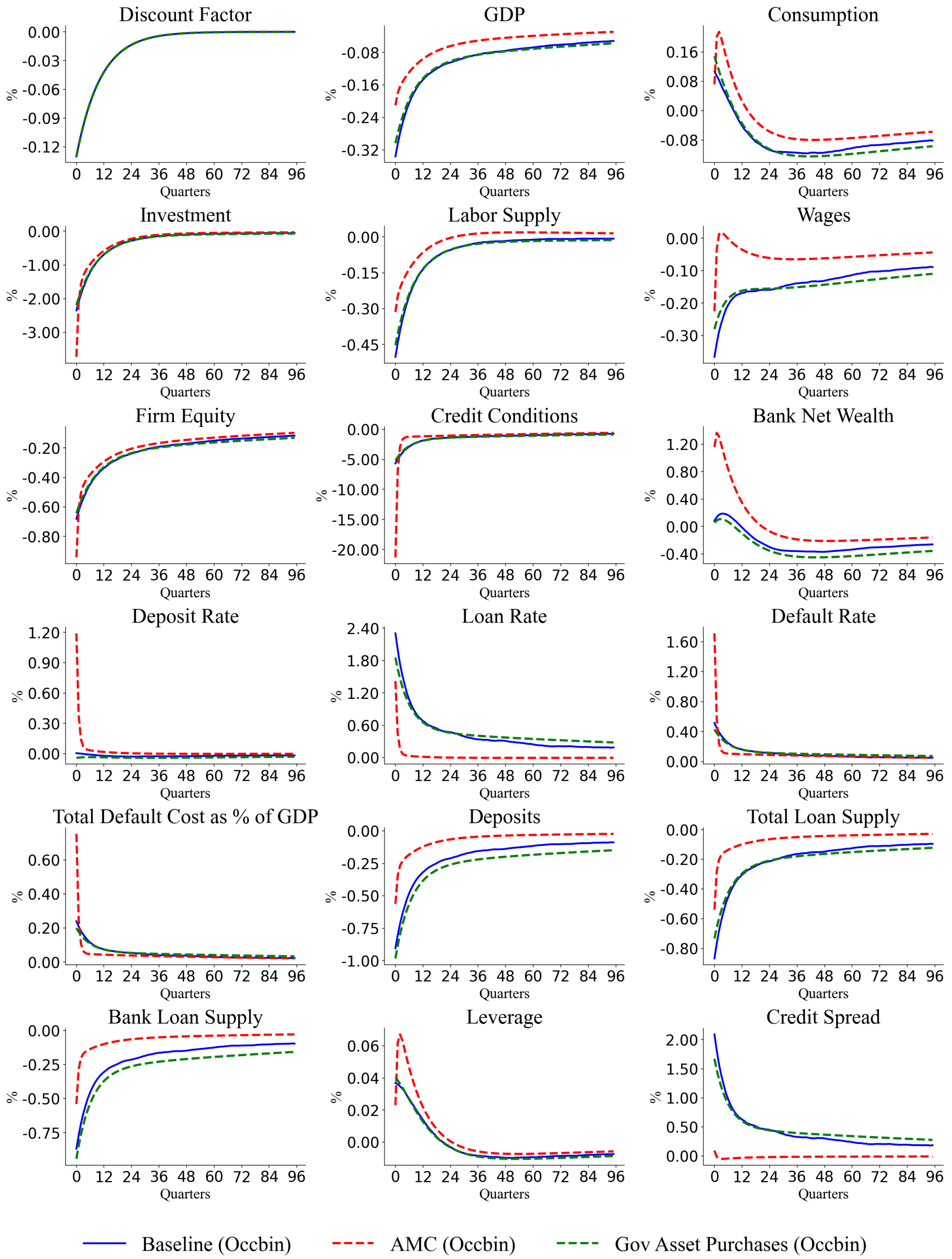

Figure 7: Impulse Responses to a One-Standard-Deviation Negative Discount Factor Shock.

Note: Occbin simulations. Blue solid lines show the baseline (no-policy). Red dashed lines show the asset-management-company policy. Green dashed lines show the government-asset-purchase policy. Variables are expressed as percentage deviations from steady state except for interest rates (annualized percentage point deviations) and the default rate (percentage point deviation).

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