Distressed Assets and Fiscal-Monetary Support: Are AMCs a Third Way?*

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Abstract

Following the Global Financial Crisis of 2007-08, amidst increased loan delinquencies in Eurozone, Ireland, Slovenia Spain implemented significant delinquent loan purchase programs through Asset Management Companies (AMCs), amounting to about 44%, 16%, and 10% of their GDPs, respectively. While these programs were individually deemed successful, questions have been raised about their principal mechanisms and broader applicability. We investigate whether the success of AMCs, through their funding structure, stemmed from being defacto traditional capital and liquidity support to banks. Developing dynamic general equilibrium models, we show that AMCs improve welfare and enhance banking systems, and their effectiveness is largely independent of their funding structure. They directly enhance the returns to bank lending, in turn directly promoting additional lending (bank lending channel) and indirectly by improving corporate borrowers' balance sheets (balance sheet channel).

Keywords: Distressed Assets, Eurozone, Monetary Policy, Fiscal Policy, AMC, Non-Performing Loans.

JEL Classification: F34, G15, G18

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1 Introduction

Increased delinquencies in the loan portfolios of banks in an economic downturn have been primarily addressed by central banks through liquidity support, and by governments through re-capitalization.[1] Often overlooked, the Eurozone crisis following 2008 saw the implementation of large delinquent loan purchase programs (through an Asset Management Company; "AMC") in Ireland and Spain. In Ireland, the size of the AMC was around 44% of GDP while in Slovenia and Spain it was around 16% and 8%. While generally considered successful, analysis of the mechanisms by which they operate have been largely absent. The AMCs operated through a mixture of contingent fiscal and hidden monetary support. Was the success of the programs purely from mechanisms found in other forms of fiscal or monetary support to the banking system? We show that the AMCs work through a direct effect of encouraging additional lending, and an indirect effect of improving the balance sheets of corporate borrowers. In effect, the AMCs are successful because they operate through both the bank lending and balance sheet channels and reinforce each other. Importantly, we show that the funding structure (whether fiscal or monetary) is not quantitatively important for effectiveness of the AMC and suggests that it is an alternative policy tool to traditional fiscal and monetary policy.

We first develop a closed-economy Real Business Cycle (RBC) model, calibrated to Eurozone data, incorporating distressed assets and then develop a small open economy New Keynesian model of the Irish economy to show how our results extend to a small open economy setting. In both closed and small open economies, our results show that an AMC can be welfare improving though our results and mechanisms do not depend on the particular economic structure of the region. In our model, the AMC purchases loans from banks paying a price that depends on the steady state rate of default rather than the prevailing rate. In a downturn, this means that banks receive a higher than market price for their loans and boosts their return, allowing them to offer higher rates to depositors. This increase in deposit rates leads to a larger supply of deposits, easing credit constraints for firms and spurring greater investment, output, and profits. Improved profits enhance the value of firm equity, which in turn betters credit conditions and leads to higher repayment rates. This creates a positive feedback loop,

[1] And to a lesser extent through regulatory forbearance or macroprudential tools.

further enhancing returns for financial intermediaries. Consequently, intermediaries can reduce the lending rates to firms and simultaneously offer even higher returns to depositors.

Our paper fills an important analytical gap. Even ex-post, AMCs are typically only assessed using partial equilibrium criteria, such as their financial (business) performance. Born in crises, absent a counterfactual, and impacting the balance sheets of the establishing state, banks, firms, and possibly other economic actors, empiricalstudies to assess the overall economic impact of AMCs are highly challenging. The main contribution of this paper to the debate about the pros and cons of AMCs as a resolution tool for NPLs is that an RBC model is deployed to look holistically at the welfare effects of a possible AMC, thus filling an important gap in the literature on distressed asset resolution and crisis management.

There are important policy questions about the role and macroeconomic impact of systemic (multi-bank) AMCs to be answered. Systemic AMCs, often erroneously referred to as 'Bad Banks,' are an NPL resolution approach often used in financial crises, which typically entail high NPL ratios. Ultimately, AMCs offset further capital losses through the combination of time and a source of low-cost funding liquidity and have had some success in Ireland, Spain, and Slovenia (Medina Cas and Peresa, 2016). It is well known that recessions and crises, with the attendant impact on bank balance sheets, can become procyclical. As impairments rise, banks reduce credit, thereby exacerbating the slowdown.[2]

2 A Primer on Asset Management Companies

Over the past 30 years, systemic AMCs have been used in various parts of the world, but primarily in Europe and Asia, to deal with high NPL stocks in banking systems. This has usually been in the aftermath of major economic and financial crises, such as the Asian financial crisis in the late 1990s and the eurozone sovereign debt crisis starting in 2010.[3] A summary

[2]NPLs can significantly negatively impact the bank transmission channel; see, for example, Huljak et al. (2020). Resolving NPLs swiftly and effectively from bank balance sheets is thus essential to enable investments and growth.

[3]AMCs are not universally relevant. For example, accounting standards in the US lead to the rapid write-off of impaired credits. While this does, on the one hand, prevent a build-up of NPLs on bank balance sheets and the resultant problems, it may, on the other hand, be value destructive. In the absence of NPLs, there is no role for AMCs. It can be argued, however, that in certain circumstances, US Government-Sponsored Entities, such as Fannie Mae and Freddie Mac, mimic some of the functions and features of a systemic AMC.

overview of the use of AMCs may be found in Fell et al. (2021).

The main function of systemic AMCs is to 'bridge' the inter-temporal pricing gaps which typically emerge when market prices for NPLs and the related collateral are temporarily depressed; see Fell et al. (2017) for an exposition. This may result from heightened risk aversion and illiquidity in the market or from more fundamentally-driven declines in asset prices in, for example, real estate. Market prices should, however, recover as economic conditions improve.[4] Bridging this inter-temporal pricing gap for distressed assets is accomplished by removing a significant share of NPLs, usually belonging to a particular asset class, from bank balance sheets and resolving them over a time horizon long enough to maximize their recovery value. With assets purchased from banks by the systemic AMC at long-term or 'real economic' value, the fire sales resulting from NPL disposals into illiquid markets, where the risk premia required by outside investors may be high, can be avoided. This effect can be significant if multiple banks aim to resolve NPLs simultaneously.[5]

In the eurozone, AMCs have in recent decades been used in Ireland, Spain, and Slovenia.[6] 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.[7] The banks may be able to pledge the senior bonds with the central bank to access credit operations, a particularly important aspect if the bank is otherwise liquidity constrained, a reasonable expectation in a crisis management context. Based on available performance criteria, the track record of these country-specific, systemic AMCs in the eurozone has, overall, been relatively positive. They contributed to repairing and unblocking the investment channel in these countries, although, as expected, there is some degree of heterogeneity across the three countries; for an overview, see Medina Cas and Peresa (2016).

[4] A key criterion for the success of a systemic AMC is that it purchases NPLs with values inherently linked to real economic outcomes. As the economy recovers, so too should the value of the underlying assets collateralizing the loans purchased by the AMC. For example, AMCs often avoid purchasing SME loans, as their likelihood of recovery depends on many more factors than a broad-based economic recovery.

[5] Systemic AMCs acquire assets from a range of, usually distressed, banks, as opposed to bank-specific or 'rump' AMCs, which may result from the resolution of a single entity and or the creation of a bridge bank.

[6] These were NAMA in Ireland, Sareb in Spain, and DUTB in Slovenia.

[7] For various reasons, AMCs may acquire performing as well as non-performing loans, albeit the former in relatively small proportions relative to the latter.

The overall positive experience with systemic AMCs has been mirrored outside the eurozone. Sweden, a frontrunner in the use of AMCs, provided a seminal example of what can be achieved with carefully designed vehicles and an integrated approach to bank and asset resolution, along with a broad program for economic recovery, in the face of the financial crisis; see, for example, Jonung (2009). The Asian Financial Crisis is also a testament to systemic AMCs' role in resolution and recovery, although there was also some heterogeneity in AMC performance across countries; see, for example, He (2004).

In the European context, the potential benefits of systemic AMCs were recognized in the 2017 EU Council Action Plan on NPLs, which cited a pivotal role for AMCs in resolving large NPL stocks. In addition, a 'blueprint' for European AMCs, prepared by staff from the European Central Bank, EU Commission, and European Banking Authority, was published in 2018.[8] The 'blueprint' summarises international best practices in setting up and running systemic AMCs and clarifies the relevant EU legal provisions, such as state aid and bail-in rules related to using AMCs in this jurisdiction.

Despite the considerable expertise with systemic AMCs across various countries, the discussion about their economic costs and benefits is still hampered by a lack of model-based evidence about their macroeconomic and welfare effects. Multiple studies have attempted to quantify the benefits of specific systemic AMCs, but these typically remain partial studies with limited scope.[9] More holistic analyses face the challenge of empirically capturing the various effects of AMCs, including the repercussions on the balance sheets of the sponsoring state, the participating banks, and the debtors acquired by the AMC. Counterfactual analysis is typically not feasible either. This paper aims to address this shortcoming using a DSGE modeling approach.

[8]European Council "Council conclusions on Action plan to tackle non-performing loans in Europe", 11 July 2017. "Commission Staff Working Document, AMC Blueprint, Communication From the Commission To the European Parliament, The European Council, The Council and the European Central Bank", 14 March 2018 (SWD(2018) 72 final).

[9]See, for example, a report by Ernst & Young on the socio-economic impact of Spain's AMC, Sareb: 2017.

3 Closed Economy Model

We study the closed economy RBC model of Jaccard (2024) that incorporates a household, corporate, and banking sector that intermediates funds between the two. To this set up we introduce endogenous default by the firms on their loans to the banks. In addition, we introduce an agency (AMC) that purchases loans from banks at a price that depends on the steady state rate of default. The funding structure of the AMC can be either purely fiscal (fiscal-neutral) or purely monetary (liquidity-neutral). These two extremes allow us to examine the role of the funding decision on the outcomes of the AMC.[10]

The deterministic growth rate along the balanced growth path is denoted by γ. Adjustment costs are rebated as lump sum transfers to focus on marginal effects. The maximization problem for each agent is given in the Appendix.

Households

Households maximize the value of consumption c_t and leisure z_t by renting labor n_t to firms for wages w_t from their endowment of time 1. Households make deposits at banks D_t in nominal terms and purchase government debt B_{t+1}. Deposits pay an intraperiod return of $i_{D,t}$ but their principal is only available the following period. Government bonds are standard one-period nominally riskless bonds. The interest rate on government Bonds $i_{B,t}$. π_t is the net cash-flow of the firm each period, or equivalently, dividends. tr_t is the transfer from the monetary-fiscal authority and amounts to the net segniorage transfer. γ is the rate of population growth. The flow budget constraint is

$$\begin{aligned} c_t + x_t + \gamma \frac{M_{t+1}}{P_t} + \frac{1}{1+i_{B_t}} \gamma \frac{B_{t+1}}{P_t} \\ = \Pi_{T_t} + tr_t + r_{K_t} k_t + w_t n_t + i_{D_t} \frac{D_t}{P_t} + \frac{M_t}{P_t} + \frac{B_t}{P_t}. \end{aligned} \tag{1}$$

[10]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 sheet was not included in national debt. In this way, the debts raised to facilitate the establishment of the AMC can be seen as 'external' as they are not accounted for nationally. In reality, there is a contingent liability, only realizable in case the AMC fails in its aims.

The Labor (n_t)-leisure (z_t) trade-off depends on the endowment of time, set to 1:

$$z_t + n_t = 1. \tag{2}$$

The cash constraint is

$$\gamma M_{t+1} = D_t, \tag{3}$$

where it is binding as interest rates are assumed to be strictly positive, and where D_t is nominal deposits and γM_{t+1} is the cash needed for deposits. Capital accumulation is given by

$$\gamma k_{t+1} = (1-\tau)k_t + (\frac{\theta_1}{1-\epsilon}(\frac{x_t}{k_t})^{1-\epsilon} + \theta_2)k_t. \tag{4}$$

Utility is

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \hat{\beta}_t \frac{(c_t^{\kappa}(\psi + z_t^{\nu}))^{1-\sigma}}{1-\sigma}. \tag{5}$$

Define $\hat{\beta} = \tilde{\beta}\gamma^{1-\sigma}$. The Lagangian is

$$L = \mathbb{E}_0 \sum_{t=0}^{\infty} \hat{\beta}^t \left[\begin{array}{l} \frac{(c_t^{\kappa}(\psi+z_t^{\nu}))^{1-\sigma}}{1-\sigma} \\ \quad - \lambda_t[c_t + x_t + \frac{D_t}{P_t} + \frac{1}{1+i_{B_t}}\gamma\frac{B_{t+1}}{P_t} - \Pi_{T_t} - tr_t - r_{K_t}k_t - w_t(1-z_t) - i_{D_t}\frac{D_t}{P_t} - \frac{1}{\gamma}\frac{D_{t-1}}{P_t} - \frac{B_t}{P_t} \\ \quad - \lambda_t q_t[\gamma k_{t+1} - (1-\tau)k_t - (\frac{\theta_1}{1-\epsilon}(\frac{x_t}{k_t})^{1-\epsilon} + \theta_2)k_t]. \end{array} \right. \tag{6}$$

Define $\beta = \tilde{\beta}\gamma^{-\sigma}$. The optimality conditions are given by

$$[c_t]: \quad \kappa c_t^{\kappa-1}(\psi + z_t^{\nu})(c_t^{\kappa}(\psi + z_t^{\nu}))^{-\sigma} = \lambda_t \tag{7}$$

$$[z_t]: \quad c_t^{\kappa}\nu z_t^{\nu-1}(c_t^{\kappa}(\psi + z_t^{\nu}))^{-\sigma} = \lambda_t w_t \tag{8}$$

$$[x_t]: \quad 1 = q_t\theta_1(\frac{x_t}{k_t})^{-\epsilon} \tag{9}$$

$$[k_{t+1}]: \quad \lambda_t q_t = \mathbb{E}_t\beta\lambda_{t+1}r_{K_{t+1}} + \mathbb{E}_t\beta\lambda_{t+1}q_{t+1}\left[(1-\tau) + \frac{\theta_1}{1-\epsilon}(\frac{x_t}{k_t})^{1-\epsilon} + \theta_2 - \theta_1(\frac{x_t}{k_t})^{1-\epsilon}\right] \tag{10}$$

$$[B_{t+1}]: \quad \lambda_t\frac{1}{P_t}\frac{1}{1+i_{B_t}} = \mathbb{E}_t\beta\lambda_{t+1}\frac{1}{P_{t+1}} \tag{11}$$

$$[D_{t+1}]: \quad \lambda_t\frac{1-i_{D_t}}{P_t} = \mathbb{E}_t\beta\lambda_{t+1}\frac{1}{P_{t+1}}. \tag{12}$$

Firms

Firms are infinitely lived and pay dividends to owners (the 'Free Cash Flow to Equity'). Revenue from production/sales is (y_t) and depends on capital (k_t) and labor (n_t) with output being generated from a constant returns to scale production function. Firms maximize the present discounted value of dividends/profits (Π_t), or equivalently, the value of equity is given by $\nu_t = \Pi_t + r_t k_t + \beta\frac{\lambda_{t+1}}{\lambda_t}\mathbb{E}_t\nu_{t+1}$, where λ_t is the marginal value of profits for the firm and β is the firm's discount factor.

Firms take intraperiod loans from banks l_t at net interest rate $i_{L,t}$. When debt is due they can renegotiate with creditors and obtain a haircut (or debt forgiveness) of δ_t%. The cost of renegotiating this debt is $\frac{\Omega_t}{1+\psi}\left[\delta_t l_t(1+i_{L,t})\right]^{1+\psi}$ where Ω_t is a macro-variable representing aggregate credit conditions (that firms take as given) with $\Omega_t = (\frac{N_t}{N_s})^{\omega_s}$ where $\omega_s > 0$ reflects the elasticity of credit conditions with respect to the equity value. $N_t = \int \nu_t$ is the aggregate value of equity of all firms. Ω_t varies positively with the aggregate equity value of firms, but individual firms do not internalize how their borrowing decisions affect aggregate credit conditions. $\frac{\Omega_t}{1+\psi}\left[\delta_t l_t(1+i_{L,t})\right]^{1+\psi}$ is the pecuniary cost of the loss-given-default (cost of renegotiating the debt) where $\psi > 0$ governs the elasticity of the cost of renegotiation with respect to the gain (where $\delta_t l_t(1+i_{L,t})$ is the total haircut on debt).

Output is given by

$$y_t = a_t k_t^{\alpha} n_t^{1-\alpha}$$

where total factor productivity follows

$$loga_t = \rho_a loga_{t-1} + \epsilon_a, \tag{13}$$

and where $1 > \rho_a \geq 0$, and ϵ_a is a shock of mean 0 and standard deviation σ_a.

$$\Pi_{F,t} = y_t - r_{K,t}k_t - w_t n_t + (1 - (1-\delta_t)(1+i_{L,t}))l_t - \frac{\Omega}{1+\psi}[\delta_t l_t(1+i_{L,t})]^{1+\psi} \tag{14}$$

$$= y_t - (1 - \mu(1 - (1-\delta_t)(1+i_{L,t})))(r_{K,t}k_t + w_t n_t) - \frac{\Omega}{1+\psi}[\delta_t l_t(1+i_{L,t})]^{1+\psi} \tag{15}$$

subject to working capital constraint:

$$\frac{L_t}{P_t} \geq \mu(r_{K,t}k_t + w_t n_t) \tag{16}$$

Optimality conditions are given by

$$[k_t]: \quad \alpha\frac{y_t}{k_t} = (1 - \mu(1 - (1-\delta_t)(1+i_{L,t})))r_{K,t} + \frac{\Omega}{l_t}[\delta_t l_t(1+i_{L,t})]^{1+\psi}\mu r_{K,t} \tag{17}$$

$$[n_t]: \quad (1-\alpha)\frac{y_t}{n_t} = (1 - \mu(1 - (1-\delta_t)(1+i_{L,t})))w_t + \frac{\Omega}{l_t}[\delta_t l_t(1+i_{L,t})]^{1+\psi}\mu w_t \tag{18}$$

$$[\delta_t]: \quad \frac{\Omega}{\delta_t}[\delta_t l_t(1+i_{L,t})]^{1+\psi} = \mu(1+i_{L,t})(r_{K,t}k_t + w_t n_t). \tag{19}$$

Rearranging these gives us:

$$[k_t]: \qquad r_{K,t} = \frac{\alpha \frac{y_t}{k_t}}{(1-\mu(1-(1-\delta_t)(1+i_{L,t}))) + \frac{\Omega}{l_t}[\delta_t l_t]^{1+\psi}\mu} \tag{20}$$

$$[n_t]: \qquad w_t = \frac{(1-\alpha)\frac{y_t}{n_t}}{(1-\mu(1-(1-\delta_t)(1+i_{L,t}))) + \frac{\Omega}{l_t}[\delta_t l_t(1+i_{L,t})]^{1+\psi}\mu} \tag{21}$$

$$[\delta_t]: \quad \frac{\Omega}{\delta_t}[\delta_t l_t(1+i_{L,t})]^{1+\psi} = \mu(1+i_{L,t})(r_{K,t}k_t + w_t n_t). \tag{22}$$

Note that

$$r_{K,t}k_t + w_t n_t = \frac{y_t}{(1-\mu(1-(1-\delta_t)(1+i_{L,t}))) + \frac{\Omega}{l_t}[\delta_t l_t(1+i_{L,t})]^{1+\psi}\mu},$$

and Credit Conditions are given by

$$\Omega_t = \bar{\Omega}(\frac{N_t}{\bar{N}})^{\phi}.$$

Therefore the optimality conditions are

$$r_{K,t} = \frac{\alpha \frac{y_t}{k_t}}{1+\mu i_{L,t}} \tag{23}$$

$$w_t = \frac{(1-\alpha)\frac{y_t}{n_t}}{1+\mu i_{L,t}} \tag{24}$$

$$\frac{\Omega}{\delta_t}[\delta_t l_t(1+i_{L,t})]^{1+\psi} = l_t(1+i_{L,t}) \tag{25}$$

$$\Omega_t = \bar{\Omega}(\frac{N_t}{\bar{N}})^{\phi} \tag{26}$$

$$l_t = \mu \frac{y_t}{1+\mu i_{L,t}}. \tag{27}$$

The marginal pecuniary cost of renegotiating debt is $\Omega_{t,s}\left[\delta_t l_{t,s}(1+i_{D,t})\right]^{\psi}$ while the marginal pecuniary benefit is 1. As a result, when aggregate conditions improve, and industry equity value increases, Ω_t increases, and the marginal pecuniary cost of renegotiating debt increases, and the firms choose a lower haircut δ_t. Similarly, the higher the level of industry indebtedness, the lower is industry profits and hence equity values, and haircuts of debt are higher.

As firms may choose to renege on some of their contractual debt obligations, but then suffer a renegotiation cost proportional to the scale of default, the decision to default is strategic. This cost effectively creates a borrowing constraint and stems from Shubik and Wilson (1977) and Dubey et al. (2005), and applied in Tsomocos (2003), Goodhart et al. (2005) and Goodhart et al. (2006). In the RBC literature, our model shares similar features to De Walque et al. (2010). Our closest methodological precursors are Peiris and Tsomocos (2015), that studied a two-period large open international economy with incomplete markets and default; Goodhart et al. (2013), that explored the effect of international capital flow taxation on default and welfare in a deterministic two-period large open economy; and Walsh (2015*a*) and Walsh (2015*b*), who considered default in a small open dynamic incomplete markets economy. In these latter two papers, the marginal cost of default depends on the level of wealth, so the propensity to default depends on business cycle fluctuations. We follow this notion here by introducing a macrovariable that governs the marginal cost of renegotiating debt (default), termed "credit conditions." This reflects changing motivations and incentives of debtors to make the necessary sacrifices to repay their obligations, as emphasised by Roch et al. (2016). Firms pay lenders a total pecuniary return on their debt of $(1 - \delta_t)(1 + i_{L,t})$ but incur a pecuniary penalty for the haircut obtained, equal to $\delta_t(1 + i_{L,t})$ (see Appendix for derivations). As a result, the effective cost to the firm of the debt is $(1 + i_{L,t})$. The wedge between the effective cost of debt to the firm, and the total return to the lenders is δ_t and represents the inefficiency or dead-weight loss incurred as a result of default. Importantly, the total cost of debt paid by firms is equated to the total return on capital investment by firms. Higher total costs of debt because of higher default rates reduce investment, a mechanism which the AMC mitigates, and discussed in the next section.

Commercial Banking Sector

The commercial banking sector plays a critical role in mediating funds between households and the nonfinancial sector (Van den Heuvel, 2008; Jaccard, 2024; Peiris et al., 2024). In our model, similar to Goodfriend and McCallum (2007), we posit that banks are equipped with a technology that allows for the creation of credit using deposits as input. This process is represented by a linear production function that correlates the quantity of loans extended to the nonfinancial sector with the quantity of deposits gathered at the start of the period.

The sequence of events in our banking model is as follows: At the onset of the period, banks receive deposits from households, denoted as a real quantity of deposit $d_t = D_t/P_t$. Subsequently, these deposits are used to provide loans to firms, represented by the loan quantity $l_t = L_t/P_t$. As the period progresses, banks collect the sum $(1 + i_{L,t})(1 - \delta_t)L_t/P_t$ from firms, which includes the principal and interest on the loans less the fraction that is defaulted upon. Before the period concludes, banks repay the households' deposits with interest, totaling $(1 + i_{D,t})D_t/P_t$.

When the AMC is operational it purchases loans from banks after they have been extended paying a price of $(1+i_{L,t})(1-\bar{\delta})L_t/P_t$ (while firms pay $(1+i_{L,t})(1-\bar{\delta})L_t/P_t$). As we assume banks are obliged to sell to the AMC, this means that banks take the default rate offered by the AMC (as well as the interest rate) as given when loans are extended. Our approach simplifies the analysis by assuming that both the lending and deposit transactions occur within the same period (as opposed to the intertemporal loan and deposit contracts of Peiris et al. (2024)), thereby streamlining the understanding of banking operations and their impact on the economic system. The lending constraint faced by banks is

$$l_t = \eta d_t,$$

while the profit function of banks is given by

$$\Pi_{b,t} = l_t(1 - \delta_t)(1 + i_{L,t}) - d_t(1 + i_{D,t}) - l_t + d_t \tag{28}$$

$$= \eta d_t((1 - \delta_t)(1 + i_{L,t}) - 1) - d_t i_{D,t}. \tag{29}$$

The optimality condition is given by

$$i_{L,t} = \frac{\frac{1}{\eta} i_{D,t} + 1}{(1 - \delta_t)} - 1. \tag{30}$$

Monetary and Fiscal Policy

The money supply rule is

$$\gamma M_{t+1} = \gamma \bar{M} + \rho_M(M_t - \bar{M}) - \phi_\pi(P_t - \bar{P}) + \epsilon_{M_t} \tag{31}$$

where ϵ_{M_t} is a shock with mean 0 and standard deviation σ_M. Fiscal Policy is given by the net (seigniorage) transfer

$$tr_t = \gamma \frac{M_{t+1}}{P_t} - \frac{M_t}{P_t} + \frac{1}{1 + i_{B_t}} \gamma \frac{B_{t+1}}{P_t} - \frac{B_t}{P_t}. \tag{32}$$

This is also the unified monetary-fiscal authority budget constraint. Note that unfunded monetary transfers raise the price level (cf. Fiscal Theory of the Price Level).

Aggregate Resource Constraint

Output is distributed between consumption, investment, and the cost of default

$$c_t + x_t + \frac{\Omega}{1+\psi}[\delta_t l_t (1 + i_{L,t})]^{1+\psi} = y_t. \tag{33}$$

Market clearing demands that the supply of deposits by households equals the demand by banks. The supply of loans by banks equals the demand by firms. The supply of labor by households equals the demand by firms, and the supply of money and bonds by the monetary-fiscal authority equals the demand by households (and potentially the AMC). All agents and institutions are price takers and expectations are rational.

Asset Management Company

AMC buy the loan from banks, receiving the payment from firms (the gross interest rate times the repayment rate), and paying a price equal to the the gross interest rate times the steady state repayment rate. This transaction is equivalent to AMCs subsidizing the return to lenders by increasing the fraction of delinquent loans to the steady state value. The expdnditure of the

AMC is given by $M_t^{AMC} = L_t((1-\bar{\delta}) - (1-\delta_t))(1+i_{L,t})$. That is, the AMC guarantees that the default rate on the loans extended by lenders is at the steady state level. When the default rate incurred by borrowers is above (below) the steady state, the AMC is in deficit (surplus).

In practice, during economic downturns, AMCs often buy Non-Performing Loans (NPLs) at a price higher than the market value, thereby decreasing the banks' Loss Given Default (LGD). In our model, for simplicity, we assume that the AMC reduces the Probability of Default (PD) of the bank's assets, meaning the likelihood of assets turning into NPLs, instead of reducing the LGD. This represents a different conceptual approach to diminishing the banks' overall losses, but the economic effect is similar. The crucial aspect for assessing the health of a bank's balance sheet and its capacity to provide loans to the economy is its overall Expected Loss (EL), which is calculated as PD multiplied by LGD.

We will consider two funding structures that allow us to focus on the role of the AMC affecting the default margin,rather than liquidity affecting the interest rate margin. The "Fiscal-Neutral" structure will be where the a policy that does not affect the total quantity of money. This means that the expenditure of the AMC is funded entirely by lump-sum transfers from households in the same period. The second funding structure we call "Liquidity-Neutral". Here, the AMC is funded by debt issued to the Central Bank. However the total liquidty in the economy grows according to pre-specified rules so that the additional liquidity demand by the AMC crowds out the liquidity demand of households for deposits.

The AMC presented in the model here is an abstraction, but nevertheless follows closely the economic logic that underpinned NAMA in Ireland. That agency was endowed with unfunded (unissued) Government bonds and lightly capitalised in the public-private partnership. This implied that NAMA remained off the state balance sheet from an accounting perspective, being only a contingent liability to the state in the case it could not repay those bonds. The bonds were used by NAMA to 'purchase' selected assets from participating banks. Those bonds were, in turn, used by the banks as collateral in central bank refinancing operations, thereby relieving those banks of their liquidity constraints (that stemmed in part from a scarcity of eligible collateral they could borrow against at the central bank). NAMA purchased assets from banks at so-called real economic value, on the basis that contemporaneous market conditions undervalued that assets, and that with appropriate management, the passage of time, and the avoidance of firesale conditions, higher asset values could be achieved in future. This is a fundamental principle of asset management companies.

3.1 Quantitative Results

Calibration

We have adopted the calibration method of Jaccard (2024) for the Eurozone using data from the mid to late 1990s to 2018. The deterministic growth rate of the economy is determined using annual data on population growth from 1960 onwards. During the period from 1960 to 2018, the average annual population growth rate for the countries now in the Eurozone was 0.45%, leading to a quarterly growth rate (γ) of 1.00112. In the production function for the final output good, we set the capital share parameter (α) at one-third, implying a labor share of two-thirds. The curvature parameter (σ) is set at 1. The first labor supply parameter (ψ) is calibrated so that in a stable state, individuals allocate approximately 20% of their time to work-related activities, equating to a value of 0.2 for n. Finally, the curvature parameter (ν) is selected to reflect a Frisch elasticity of labor supply around 0.7. The steady state money supply $\bar{M}$ is set to 1 given the long-run neutrality of the level of money supply in the model. The default rate on loans each quarter is set to 5%.

Table 1: **Parameters Calibrated to Match Moments**

β	μ	ϕ_π	η	ϵ	τ	σ_a	ρ_a	σ_M	ρ_M
0.991	0.92	2.1	0.52	0.2	.011	0.0069	0.978	0.0228	0.6

Note: Parameters in this table are chosen to match the moments in the table below. β,μ,ϕ_π,η,ϵ, and δ are the discount factor, credit constraint, coefficient of inflation in the Monetary rule, intermediation efficiency, elasticity of the investment cost and depreciation rate respectively. σ_a, ρ_a, σ_M, and ρ_M are the standard deviation and autoregressive coefficient of the TFP and monetary shocks respectively. Although we have less parameters than Jaccard (2024), keep the values of the common parameters except for ϵ, the elasticity of investment which is significantly smaller.

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

	Data		Model
	95% Confidence Interval	Jaccard (2024)	Simulated Moments (2nd Order)
$std(g_y)$	[1.6, 2.1]	1.8	1.8
$std(g_c)$	[0.9, 1.2]	0.9	1.3
$std(g_x)$	[5.0, 6.6]	5.6	5.4
$std(g_M)$	[2.8, 3.8]	3.3	2.8
$std(g_D)$	[1.8, 2.4]	2.0	2.8
$std(g_P)$	[0.8, 1.1]	0.9	0.9
$std(i_D)$	[1.8, 2.4]	2.5	1.8
$E(i_D)$	[2.1, 2.6]	2.4	3.8
$E(i_L^* - i_D)$	[2.2, 2.4]	2.3	2.3
$E(l/y)$	[0.88, 0.95]	0.91	086
$E(x/y)$	[0.21, 0.22]	0.21	0.17

Note: The moments in Jaccard (2024) are for the 3rd order approximation however are identical at the 2nd order. g_y, g_c, g_x, g_M, g_D, g_P are the growth rates of output, consumption, investment, money supply, deposits, and price levels between the current qurter and 4 quarters prior (year on year growth rates). i_D is the annualized quarterly deposit rate, while i_L^* is the annualized quarterly loan rate after default (i.e. the net of default loan rate). l/y is the ratio of real loans to output and x/y is the ratio of investment to output.

Simulation and Results

We compare two alternate funding regimes for the AMC. In the first, the expenditure of the AMC is financed entirely through lump-sum fiscal transfers (immediately) and is so neutral on the fiscal balance. We call this the Fiscal-Neutral regime. The second regime is where the expenditure of the AMC is financed through borrowing from the central bank, but without expanding total money supply. In this regime, which we call the Liquidity-Neutral the expenditure of the AMC crowds out the liquidity used for the deposit/loan market.

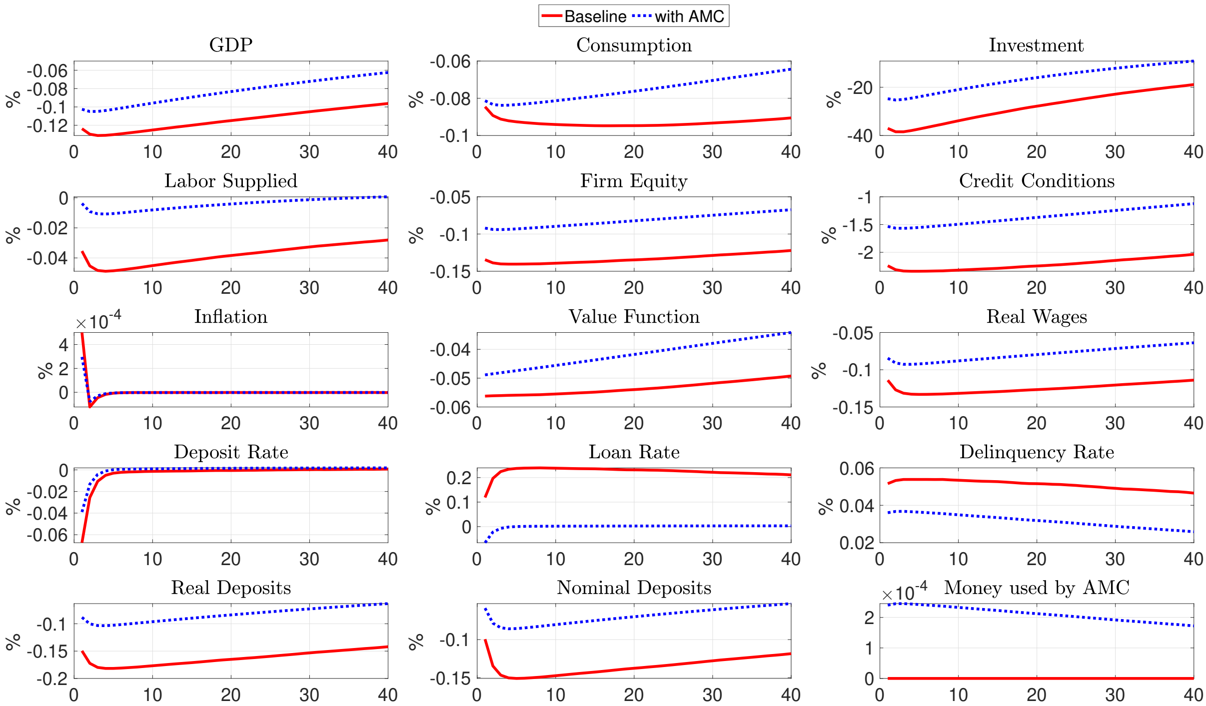

Figure 1: IRFs to a 1% negative TFP shock for the Fiscal-Neutral regime.

The funding structures described in Figures 1 and 3 (in the Appendix) lead to almost identical economic outcomes. The expenditure by the AMC supports the net of default return of intermediaries who then pass on the higher rate to depositors. The higher deposit rate increases the supply of deposits and loosens the credit constraint of firms leading to higher investment, output, and profits. The latter improves the value of firm equity which, in turn, improves credit conditions and causes higher repayment rates. This then reinforces the improved return to financial intermediaries who can lower the rate that they lend to firms and further increase the return to depositors.

In our model, the creation of an Asset Management Company (AMC) does not directly reduce delinquency rates. Instead, it effectively lowers the default rate banks face through the AMC's support. In reality lower delinquency rates are achieved by purchasing non-performing assets from banks, often at a premium. This action reduces the banks' delinquency rates, which in turn helps to sustain depositor confidence. The increase in real deposits in our model is consistent with the observed behavior of deposits under NAMA. Relieved from the weight of non-performing loans, banks may increase deposit rates to attract more depositors. Moreover, having cleaner balance sheets and relieved from the burden of bad loans, banks are in a better position to issue new credit, a change that aligns with the increase in loan rates observed in our model. Thus, while our model's AMC may not mirror the exact asset purchasing dynamics and pricing strategies of NAMA, the impacts on these key financial variables remain consistent and realistic.

Welfare

We present conditional and unconditional welfare differences with the AMC under the Fiscal-Neutral regime (the results with the Liquidity-Neutral Regime are similar). The results are under both TFP and Monetary shocks using the parameterizations for the shocks described in Section 4. Unconditional welfare is the ergodic mean of the simulation under the second-order Taylor series appriximation of the economy. Conditional welfare is the welfare of the economy at the deterministic steady state (Schmitt-Grohe and Uribe, 2004; Born and Pfeifer, 2020). This welfare measure considers the economy's position at a given starting point and assesses it using a second-order Taylor approximation around the deterministic steady state. Our primary welfare metric evaluates households' welfare when they anticipate future shocks from this steady state. This assessment requires estimates of policy functions and shock parameters. Table 3 presents the changes in both measures of welfare. Under both welfare measures, the AMC is welfare improving. Importantly, this is not conditional on a negative shock. This means that the AMC is providing lower prices for loans (higher default rates) to banks during booms as well as the opposite during downturns.

Table 3: **Welfare with Fiscal-Neutral AMC minus Baseline**

	Unconditional	Conditional
Monetary and TFP Shock	6.2	2.4

Note: Welfare is calculated at the steady state by simulating the economy using a second-order Taylor series approximation and taking the welfare value with the AMC under the Fiscal-Neutral funding structure and subtracting the baseline. The conditional weflare conditions on the deterministic steady state. The economy is subject to both shocks that are parameterized according to the calibrated values.

4 New Keneysian Small Open Economy Model

We now present a Small Open Economy New Keynesian extension of the model presented in Section 3 calibrated to the Irish economy. The Firms in the closed economy are now labelled "Wholesale Firms". They produce using capital and labor as before, but produce $y_{w,t}$ and sell their goods to "Intermediate Goods Producers" at a price of $P_{w,t}$. In turn, intermediate goods producers then sell their unique output to "Retail Firms" at a nominal price with a markup over the wholesale firms' price. Retail firms produce a homogeneous composite non-tradable final good of quantity y_t sold at nominal price P_t. The economy takes international goods prices, interest rates, and the monetary policy rule as given. Variables and constraints that are identical in Section 3 are not explicitly mentioned here but are present in the dynamic equations that represent the economy. Banks are now endowed with equity $e_{b,t}$ from households according to a rule based on profits, and also have (unmodelled) foreign assets that yield NFA_t in foreign currency terms. The AMC and its possible funding structures are as before.

Households

Households now choose between consuming domestically produced non-tradable (final) goods c_t and foreign produced (tradable) goods c_t^*. The nominal price of foreign goods is P_t^* and the nominal exchange rate is Q_t. They can also purchase internationally traded bonds B_{t+1}^* at foreign net interest cost of $i_{B_t^*}$. They are also endowed with an exportable (non-consumable) good of quantity y_t^* which is worth $\frac{Q_t P_{y_t^*}^*}{P_t}$ in domestic non-tradable terms. Households now inject equity of $e_{b,t}$ into the banks each period according to a rule based on profits.

$$c_t + \frac{Q_t P_t^*}{P_t} c_t^* + x_t + \gamma \frac{M_{t+1}}{P_t} + \frac{1}{1+i_{B_t}} \gamma \frac{B_{t+1}}{P_t} + \frac{Q_t}{1+i_{B_t^*}} \gamma \frac{B_{t+1}}{P_t} + adj_t$$
$$= \Pi_{T_t} + tr_t + r_{K_t} k_t + w_t n_t + i_{D_t} \frac{D_t}{P_t} + \frac{M_t}{P_t} + \frac{B_t}{P_t} + \frac{Q_t B_t^*}{P_t} + \frac{Q_t P_{y_t^*}^*}{P_t} y_t^*. \tag{34}$$

$adj_t = \frac{paraadj}{2}(\frac{Q_t/P_t}{1+i_{B_t^*}} B_{t+1}^* - \frac{\bar{Q}/\bar{P}_t}{1+\bar{i}_{B^*}} \bar{B}^*)^2$ is a quadratic adjustment cost on foreign assets around the steady state value and represents the additional cost of trading international bonds with $paraadj$ a parameter.[11] $\frac{Q_t P_t^*}{P_t}$ is the real exchange rate.

Households value the consumption bundle $C_t = [\phi_c^{1/\nu_c} c_t^{(\nu_c-1)/\nu_c} + (1-\phi_c)^{1/\nu_c} (c_t^*)^{(\nu_c-1)/\nu_c}]^{\nu_c/(\nu_c-1)}$. Utility is $\mathbb{E}_0 \sum_{t=0}^{\infty} \hat{\beta}_t \frac{(C_t^{\kappa}(\psi+z_t^{\nu}))^{1-\sigma}}{1-\sigma}$. The equity investment rule for banks is $e_{b,t} = \rho_{b,e} e_{b,t-1} + = \rho_{b,\Pi_b} \Pi_{b,t-1}$. Note that equity is returned in the same period back to households but they can spend the profits distributed in that period.

Commercial Banking Sector

Banks now receive equity from households each period, $e_{b,t}$, $l_t = \eta d_t, + e_{b,t}$. In addition we assume that banks have (unmodeled) assets abroad which yield a revenue of $\frac{Q_t}{P_t} NFA_t$ each period. The profit function of banks is given by

$$\Pi_{b,t} = l_t(1-\delta_t)(1+i_{L,t}) - d_t(1+i_{D,t}) - l_t + d_t + \frac{Q_t}{P_t} NFA_t + e_{b,t} \tag{35}$$

Intermediate goods producers

Each intermediate Goods Producer k acts in a monopolistically competitive market produce a differentiated intermediate good using wholesale goods according to $y_t(k) = y_t^w(k)$. Hence, they solve: $\min_{y_t(k)} \frac{P_{w,t}}{P_t} y_t(k) + \lambda_t^{ret}(y_t(k) - y_t^w(k))$. Intermediate goods producer sets the price $P_t(k)$ by solving $\max_{P_t(k)} V_t^{int} = \lambda_t^h \left[\frac{P_t(k)}{P_t} c_t(k) - \lambda_t^{ret} c_t(k)\right] + \beta_t \theta_{ps} \mathbb{E}_t V_{t+1}^{int}$ s.t. $y_t(k) = (\frac{P_t(k)}{P_t})^{-\theta_c} y_t$. The solution to this problem is given by $\lambda_t^h \left[(1-\theta_c)\frac{\hat{P}_t(k)}{P_t} + \lambda_t^{ret}\theta_c\right] (\frac{\hat{P}_t(k)}{P_t})^{-\theta_c} \left(\frac{1}{\hat{P}_t(k)}\right) y_t + E_t \sum_{i=1}^{\infty} (\beta_{t+i-1}\theta_{ps})^i \lambda_{t+i}^h \left[(1-\theta_c)\frac{\hat{P}_t(k)}{P_{t+i}} + \lambda_{t+i}^{ret}\theta_c\right] (\frac{\hat{P}_t(k)}{P_{t+i}})^{-\theta_c} \left(\frac{1}{\hat{P}_t(k)}\right) Y_{t+i}^{ret} = 0$. It can be shown that $(1+\pi_t)^{1-\theta_c} = (1-\theta_{ps})(1+\pi_t^*)^{1-\theta_c} + \theta_{ps}$ where π_t is the inflation rate on domestically produced

[11] They also are important to ensure convergence to the steady state.

final goods and $y_t = y^w_t / v^p_t$. Price persistence v^p_t is defined as $v^p_t = (1-\theta_{ps})(\frac{1+\pi_t}{1+\pi^*_t})^{\theta_c} + \theta_{ps}(1+\pi_t)^{\theta_c} v^p_{t-1}$.

Retailers

Retail firms create a composite final good using as inputs goods purchased from intermediate goods producers that is then demanded by households, the government and capital producers, and is given by $y_t = \left(\int_0^1 y_t(k)^{(\theta_c-1)/\theta_c} dk\right)^{\frac{\theta_c}{(\theta_c-1)}}$. The demand for the individual good k is given by $y_t(k) = (\frac{P_t(k)}{P_t})^{-\theta_c} y_t$, where y_t is the bundle of domestically-priced final goods consumed by agents.

Monetary and Fiscal Policy

The money supply rule is now constant and reflects that the small open economy assumption and that the European Central Bank (ECB) decision on the quantity of money is independent of the demand for money in Ireland ($\gamma M_{t+1} = \gamma \bar{M} + \epsilon_{M_t}$). Note that the foreign interest rate is interpreted as the ECB's policy rate and there is convergence to that rate through capital flows. The seigniorage transfer still depends on the issuance of domestic bonds and reflects additional liquidity from the ECB through government debt issuance.

Aggregate Resource Constraint and Balance of Payments

The aggregate resource constraint for non-tradable final goods now includes the adjustment cost on external debt:

$$c_t + x_t + adj_t + \frac{\Omega}{1+\psi}[\delta_t l_t(1+i_{L,t})]^{1+\psi} = y_t. \tag{36}$$

The balance of payments is

$$\frac{Q_t}{1+i_{B^*_t}} \gamma \frac{B_{t+1}}{P_t} - \frac{Q_t B^*_t}{P_t} + \frac{Q_t}{P_t} NFA_t = \frac{Q_t P^*_t}{P_t} c^*_t - \frac{Q_t P^*_{y^*_t}}{P_t} y^*_t \tag{37}$$

Data and Calibration

We calibrate to the Irish economy. Our data is drawn from two sources. For output, consumption, investment and the price level, we use series from the Central Statistics Office.[12] Other series are drawn from the Central Bank of Ireland, including money supply, deposits, the monetary policy rate, and the intermediation spread. M1 money supply; total deposits of Irish households, amounts outstanding; for the monetary policy rate, the three-month EURIBOR rate; and for the intermediation spread, the difference between the rate of new loans to nonfinancial corporations of less than one year's duration and the three-month EURIBOR rate. The loan-to-deposit ratio is calculated from Bank for International Settlements data on credit from all sectors to non-financial corporations.

The population growth rate is 2% per annum. The coefficient of relative risk aversion is still 1, household time spent working is still 20% and the Frisch elasticity of labor is 0.8. The default rate on loans each quarter is set to 10%.

The steady state value of TFP is now 10. The ratio of the endowment of exports to imported consumption is set to 1.7., exports to GDP is 0.6, and Net International Investment Position to GDP (which is composed of the foreign bonds plus the foreign assets of banks) is 0.3. The moments that we match are in Table 5. The adjustment cost on external debt is at 1%, the ratio of exports to imports is 1.7, the ratio of exports to GDP is 0.6, Net International Investment Position to GDP is set to 30% and the steady state capital adequacy ratio is set at 10%.

Table 4: **Parameters Calibrated to Match Moments**

β	μ	η	ϵ	τ	ν_c	ϕ_c	σ_a	ρ_a	σ_M	ρ_M
0.991	0.92	0.75	0.2	.011	0.5	0.5	0.008	0.978	0.01	0.6

Note: Parameters in this table are chosen to match the moments in the table below. β,μ,ϕ_π,η,ϵ, and δ are the discount factor, credit constraint, coefficient of inflation in the Monetary rule, intermediation efficiency, elasticity of the investment cost and depreciation rate respectively. σ_a, ρ_a, σ_M, and ρ_M are the standard deviation and autoregressive coefficient of the TFP and monetary shocks respectively. Although we have less parameters than Jaccard (2024), keep the values of the common parameters except for ϵ, the elasticity of investment which is significantly smaller.

[12]For output, GDP at current prices; for consumption, final consumption expenditure at current prices; for investment, gross domestic fixed capital formation; and for the price level, the harmonised index of consumer prices.

Table 5: **Moments: Model vs Data**

	Data		Model
	95% Confidence Interval	Irish Data	Simulated Moments (2nd Order)
$std(g_y)$	[3.0, 3.9]	3.4	3.7
$std(g_c)$	[2.3, 3.1]	2.6	3.6
$std(g_x)$	[13.8, 18.0]	15.7	10.4
$std(g_d)$	[2.0, 2.7]	2.2	8.0
$std(i_D)$	[1.8, 2.4]	2.5	4.7
$E(i_D)$	[2.1, 2.6]	2.4	5.3
$E(i_L - i_D)$	[2.62, 2.64]	2.6	1.7
$E(l/y)$	[.89, 108]	0.99	0.66
$E(x/y)$	[0.34, 0.36]	0.35	0.16

Note: g_y, g_c, g_x, g_M, g_d, g_P are the growth rates of output, consumption, investment, money supply, real deposits, and price levels between the current qurter and 4 quarters prior (year on year growth rates). i_D is the annualized quarterly deposit rate, while i_L^* is the annualized quarterly loan rate after default (i.e. the net of default loan rate). l/y is the ratio of real loans to output and x/y is the ratio of investment to output.

Simulation, Results, and Welfare

The IRF for a one standard deviation shock to TFP is presented in Figure 2 For the Fiscal-Neutral regime. The results are similar to that of the closed economy. Following the TFP shock, the real exchange rate starts to depreciate and the fall in deposits/savings is compensated by capital inflow. The lower profits of the wholesale firm results in a deterioration of credit conditions and an increase in the delinquency rate. The AMC here is pricing the loans at a delinquency rate that is the average of the steady state and the default rate of the firms (in the closed economy case it was only the steady state default rate).[13] As in the closed economy, the AMC lowers the loan rate and stimulates deposits which combine to lower the default rate of firms. In equilibrium, the AMC is so effective that it drives default rates below steady state values and thereby making a profit.

The welfare results in Table 6 are also similar to the closed economy. However the increase in the unconditional welfare is of orders of magnitude larger than the conditional case. This

[13] The change is only to satisfy Blanchard-Kahn conditions.

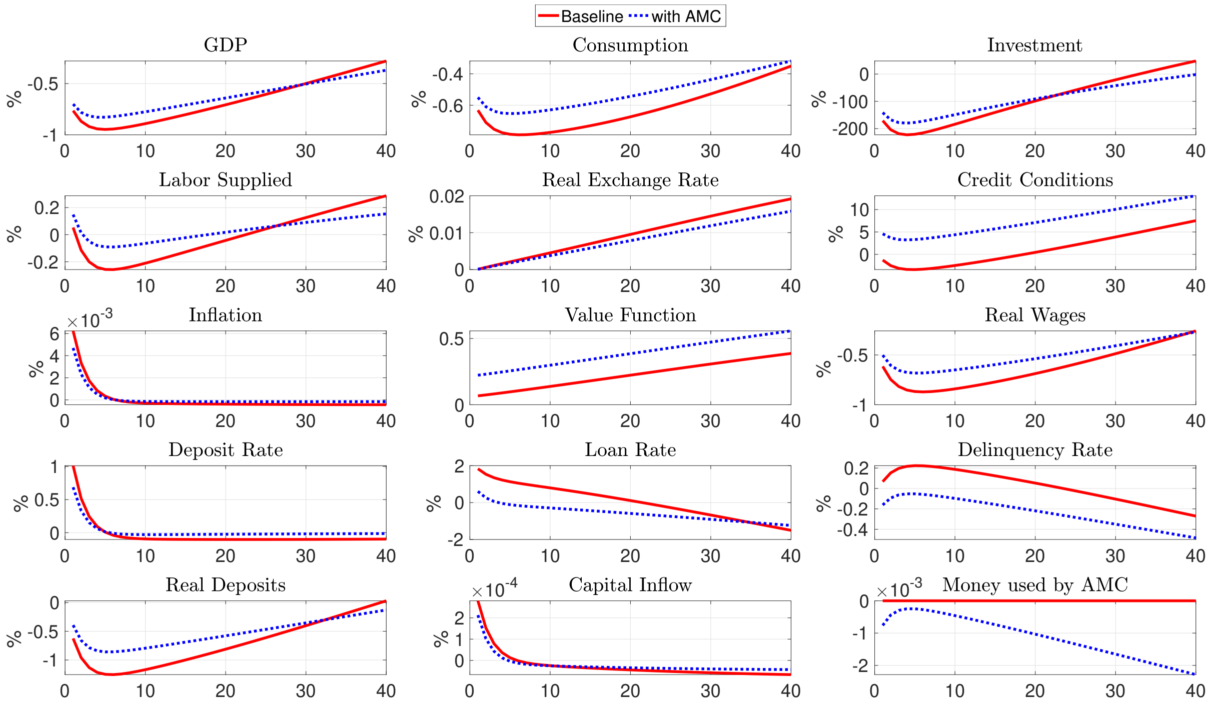

Figure 2: SOE IRFs to a 1% negative TFP shock for the Fiscal-Neutral regime.

reflects how the funding of the AMC is countercyclical due to the extent to which it moves the equilibrium delinquency rate. This countercyclical funding policy has state contingent welfare effects that are strongly positive on average, but more weakly positive in expectation.

Table 6: **Welfare with Fiscal-Neutral AMC minus Baseline**

	Unconditional	Conditional
Monetary and TFP Shock	2087.6	0.3

Note: Welfare is calculated at the steady state by simulating the economy using a second-order Taylor series approximation and taking the welfare value with the AMC under the Fiscal-Neutral funding structure and subtracting the baseline. The conditional weflare conditions on the deterministic steady state. The economy is subject to both shocks that are parameterized according to the calibrated values.

5 Conclusion

In the context of again-heightened concerns for rising NPLs in Europe and beyond due to Covid-19, post-pandemic economic perturbations, and the consequences of conflict in Europe, AMCs have taken on a renewed relevance. We set out to address the need for empirical analysis of the potential for AMCs to mitigate the economic consequences of downturns that result in high NPL stocks. In particular, high NPL stocks can impact the bank lending channel and disrupt investment. An important aspect in understanding the functioning of AMCs concerns welfare; that is, should moral hazard and adverse selection predominate in impaired asset resolution, or is there a role for a welfare-based, general equilibrium perspective?

Many eurozone countries experienced a major surge in non-performing loans (NPLs) during the last decade, the stock of which peaked in 2015. By means of a combination of relatively robust economic growth, increased supervisory pressure and more advanced NPL resolution approaches such as securitizations, the situation was brought under control in the years after 2015, but the risk of a renewed increase in NPLs in the eurozone remains present. When the Covid-19 pandemic started in early 2020, the potential impact of the Covid-induced deep recession on asset quality soon became a major concern. A combination of supervisory forebearance, accomodative monetary policy and expansionary fiscal policy prevented the re-emergence of high NPL ratios. Going forward, however, it is doubtful, whether such policy measures remain possible. In particular, the fiscal space in many European countries has become rather limited.

This paper thus addresses the question whether an institutional arrangement, in the form of an Asset Management Company (AMC), can be used to manage NPLs without having to take recourse to expansionary fiscal of monetary policy. We have shown that an AMC can positively impact welfare by increasing the supply of loanable funds, improving firm balance sheets, and stimulating capital investment.

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6 Appendix

Dynamic Equations

$$\kappa c_t^{\kappa-1}(\psi + z_t^{\nu})(c_t^{\kappa}(\psi + z^{\nu}))^{-\sigma} = \lambda_t \tag{38}$$

$$c_t \frac{\nu z_t^{\nu-1}}{\kappa(\psi + z_t^{\nu})} = w_t \tag{39}$$

$$1 = q_t \theta_1 (\frac{x_t}{k_t})^{-\epsilon} \tag{40}$$

$$\begin{aligned} \lambda_t q_t = {} & \mathbb{E}_t \beta \lambda_{t+1} r_{K_{t+1}} \\ & + \mathbb{E}_t \beta \lambda_{t+1} q_{t+1} \left[(1-\delta) + \frac{\theta_1}{1-\epsilon} (\frac{x_t}{k_t})^{1-\epsilon} + \theta_2 - \theta_1 (\frac{x_t}{k_t})^{1-\epsilon} \right] \end{aligned} \tag{41}$$

$$\lambda_t \frac{1}{P_t} \frac{1}{1 + i_{B_t}} = \mathbb{E}_t \beta \lambda_{t+1} \frac{1}{P_{t+1}} \tag{42}$$

$$\lambda_t \frac{1 - i_{D_t}}{P_t} = \mathbb{E}_t \beta \lambda_{t+1} \frac{1}{P_{t+1}} \tag{43}$$

$$\gamma k_{t+1} = (1-\delta) k_t + (\frac{\theta_1}{1-\epsilon} (\frac{x_t}{k_t})^{1-\epsilon} + \theta_2) k_t \tag{44}$$

$$l_t = \eta d_t \tag{45}$$

$$i_{L,t} = \frac{\frac{1}{\eta} i_{D,t} + 1}{(1 - \delta_t)} - 1 \tag{46}$$

$$y_t = a_t k_t^{\alpha} n_t^{1-\alpha} \tag{47}$$

$$r_{K,t} = \frac{\alpha \frac{y_t}{k_t}}{1 + \mu i_{L,t}} \tag{48}$$

$$w_t = \frac{(1-\alpha) \frac{y_t}{n_t}}{1 + \mu i_{L,t}} \tag{49}$$

$$\Omega_t = \bar{\Omega} (\frac{N_t}{\bar{N}})^{\phi} \tag{50}$$

$$\frac{\Omega}{\delta_t} [\delta_t l_t (1 + i_{L,t})]^{1+\psi} = l_t (1 + i_{L,t}) \tag{51}$$

$$l_t = \mu \frac{y_t}{1 + \mu i_{L,t}} \tag{52}$$

$$\gamma M_{t+1} = \gamma \bar{M} + \rho_M (M_t - \bar{M}) - \phi_{\pi} (P_t - \bar{P}) + \epsilon_{M_t} \tag{53}$$

$$log a_t = \rho_a log a_{t-1} + \epsilon_a \tag{54}$$

$$c_t + x_t + \frac{\Omega}{1 + \psi} [\delta_t l_t (1 + i_{L,t})]^{1+\psi} = y_t \tag{55}$$

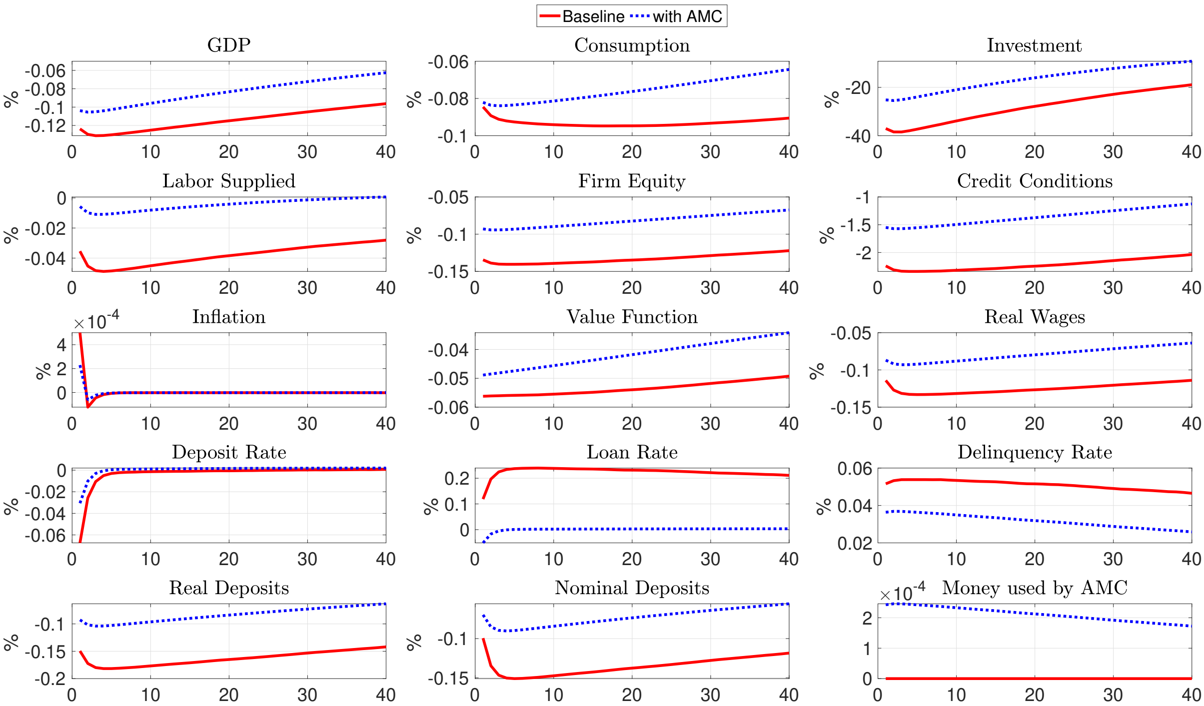

Figure 3: IRFs to a 1% negative TFP shock for the Liquidity-Neutral regime.