Monetary Policy and Financial Stability*

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Abstract

How should monetary policy respond to deteriorating financial conditions? We develop and estimate a dynamic new Keynesian model with financial intermediaries and sticky long-term corporate leverage to show that active response to movements in credit conditions helps to mitigate losses in aggregate consumption and output associated with macro fluctuations. A (credible) monetary policy rule that includes credit spreads is thus welfare-improving, sometimes even obviating the need for explicit inflation targeting.

Keywords: Credit spreads, monetary policy rules, financial stability

JEL Codes: E12, E43, E44, E52, G32

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1 Introduction

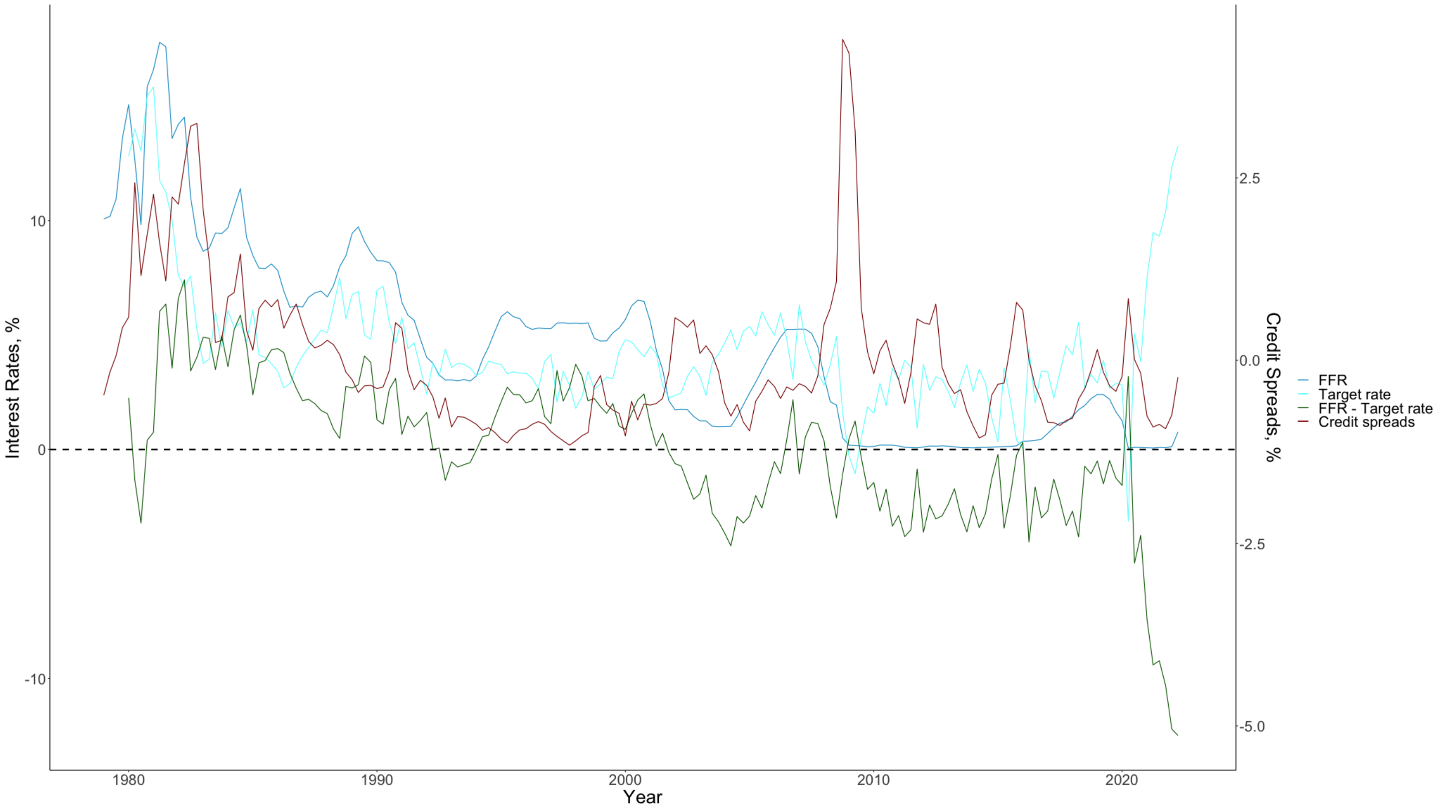
Monetary policy during the recoveries that followed the 2008 and 2020 recessions was extremely restrained. Despite evidence of rising economic growth and inflation expectations, Central Banks increased interest rates only reluctantly and very slowly. Concerns about financial stress and the possible consequences of sharp increases in the interest rate on defaults and financial stability more generally were often mentioned as a possible justification.

As is well known, the behavior of central banks around the globe, including the US Federal Reserve, can be reasonably approximated by a Taylor rule (Taylor (1993)) linking policy rates to inflation and the output gap: when either of these is high, interest rates often will (and should) raise. As the rise in inflation in 2021-22 amply demonstrates, Central banks, however, do not follow this rule precisely. Notably, as Figure 1 shows, deviations from the Taylor rule in the US have become consistently negative since 2008. More significantly, they have also become more correlated with variables such as corporate credit spreads, suggesting that the Fed has indeed become much less willing to target inflation when financial markets are in distress, instead focusing on addressing the financial shocks (Haddad, Moreira, and Muir (2021).

In this paper, we investigate whether these general concerns about financial resilience should have any impact on how monetary policy might respond to inflation and output data. To do this, we develop a computable dynamic general equilibrium model that combines financial frictions with wage and price rigidities to study how monetary policy should respond to financial market conditions and, specifically, credit spreads. Our financial frictions take the form of defaultable long-term nominal corporate debt. As Gomes, Jermann, and Schmid (2016) show, introducing long-term nominal debt in general equilibrium monetary models greatly enhances the impact of a deterioration in financial market conditions on real variables by generating an endogenous overhang effect.

Our key results imply that a monetary policy rule that credibly responds to, and seeks to stabilize fluctuations in credit spreads is generally welfare-improving. Specifi-

Figure 1: Deviations from Taylor Rule and Credit Spreads



Note: This figure plots deviations from Taylor rule of the Fed and demeaned corporate credit spreads. Dark blue line corresponds to actual Federal Funds rate, light blue line – to FFR according to Taylor rule, green line – to deviations of actual FFR from its target, and red line – to Baa-Aaa corporate credit spreads. Taylor rule is estimated using iterative GMM following Clarida, Gali, and Gertler (2000). The data are downloaded from St. Louis Fed FRED database.

cally, including credit spreads is welfare-improving and even obviates the need for explicit inflation targeting when addressing TFP, corporate default, or intermediation shocks. Targeting corporate spreads dominates more aggressive output gap targeting when mitigating consequences of corporate default and banking shocks.

To perform a detailed quantitative analysis of our model we first estimate its key parameters using state-of-the-art Bayesian methods.[1] These parameters include the average debt maturity, the cost of default and the sensitivity of credit prices to leverage, as well as the persistence and volatility of shocks to productivity and firm default rates.

To build some intuition about the workings of our model economy, we next illustrate

[1] Other papers that estimate models of leverage and spreads are Graham (2000); Korteweg (2010); Whited and Zhao (2021)

how the quantitative model economy would respond to various individual shocks under alternative monetary policy rules: a standard Taylor rule that seeks to stabilize output and inflation and a *a modified Taylor rule* that also includes corporate spreads. The latter mitigates losses in many key variables such as consumption, investment, labor, output and default rates. This is true regardless of whether a recession is triggered by a negative productivity shock, a corporate default shock, or an intermediation shock.

We then conduct a detailed second-order welfare analysis across a wide range of values for the monetary policy weights on the inflation rate, the output gap, and corporate spreads. We show that, when the central bank commits to react to corporate spreads strongly enough, inflation targeting is no longer necessary or even desirable.[2] Again, this is true regardless of whether the economy is buffeted by productivity, default, or intermediation shocks.

Taken together, our results suggest that monetary policy benefits from taking into account indicators of financial market conditions, such as corporate credit spreads, more so when the economy is hit by corporate default shocks.

These findings perhaps align with Ben Bernanke's 2002 remarks that monetary policy rule should ignore asset bubbles and focus on price and output gap stability alone. After 2008, however, most economies throughout the world faced some severe financial stress, suggesting a novel approach to monetary policy was necessary.

We view our paper as primarily a contribution to a new and growing literature on the financial aspects of monetary policy. Naturally, it is also relevant for an even older literature on optimal monetary policy rules (Clarida and Gertler (1999); Woodford (2001); Giannoni and Woodford (2003); Orphanides (2001, 2003); Aoki (2003); Mertens and Williams (2021)). To the best of our knowledge, only a few papers suggest adding financial variables to these rules (Taylor and Williams (2008); Curdia and Woodford (2010)). We, therefore, contribute to the literature on the impact of monetary policy on the real economy (Bernanke and Blinder (1988, 1992);

[2]Formally, the weight on inflation in the policy rule should be set at 1, the lowest value consistent with system stability (Taylor principle).

Kashyap and Stein (2000); Bolton and Freixas (2000); Brunnermeier and Sannikov (2014); Drechsler, Savov, and Schnabl (2017)).

We model defaultable long-term nominal bonds, thus producing high credit spreads and debt overhangs that are necessary for our results. Typical models of financial frictions focus on debt and identify leverage as both a source of and an important mechanism of transmission of economic fluctuations (Kiyotaki and Moore (1997); Carlstrom and Fuerst (1997); Bernanke, Gertler, and Gilchrist (1999); Cooley, Marimon, and Quadrini (2004); Jermann and Quadrini (2012); Gourio (2013); Elenev, Landvoigt, and Van Nieuwerburgh (2021); Nikolov, Schmid, and Steri (2021)).[3] Such models fail to produce debt overhang which is an important source of financial distress (Reinhart and Rogoff (2011); Mian and Sufi (2014); Dobbie and Song (2020)). Our model produces a so-called *sticky leverage* – the debt burden becomes larger as a result of deflation (Gomes, Jermann, and Schmid (2016)) which allows us to produce counter-cyclical (Krishnamurthy and Muir (2017)) and high (Chen (2010); Bai, Goldstein, and Yang (2020)) corporate spreads.

The rest of the paper is organized as follows. Section 2 sets up a dynamic general equilibrium model. Section 3 describes the solution strategy and overview of the welfare analysis. Section 4 provides details on calibration and Bayesian estimation of the model. Section 5 shows results of the quantitative analysis and welfare implications. Section 6 concludes.

2 Model

In this section, we develop a medium-scale dynamic general equilibrium framework that integrates price rigidities, long-term nominal debt contracts, and financial intermediaries. The model has several types of agents: households, labor unions, banks, final goods and

[3] Several papers that model nominal debt are Doepke and Schneider (2006); Fernández-Villaverde (2010); Bhamra, Fisher, and Kuehn (2011); Fiore, Teles, and Tristani (2011); Gârleanu, Panageas, and Yu (2015); Gomes and Schmid (2021).

intermediate goods producing firms, and a monetary policy authority. We discuss each of them in turn.

2.1 Households

There are a continuum of households, indexed by $i \in [0,1]$, that choose consumption, $C_{i,t}$, hours worked, $N_{i,t}$, and bank deposits, $D_{i,t}$ to maximize their lifetime utility function:

$$U = \mathbb{E}_t \left[\sum_{s=0}^{\infty} \beta^s \left(\frac{(C_{i,t+s})^{1-\kappa} - 1}{1-\kappa} - \zeta_n \frac{(N_{i,t+s})^{1+\theta}}{1+\theta} \right) \right] \tag{1}$$

where β is the intertemporal discount factor, $1/\kappa$ is the intertemporal elasticity of substitution for consumption, $1/\theta$ is the intertemporal elasticity of substitution for labor, and ζ_n is a labor disutility parameter.

The per-period budget constraint for each agent i is given by

$$P_t C_{i,t} + D_{i,t+1} = W_t N_{i,t} + (1 + R_t) D_{i,t} + T_{i,t} \tag{2}$$

where P_t is the aggregate price level, R_t the nominal interest rate and $T_{i,t}$ summarizes the total net distributions from firms and the government.

The optimal Euler equation for deposits is given by

$$1 = \mathrm{E}_t M_{t,t+1} \frac{1 + R_{t+1}}{1 + \pi_{t+1}} \tag{3}$$

where $M_{t,t+1} = \beta \left[\frac{C_{t+1}}{C_1} \right]^{-\kappa}$ is the real stochastic discount factor and $\pi_{t+1} = P_{t+1}/P_t - 1$ is the rate of inflation in the economy.

2.2 Labor Unions

Labor unions aggregate the labor choice of households through the Dixit-Stiglitz technology:

$$N_t = \left(\int_0^1 N_t(i)^{1-v_{w,t}} di \right)^{\frac{1}{1-v_{w,t}}} \tag{4}$$

where $v_{w,t}$ is an elasticity parameter. Each individual labor supply then obeys:

$$N_{i,t} = \left(\frac{W_{i,t}}{W_t} \right)^{-1/v_{w,t}} N_t \tag{5}$$

where $W_{i,t}$ is the wage that satisfies household i and W_t is the average wage in the economy. They are linked through the usual Dixit-Stiglitz aggregator:

$$W_t = \left(\int_0^1 W_{i,t}^{\frac{v_{w,t}-1}{v_{w,t}}} di \right)^{\frac{v_{w,t}}{v_{w,t}-1}} \tag{6}$$

We introduce nominal wage stickiness in the manner of Calvo, by assuming unions can change their wage optimally in period t with probability $1 - \gamma_w$. We assume that mark-ups, $\lambda_{w,t} = 1/(1 - v_{w,t})$, are exogenous and follow the AR(1) process:

$$\ln \lambda_{w,t} = (1 - \rho_w)\lambda_w + \rho_w \lambda_{w,t-1} + \sigma_w \epsilon_{w,t} \tag{7}$$

where $\epsilon_{w,t}$ is standard normal. The optimal wage setting process is described in detail in the Appendix.

2.3 Production and Firms

Production of final goods is organized in two separate stages to allows us to combine nominal price rigidities with financial frictions in a highly tractable way. In the first stage, a continuum of perfectly competitive firms, indexed $j \in [0, 1]$, combines capital and labor to produce a common intermediate good, Y^m. In the second stage, the intermediate good is repackaged as a continuum of differentiated goods, Y_r, each sold by a single monopolistic retailer, or final producer, indexed in $r \in [0,1]$.

2.3.1 Retailers

Final goods are aggregated using the Dixit-Stiglitz technology

$$Y_t = \left(\int_0^1 Y_{r,t}^{1-v} dr \right)^{\frac{1}{1-v}} \tag{8}$$

where $1/v$ is an elasticity parameter.

Thus, each individual retailer $r \in [0,1]$ faces the downward slopping demand function

$$Y_{r,t} = \left(\frac{P_{r,t}}{P_t} \right)^{-1/v} Y_t \tag{9}$$

where $P_{r,t}$ is the price for good r and P_t is the average price level in the economy, defined through the usual Dixit-Stiglitz aggregator.

$$P_t = \left(\int_0^1 P_{r,t}^{\frac{v-1}{v}} dr \right)^{\frac{v}{v-1}} \tag{10}$$

We assume each retailer can only change their price optimally in period t with probability $1-\gamma$. For brevity, we omit the (well-known) details about optimal price-setting behavior.

2.3.2 Intermediate goods producers

Each intermediate good j is produced by the monopolist with the following demand schedule

$$Y_{j,t} = A_t K_{j,t}^{\alpha} N_{j,t}^{1-\alpha} \tag{11}$$

where $K_{j,t}$ is the number of capital goods used, $N_{j,t}$ is the labor input, and A_t is an exogenous total productivity that evolves according to the following stationary AR(1) process

$$\ln A_t = \rho^a \ln A_{t-1} + \sigma^a \epsilon_{A,t} \tag{12}$$

where $\epsilon_{A,t}$ is standard normal.

Pre-tax, operating profits for intermediaries can be constructed from solving for optimal labor demand:

$$R_t^k K_{j,t} = \max_{N_{j,t}} A_t K_{j,t}^{\alpha} N_{j,t}^{1-\alpha} - W_t N_{j,t} \tag{13}$$

where $R_t^k = \alpha \frac{Y_t}{K_t}$ is equal across all firms j.

To generate cross-sectional variation in default rates, we assume that operating profits are subject to additive idiosyncratic shocks, $z_{j,t} K_{j,t}$, where $z_{j,t}$ is distributed with c.d.f. $F_t^z(z)$ with mean μ_t^z and standard deviation σ^z. The mean of these shocks is time-varying and follows the AR(1) process

$$\ln \mu_{t+1}^z = \rho^z \ln \mu_t^z + \epsilon_{t+1}^z \tag{14}$$

where ϵ_{t+1}^z is i.i.d Normal. In what follows we use $\Phi^{\mu}(\mu_t)$ to denote the c.d.f. of μ_t.

Intermediate producers accumulate capital through the usual equation:

$$K_{j,t+1} = (1-\delta) K_{j,t} + I_{j,t} \tag{15}$$

so that the gross growth rate of capital is $g_{j,t} = \frac{I_{j,t}}{K_{j,t}} + (1-\delta)$.

Financing for these firms takes place through the issuance of new equity and long-term, defaultable debt with nominal face value $B_{j,t}$ Corporate debt entails payment of a fixed per-period coupon, c, until the stochastic maturity date. Every period, with probability η, the economy is hit by an aggregate liquidity shock that requires that every firms must repay the outstanding debt plus the coupon in the current period.

A firm that does not currently have the resources to repay its debt obligations enters into default. Formally, this is defined implicitly by the equation for a threshold level of firm level productivity, $z_{j,t}^{\star}$:

$$(1-\tau)\left(R_t^k - z_t^{\star}\right) K_{j,t} - (1+(1-\tau)c)\frac{B_{j,t}}{1+\pi_t} + (1-\delta(1-\tau))K_{j,t} + J(K_{j,t+1}, B_{j,t+1}, \mu_t^z) \tag{16}$$

where τ is the (effective) corporate income tax rate and $J(K_{j,t+1}, B_{j,t+1}, \mu_t^z)$ captures the continuation value of the firm which we define more precisely below.

Firms problem is split into two steps. In the first step, firms decide on the default and choose their investments. In the second stage, η is realized and if $\eta = 1$, all firms choose how much debt to issue. If $\eta = 0$, firms do not default. Hence, a firm will default when ${}_{j,t} \geq z_t^\star$:

$$z_t^\star = \eta \cdot \left(R_t^k - \frac{1 + (1-\tau)c}{1-\tau} \frac{b_{j,t}}{1+\pi_t} + \frac{(1 - \delta(1-\tau)) + g_t j(b_{j,t+1}, \mu_t^z)}{1-\tau} \right) + (1-\eta) \cdot 1 \quad (17)$$

where $b_{j,t} = \frac{B_{j,t}}{K_{j,t}}$ is the leverage ratio and $j(b_{t+1}, \mu_t^z) = \frac{J(K_{j,t+1}, B_{j,t+1}, \mu_t^z)}{K_{j,t+1}}$. The probability of default is then given by $F_t^z(z_t^\star)$ and increases in the shock, μ_t^z.

Default triggers a change in ownership, whereby lenders takes over the firm and resells it to a new operator which resumes operations with unchanged capital stock and leverage. We assume that re-structuring entails a one time charge equal to a fraction, $1 - \xi$, of the firm's value, paid by the creditors.

Dropping the index j, and exploiting homogeneity, the problem for each intermediate goods producer can thus be described by the triplet of value functions:

$$v_t = \max_{g_t} \left\{ \eta v_t^1(b_t, z_t, A_t, g_t) + (1-\eta) v_t^0(b_t, z_t, A_t, g_t) \right\} \quad (18)$$

$$v_t^1(b_t, z_t, A_t, g_t) = \max_{b_{t+1}} \left\{ q_t b_{t+1} g_t + (1-\tau)(R_t^k - z_t) + (1-\delta) \right. \quad (19)$$

$$+ \tau\delta - g_t - (1 + (1-\tau)c) \frac{b_t}{1+\pi_t} + \int_{-1}^{z_{t+1}^*} v_{t+1} dz_{t+1}$$

$$v_t^0(b_t, z_t, A_t, g_t) = \left\{ (1-\tau)(R_t^k - z_t) + (1-\delta) + \tau\delta \right. \quad (20)$$

$$- g_t - (1-\tau)c \frac{b_t}{1+\pi_t} + \int_{-1}^{z_{t+1}^*} v_{t+1} dz_{t+1}$$

where $v^1(b_t, \mu_t^z)$ is the value of the firm if it has to repay the debt and $v^0(b_t, \mu_t^z)$ is the value of the firm if the repayment shock is not realized and $q_t^b = q^b(b_{t+1}, \mu_t^z)$ is the (real) price of debt. The first equation is the value of the firm at the beginning of the period.

2.4 Financial Intermediaries

There is a continuum of identical banks, or financial intermediaries, with unit measure. Each representative bank offers one period deposits, d_{t+1} to households at (real) price q_t^d and uses the proceeds to buy a perfectly diversified portfolio of corporate debt issues, b_{t+1}, valued at (real) price q_t^b. Deposits are perfectly insured so that $q_t^d = (1+\pi_{t+1})/(1+R_{t+1})$

At the beginning of every period, we define a bank's (real) net worth as the difference between the market value of its loan portfolio minus the value of its deposit liabilities:

$$nw_t = F_t^z(z_t^\star)[(1-\eta)(c+q_t^b)+\eta(1+c)]\frac{b_t}{(1+\pi_t)} + \eta\int_{z_t^\star}^{\bar{z}} \xi v_t^1 dF_t^z(z_t) - d_t \tag{21}$$

where the second term captures the impact of corporate defaults on the value of the banks assets (loans)

The bank's balance sheet constraint then requires that the market value of net new loan and deposits equals the retained net worth:

$$b_{t+1}q_t - d_{t+1}q_t^d = (1-\phi)nw_t \tag{22}$$

where, for simplicity, we assumed that banks always pay out a constant fraction, ϕ, of their net worth as dividends to their shareholders.

In addition, banks also face a leverage constraint which regulates the amount of risk-weighted deposits that banks can supply:

$$q_t^d d_{t+1} \leq \xi^d q_t b_{t+1} \tag{23}$$

As discussed by Elenev, Landvoigt, and Van Nieuwerburgh (2021), including market values ensures that we capture risk-weights in Basel-type leverage constraint.

Like firms, banks maximize shareholders' value, w, which obeys the Bellman equation

$$w(d_t, b_t, \epsilon_t) = \max_{d_{t+1}, b_{t+1}} \left[\phi \cdot nw_t - z_t^b + \mathbb{E}_t \int M_{t,t+1}\max\{w(d_{t+1}, b_{t+1}, \epsilon_{t+1}), 0\}\right] \tag{24}$$

where z_t^b is an exogenous shock to bank profits that with c.d.f $F_t^b(z^b)$ that has with time-varying mean μ_t^b which follows a stationary AR(1) process:

$$\mu_t^b = \rho_b \mu_{t-1}^b + \sigma_b \epsilon_t^b \tag{25}$$

where ϵ_t^b is standard normal.

Equation (24) captures the fact that banks may also default strategically. In this case we assume the government seizes the bank , fully insures its depositors and resells the franchise to a new operator that resumes operations in the following period.

2.5 Monetary and Fiscal Policy Rules

In our baseline case, monetary policy is described by a standard interest rate feedback, i.e. "Taylor", rule

$$R_t = R_t^{*1-\rho_R} R_{t-1}^{\rho_R} e^{\sigma_M \epsilon_{R,t}} \tag{26}$$

where $\epsilon_{R,t}$ is a standard normal monetary policy shock and $R_t^\star$ is the target rate

$$R_t^\star = r(1+\pi^\star)\left(\frac{1+\pi_t}{1+\pi^\star}\right)^{\psi_1}\left(\frac{Y_t}{Y_t^\star}\right)^{\psi_2} \tag{27}$$

where r is the steady state real interest rate, $\pi^\star$ is the inflation target, and $Y_t^\star$ is the natural aggregate output level.

Fiscal authority consumes a fraction ζ_t of aggregate output, that is $G_t = \zeta_t Y_t$. We assume that $g_t = 1/(1-\zeta_t)$ follows a stationary AR(1) process

$$\ln g_t = (1-\rho_g)\ln g + \rho_g \ln g_{t-1} + \sigma_g \epsilon_{g,t} \tag{28}$$

where $\epsilon_{g,t}$ is standard normal.

2.6 Market clearing

The market clearing conditions are given by the following equations

$$Y_t = C_t + G_t + I_t + (1-\xi)(1-F(z_t^*))(\tau\delta K_t - I_t) \tag{29}$$

$$N_t = n_t \tag{30}$$

3 Model solution

We solve the model by using local perturbation methods.

The solution is significantly complicated by the recursive firm's problem. Specifically, we need to solve for j_t^*, v_t^1, v_t^0, and $\frac{\partial q_t}{\partial b_{t+1}}$. Note that q_{t+1} depends only on b_{t+1} and not b_{t+2}, because debtholders are done with firms once the debt is repaid. Hence, losses take place in the current period and are absorbed by debtholders. Therefore, we only need the expression for the price of the debt derivative to fully characterize the firm's problem.

We partly follow Gomes, Jermann, and Schmid (2016) and obtain the value of this derivative by solving the intermediates producing firms' problem (20)-(19) globally. This yields the optimal value, leverage, and investment policies, as well as an expression for the default threshold and price of the debt. We define the survival c.d.f. as a cubic function of z:

$$\Phi(z) = \frac{1}{2} + \eta_1 z + \frac{1}{2}\eta_2 z^2 + \frac{1}{3}\eta_3 z^3 \tag{31}$$

where $\eta_2 = 0$ by symmetry.

Next we use interpolation to approximate the derivative, $\frac{\partial q_t}{\partial b_{t+1}}$ and express it as a quadratic function of leverage, b_{t+1} as well as linear function of the exogenous state variables. The R-squared from this approximation exceeds 99% and it does not increase further when we add higher order terms. Hence, we have all components of the firm problem to proceed with the local perturbations. Since the shocks in the full model occur only around the steady-state, the impact on the approximation parameters is minimal.

The tools deployed to solve the problems of other agents in the model are now well understood. Specifically, we aggregate prices and wages following the procedure described by Calvo (1983) and Christiano, Eichenbaum, and Evans (2005) and discussed in detail in the Online Appendix.

To understand how monetary policy impacts the economy, we conduct a full welfare analysis. An important part of this has to do with the impact of the Taylor rule on volatilities. More aggressive inflation targeting can help households smooth their consumption and hence, decreases the volatility of consumption regardless of the mean. For that reason, we use a second-order approximation to express the welfare as a function of consumption, labor, and their volatilities. We then input respective impulse response functions to the second-order welfare function to compute welfare gains/losses from the shocks. This allows us to compare welfare losses for different monetary policy rules.

We compare monetary policy rules along three dimensions. First, we change the inflation sensitivity parameter, ψ_1. We consider values between 1 and 2 to satisfy the Taylor principle (Taylor (1993)). We alter the output gap parameter, ψ_2 and test values between 0.2 and 2. Finally, we propose an extended Taylor rule that includes corporate spreads following Curdia and Woodford (2010):

$$R_t^* = r(1+\pi^*)\left(\frac{1+\pi_t}{1+\pi^*}\right)^{\psi_1}\left(\frac{Y_t}{Y_t^*}\right)^{\psi_2}\left(\frac{sp_t}{sp^*}\right)^{-\psi_3} \tag{32}$$

where sp^* is a steady-state corporate spread. Spreads in the model are defined as $sp_t = 1/q_t^f - 1/q_t$ where q_t^f is a price of a risk-free bond with similar maturity (i.e. with probability η of the repayment shock and with $\Phi(\cdot) = 1$). The negative parameter implies that the central bank should tighten monetary policy when spreads are low. We test values of ϕ_3 from 0 (standard Taylor rule) and 1.

4 Calibration and estimation

We calibrate a number of parameters in the model and estimate the rest. The goal of estimation is to choose parameter values that match targeted moments well. We start by calibrating and then we use Bayesian methods to estimate the rest of the parameters given the calibrated ones. Table 1 shows values of the calibrated parameters. We calibrate the discount rate to $\beta = 0.99$ following the literature (Christiano, Eichenbaum, and Evans (2005); Smets and Wouters (2007); Gomes, Jermann, and Schmid (2016)). We pick the corporate tax rate to be $\tau = 0.25$ consistent with the average post-crisis tax rate in the US.[4] Our choice of capital depreciation rate is $\delta = 2.5\%$ which is consistent with the literature (Christiano, Eichenbaum, and Evans (2005); Smets and Wouters (2007)). We follow Elenev, Landvoigt, and Van Nieuwerburgh (2021) and set $\phi_0 = 0.07$ and $\xi_d = 0.93$, i.e. banks pay 7% of their net worth to shareholders and their dividends cannot exceed 93% of risk-weighted assets. We choose Calvo price parameter $\gamma = 0.6$ to reflect that only 40% of firms can change their prices (Christiano, Eichenbaum, and Evans (2005)). We choose Calvo wage parameter $\gamma_w = 0.8$ to reflect that 20% of households can change the wage (Christiano, Eichenbaum, and Evans (2005)). Choice of $\gamma_w > \gamma$ is not random – wages should be stickier than prices to create sufficient inflation costs for households. Output aggregation parameter is equal to $\nu = 0.2$ consistent with the elasticity of substitution between goods sold by retailers equal to 5 as in Gertler and Karadi (2011) and Gomes, Jermann, and Schmid (2016). We pick the labor aggregation parameter to be equal to the output aggregation parameter. Consistent with Christiano, Eichenbaum, and Evans (2005) the choice of the parameter does not impact the model conclusions qualitatively but helps to match the moments better. We follow Clarida, Gali, and Gertler (2000) and Gomes, Jermann, and Schmid (2016) to calibrate the benchmark Taylor rule. We choose the inflation target to be $\pi^* = 0.005$, the inflation parameter to be $\psi_1 = 1.5$, and the output gap parameter to be $\psi_2 = 0.2$. We calibrate

[4] The number is bigger than 20% traditionally used in the literature (Gomes, Jermann, and Schmid (2016); Elenev, Landvoigt, and Van Nieuwerburgh (2021)) but it does better in matching key moments while not impacting qualitative results of the model.

the TFP process persistence and standard deviation by constructing Solow residuals. For that, we use data on GDP, hours, capital stock, and GDP deflator from FRED. We also calibrate the wage mark-up process persistence to be $\rho_w = 0.95$ and $\sigma_w = 0.004$. We calibrate monetary shock following Gomes, Jermann, and Schmid (2016). Finally, we set $\rho_B = 0.9$ and $\sigma_B = 0.07$ to match banking moments.

We estimate the rest of the parameters using Bayesian methods. Specifically, the set of parameters to be estimated includes capital share, risk aversion, labor disutility, labor elasticity, default distribution, costs of recovery, probability of being hit by a shock, and remaining exogenous process parameters. We propose prior distributions and initial values for all parameters. Then, we use the Blocked Metropolis-Hastings MCMC algorithm to first compute modes and tune scaling parameters and then to draw from the posterior distribution (Smets and Wouters (2003); An and Schorfheide (2007); Smets and Wouters (2007)).

We use four shocks – TFP, default, wage mark-up, and government spending. To identify the model, we can use up to four series from the data. We use output, labor share, corporate BAA spreads, and inflation from 1984 till 2008. We gather all series from FRED and detrend them. Trends are also estimated following Smets and Wouters (2007).

The analysis is complicated by the fact that we use value function iterations to approximate the derivative of the debt price. Hence, we employ the following strategy. We approximate the derivative based on initial values and obtain d_1 and d_2. Then if R^2 of the approximation exceeds 99%, we confirm that the quadratic form is correct and estimate d_1 and d_2 along with other parameters of the model to get new values for firm parameters. We also include the average default rate $\overline{Def}$ in the set of estimated parameters to confirm that its estimated value is close to the value obtained via VFI. We include TFP process parameters to the set of estimated parameters to later scale other processes to the TFP process since its parameters are reasonably calibrated in the reduced form.

Table 1: Calibration of the Model

Parameter	Symbol	Value	Source
Preferences and taxes			
Discount rate	β	0.99	Smets and Wouters (2007)
Corporate tax rate	τ	0.25	Authors
Capital costs			
Depreciation rate	δ	0.025	Christiano et al. (2005)
Banks			
Dividend share	ϕ_0	0.07	Elenev et al. (2021)
Leverage constraint	ξ_d	0.93	Elenev et al. (2021)
Prices			
Calvo price parameter	γ	0.6	Christiano et al. (2005)
Output aggregation parameter	ν	0.2	Gertler and Karadi (2011)
Wages			
Calvo wage parameter	γ_w	0.8	Christiano et al. (2005)
Labor aggregation parameter	ν_w	0.2	Authors
Taylor rule			
Inflation target	π^*	0.005	Clarida et al. (2000)
Inflation parameter	ψ_1	1.5	Clarida et al. (2000)
Output gap parameter	ψ_2	0.2	Clarida et al. (2000)
Smoothing parameter	ρ_R	0.5	Clarida et al. (2000)
Exogenous processes			
TFP process persistence	ρ_a	0.95	Solow residuals
TFP process volatility	σ_a	0.007	Solow residuals
Mark-up shock persistence	ρ_w	0.95	Smets and Wouters (2007)
Mark-up shock volatility	σ_w	0.004	Smets and Wouters (2007)
Monetary shock persistence	ρ_m	0.85	Gomes et al. (2016)
Monetary shock volatility	σ_m	0.004	Gomes et al. (2016)
Bank shock persistence	ρ_a	0.9	Authors
Bank shock volatility	σ_B	0.07	Authors

Note: This table provides values of the calibrated parameters. All of them except for the labor aggregation parameter, tax rate, and productivity shock are taken from the literature. The labor aggregation parameter is chosen by the authors. As shown by Christiano, Eichenbaum, and Evans (2005) the value of that parameter does not impact the qualitative results of the model. We calibrate the TFP process parameters using Solow residuals that we construct using data on GDP, hours, capital stock, and GDP deflator. The calibration is based on quarterly data. The rest of the parameters are estimated.

Table 2: Bayesian Estimation Results

Parameter	Symbol	Prior distribution			Posterior distribution			
		Distr.	Mean	St. Dev.	Mode	Mean	10%	90%
Preferences and production								
Risk aversion	κ	Normal	1.4	0.38	2.26	2.25	2.20	2.31
Labor elasticity	θ	Normal	0.1	0.02	0.109	0.113	0.108	0.117
Labor disutility	ζ_n	Normal	15	1.24	10.8	10.9	10.5	11.3
Capital share	α	Normal	0.33	0.01	0.403	0.404	0.395	0.411
Firm parameters								
Repayment rate	η	Beta	0.8	0.005	0.806	0.806	0.804	0.808
Recovery cost	ξ	Beta	0.4	0.02	0.538	0.532	0.525	0.541
Average default rate	$\overline{Def}$	Normal	0.023	0.001	0.024	0.024	0.024	0.024
Default distribution	η_1	Normal	0.47	0.002	0.434	0.434	0.431	0.437
Derivative constant	d_1	Normal	0.15	0.02	0.131	0.133	0.127	0.139
Derivative slope	d_2	Normal	-1.07	0.03	-1.036	-1.045	-1.064	-1.028
Exogenous processes								
Default persistence	ρ_{Def}	Beta	0.9	0.01	0.898	0.899	0.898	0.899
Default volatility	σ_{Def}	Gamma	0.007	0.008	0.004	0.004	0.004	0.005
Government persistence	ρ_g	Beta	0.95	0.005	0.887	0.887	0.887	0.888
Government volatility	σ_g	Gamma	0.007	0.019	0.009	0.009	0.006	0.006

Note: This table provides results of the Bayesian estimation of the model structural parameters obtained using Blocked Metropolis-Hastings MCMC algorithm. Columns 3-5 provide prior distribution, means, and standard deviations. Columns 6-9 show posterior mode, mean, and 90% confidence interval. Standard deviations and persistences of exogenous processes are estimated relative to the respective parameters of the TFP process.

Results of the estimation are shown in Table 2. We use priors that have been proposed by the literature on Bayesian estimation (Smets and Wouters (2003, 2007); An and Schorfheide (2007)). Specifically, we assume that the probability of being hit by shock, recovery cost, and persistence of the processes follow Beta distribution. Standard deviations of the processes follow inverse Gamma distribution. The rest of the parameters follow normal distribution. Modes and posterior means of the parameters are fairly close to the prior means. At the same time, posterior standard errors are small which means that parameters are identified. The average default rate is similar to the one obtained through VFI which confirms that the estimation process converged.

The risk aversion parameter is estimated to be equal to 2.26 which is slightly bigger than in the literature. The additional risk attitude might come from the deadweight losses due to firms' default. Capital share in the production function is equal to 0.4 – number consistent with New Keynesian literature. Labor elasticity and labor disutility are estimated to be 0.11 and 10.8, respectively.

We estimate that the probability of being hit by the shock that requires to repay the debt is 81% – this is close to the average maturity of the debt being between 1 and 2 years. $\xi = 0.54$ implies that debtholders keep 54% of the firm after the default – close to the reduced-form calibration of Elenev, Landvoigt, and Van Nieuwerburgh (2021). The debt price derivative constant and slope are fairly close to the values obtained through global methods.

Finally, we estimate exogenous processes. Default shock is less persistent and less volatile than TFP shock. That is because recessions happen more often than financial shocks in our sample – we consider the period before the 2008 crisis. The government spending process is slightly less persistent and as volatile as the TFP process since government spending is usually used to recover from the recession.

5 Quantitative analysis

We solve the model using local perturbations based on the calibration and estimation discussed in Section 4. We use four stochastic processes in the benchmark analysis – TFP, inverse of government spending, wage stickiness, and default rates. We first show how the model estimation fits empirical moments. Next, we present how the model responds to the shocks. Finally, we conduct welfare analysis to understand if inclusion of financial conditions to the monetary policy rule is welfare-improving.

5.1 Aggregate moments

Table 3 compares aggregate HP-filtered moments from the model simulations to their data counterparts. We obtain macro data from St. Louis Fed FRED database, data on defaults from Moody's, and balance sheet data on leverage from Compustat. Panel A depicts first moments. The model produces the consumption-to-GDP ratio of 66% and investment-to-GDP ratio of 14%. Their data counterparts are 67% and 17%, respectively. Labor-to-GDP ratio in the model is 34% which is lower than the actual number from the data – 59%. We exactly match pre-Covid inflation rate of 0.5% per quarter. Finally, the model predicts slightly higher spreads (1.34% as opposed to 1.19% in the data), precise corporate market leverage of 23%, and slightly lower corporate default rates (0.9% as opposed to 0.4% in the data).

Panel B provides a comparison between volatilities (relative to GDP) produced by the model and computed from the data. Generally, our model predicts lower volatilities well. Specifically, volatilities of investment and labor are close to the volatilities observed in the data. The model, however, predicts the volatilities of consumption and inflation to be lower than their data counterparts.

Panel C shows correlations of the model variables with GDP. The model matched correlations generally well. The correlation of consumption with GDP is 46% which is lower than 78% in the data. On the other hand, correlations of investments and labor with GDP are 88% and 95%, respectively – slightly larger than in the data (84% and

Table 3: Aggregate Moments

	Description	Model	Data	Source
Panel A: First moments				
C/Y	Consumption to GDP	0.66	0.67	FRED
I/Y	Investment to GDP	0.14	0.17	FRED
N/Y	Labor to GDP	0.34	0.59	FRED
Sp	Credit spreads	1.34	1.19	FRED
π	Inflation	0.005	0.005	FRED
lev	Corporate market leverage	0.23	0.23	Compustat
Φ	Default rates	0.009	0.004	Fitch
Panel B: Second moments				
$\sigma(C)/\sigma(Y)$	Consumption to GDP	0.27	0.52	FRED
$\sigma(I)/\sigma(Y)$	Investment to GDP	4.29	4.23	FRED
$\sigma(N)/\sigma(Y)$	Labor to GDP	0.85	1.07	FRED
$\sigma(\pi)/\sigma(Y)$	Inflation to GDP	0.12	0.3	FRED
Panel C: Correlations				
$\rho(C,Y)$	Consumption with GDP	0.46	0.78	FRED
$\rho(I,Y)$	Investment with GDP	0.88	0.84	FRED
$\rho(N,Y)$	Labor with GDP	0.95	0.86	FRED
$\rho(\pi,Y)$	Inflation with GDP	0.86	0.53	FRED
Panel D: Auto-correlations				
Y	GDP	0.76	0.84	FRED
C	Consumption	0.80	0.83	FRED
I	Investment	0.84	0.81	FRED
N	Labor	0.78	0.89	FRED
π	Inflation	0.81	0.81	FRED

Note: This table provides aggregate moments in the model and data. The third column provides moments simulated and HP-filtered from the model. The fourth column shows moments from the pre-2019 data. Panel A contains first moments, Panel B – second moments, Panel C – correlations with GDP, and Panel D – serial auto-correlations. Data sources are mentioned in the last column.

86%, respectively). Inflation in the model is correlated with GDP significantly more than in the data – partly because of the enforced Taylor rule without zero-lower bound. Finally, Panel D presents first-order auto-correlations. The model matches all of them well.

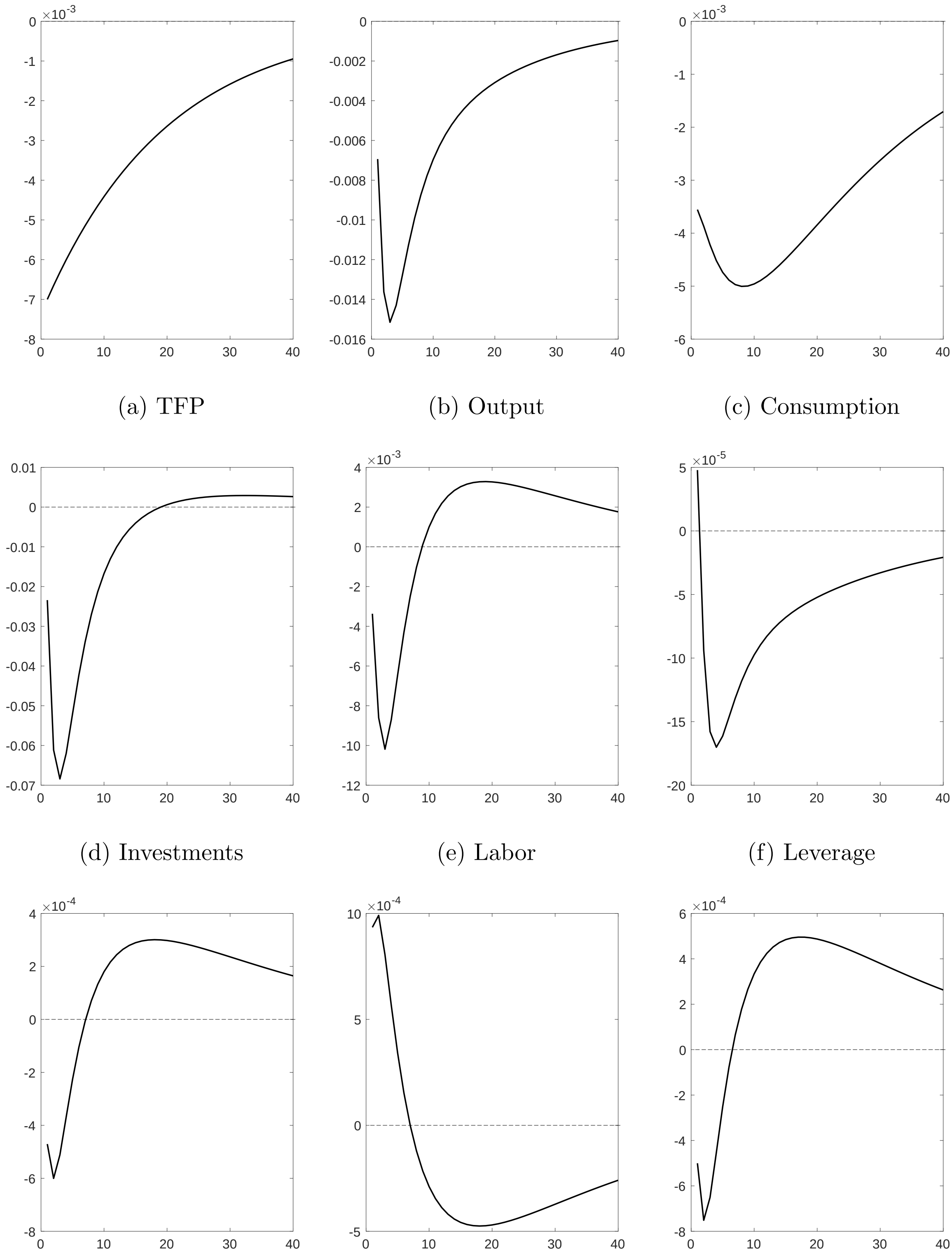
5.2 Stochastic simulations

We show the quantitative results of the model with sticky multi-period leverage and nominal rigidities. We start with the case of the standard Taylor rule given by (27). Impulse response functions to a one-standard-deviation negative productivity shock are depicted on Figure 2. Negative productivity shock leads to a drop in GDP, consumption, investments, and labor consistent with New Keynesian models. Since productivity drops, inflation also declines. Corporate leverage increases, because lower inflation and productivity make firms owe more – phenomenon that Gomes, Jermann, and Schmid (2016) call *sticky leverage*. Therefore, corporate spreads increase and default rates soar.

The effect of the productivity shock on GDP and consumption are persistent consistent with the consumption smoothing argument. The effects on investments, labor, and inflation are less persistent, potentially because corporate leverage increases. Firm variables also reverse back quickly. This is partly caused by high η – the probability of being hit by the shock. As Gomes, Jermann, and Schmid (2016) show, to get a persistently sticky leverage, one needs to model a nominal debt of a long maturity, whereas $\eta = 0.8$ is analogous to a medium-maturity bond.

Figure 3 shows IRFs to a one-standard-deviation default shock, i.e., when default rates increase unexpectedly. We find that output, consumption, investments, and labor drop significantly in response. This is caused partly by the fact that there are fewer firms to produce and partly by the dead-weight losses from firms' recoveries. Another consequence of the decreased production is a drop in inflation. Corporate leverage declines, because debt becomes too risky. This is clear from the IRF of the survival rate which shows that default rates increase. Finally, we see an increase in corporate spreads

Figure 2: Impulse Response Functions to a TFP Shock



(a) TFP (b) Output (c) Consumption

(d) Investments (e) Labor (f) Leverage

(g) Survival Rate (h) Corporate Spreads (i) Inflation

Note: This figure provides impulse response functions of the model key variables to one-standard-deviation negative productivity shock. The plots are obtained by first solving the model using first-order local perturbations around the steady-state and then by simulating the economy.

associated with an elevated riskiness of the debt.

Unlike in the case with TFP shock, firm variables change persistently. For example, corporate leverage reverses back only in 40 quarters. At the same time, consumption drop is as persistent as in the case of the TFP shock, indicating that the default shock is potentially as bad for households as the TFP shock.

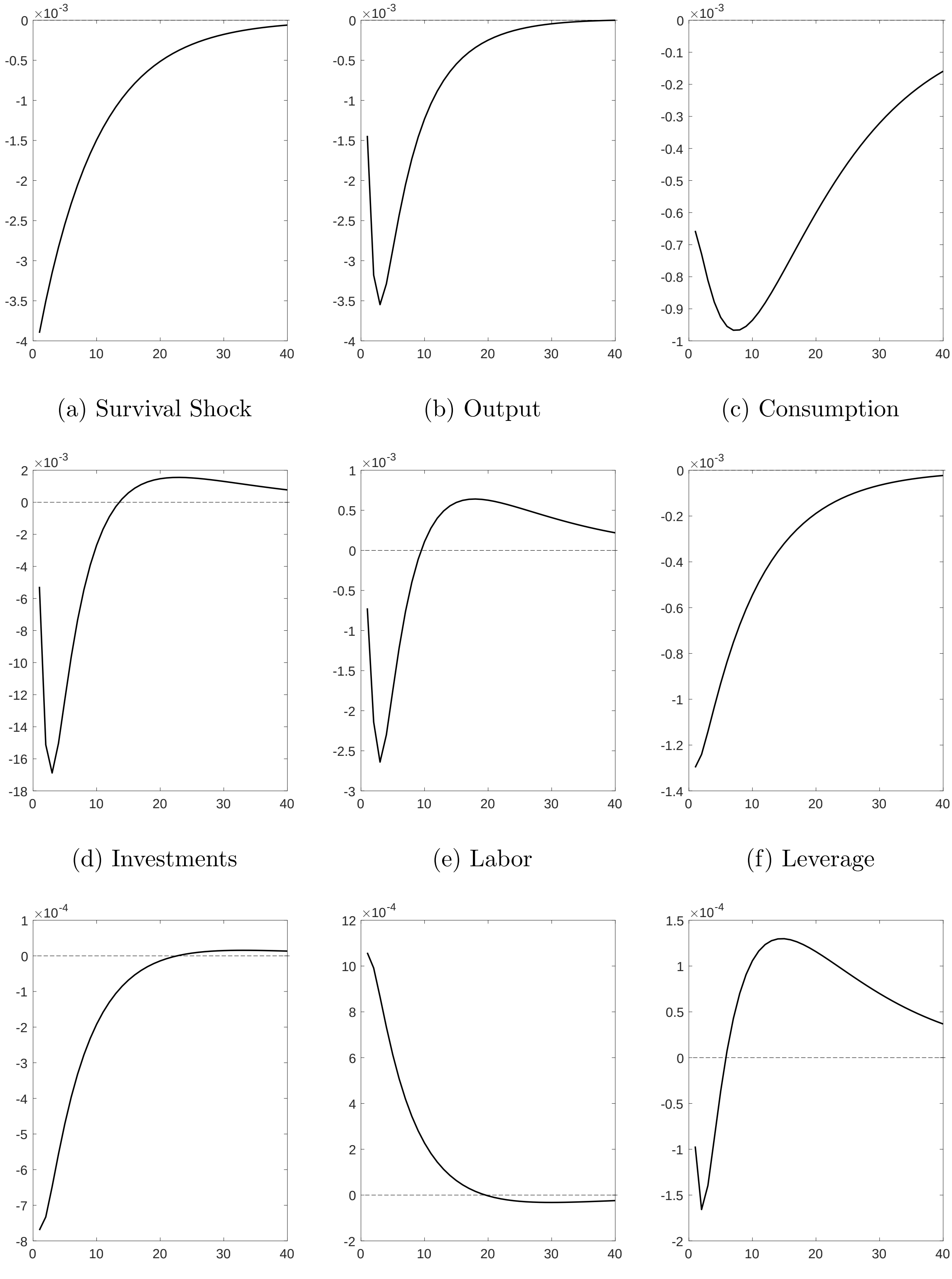
Figure 4 shows IRFs to a bank default shock, i.e., an increase in the probability of banks not being able to repay their depositors. Since bank defaults imply an increase in deadweight losses, output, consumption, and investments drop. Households also work less leading to a persistent drop in labor. Since bank defaults impact their ability to originate loans, corporate leverage declines, while defaults and spreads rise.

The results above align with the standard Taylor rule, including inflation and the output gap. We now modify the Taylor rule by setting $\psi_3 = 0.1$. It means that if corporate spreads are 1 p.p. above their steady-state, policy rate should decrease by 10 b.p. We check how model responses to TFP and default shocks change when Taylor rule is modified.

Figure 5 shows the results for the negative productivity shock. First, since spreads are in the Taylor rule, they increase less in the case of the modified Taylor rule than in the standard case, as well as the default rates increase less with spreads in the utility function. More importantly, consumption, output, investments, and labor drop less with the modified rule. Hence, including spreads in the Taylor rule improves losses in real variables over time, potentially being welfare-improving. It is important to note that we do not yet consider other changes to the Taylor rule (e.g., increased output gap parameter), we will consider these scenarios in the next section.

Next, we compare IRFs to the default shock between the model with the standard Taylor rule and the model with the modified Taylor rule that includes corporate spreads. Figure 6 shows the results. As in the case with TFP shocks, including spreads in the Taylor rule leads to a smaller drop in corporate leverage and less increase in spreads and default rates. We then see an impact on real variables – consumption, output,

Figure 3: Impulse Response Functions to a Corporate Default Shock



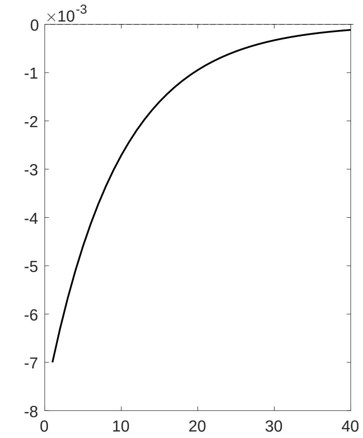
(a) Survival Shock (b) Output (c) Consumption

(d) Investments (e) Labor (f) Leverage

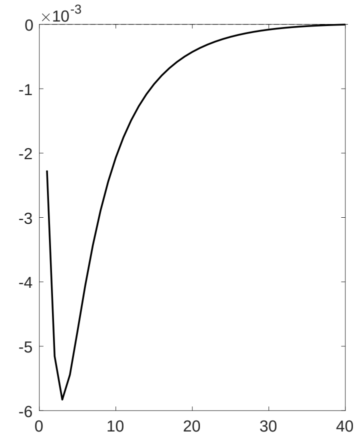
(g) Survival Rate (h) Corporate Spreads (i) Inflation

Note: This figure provides impulse response functions of the model key variables to one-standard-deviation positive default shock, i.e., unexpected increase in default rates. The plots are obtained by first solving the model using first-order local perturbations around the steady-state and then by simulating the economy.

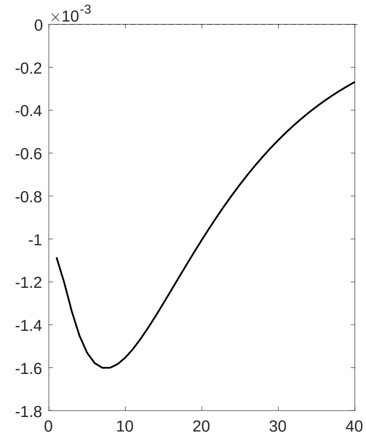
Figure 4: Impulse Response Functions to a Bank Default Shock



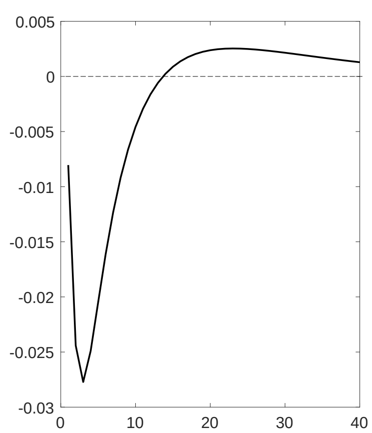
(a) Bank Survival Shock



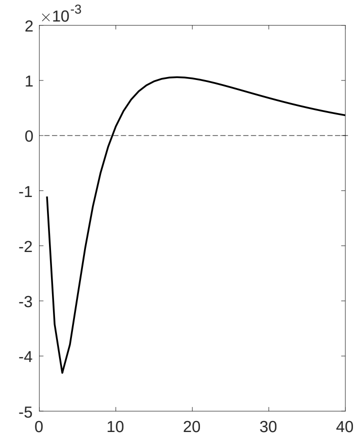
(b) Output



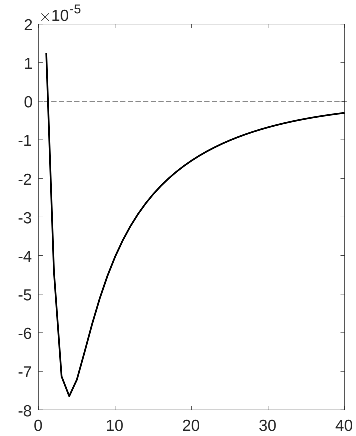
(c) Consumption



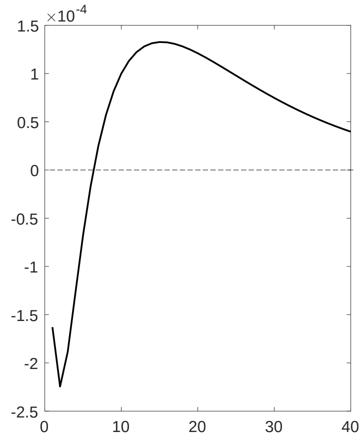
(d) Investments



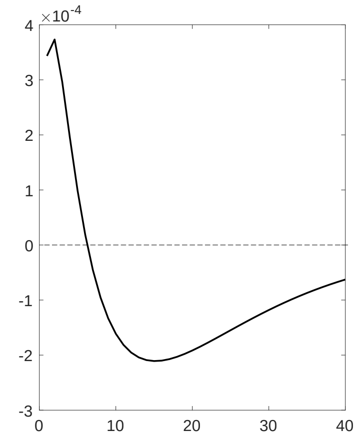
(e) Labor



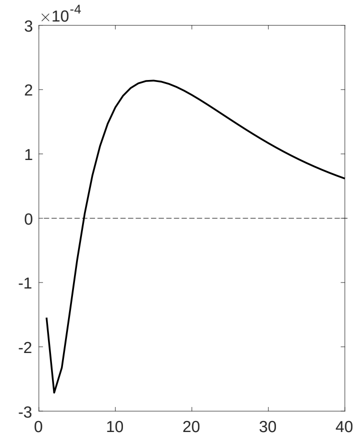
(f) Leverage



(g) Survival Rate



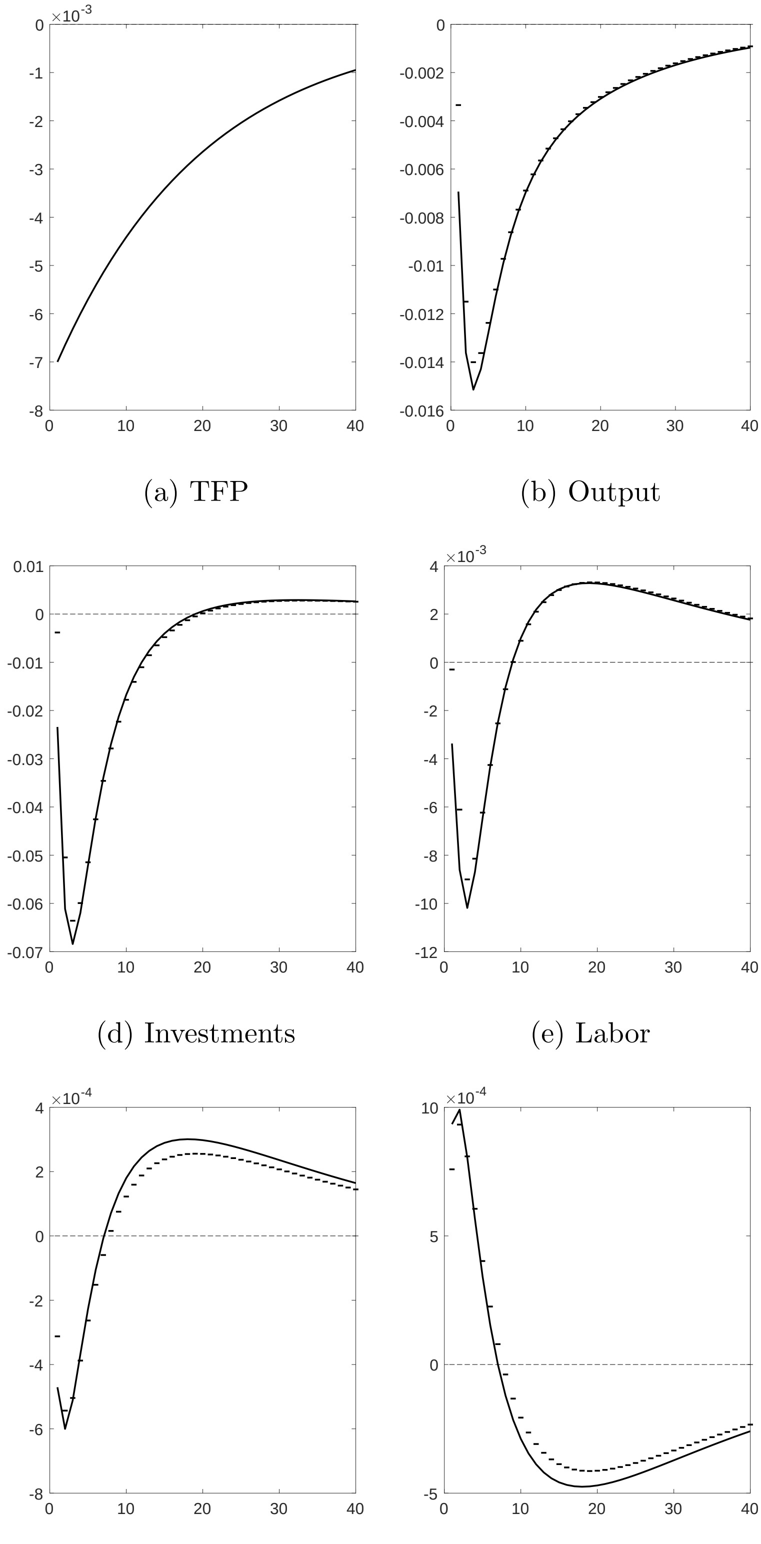
(h) Corporate Spreads



(i) Inflation

Note: This figure provides impulse response functions of the model key variables to one-standard-deviation positive bank default shock, i.e., unexpected increase in default rates. The plots are obtained by first solving the model using first-order local perturbations around the steady-state and then by simulating the economy.

Figure 5: Impulse Response Functions to a TFP Shock with Spreads



(a) TFP (b) Output (c) Consumption

(d) Investments (e) Labor (f) Leverage

(g) Survival Rate (h) Corporate Spreads (i) Inflation

Note: This figure provides impulse response functions of the model key variables to one-standard-deviation negative productivity shock. The solid line shows IRFs in the case of the standard Taylor rule, while the dashed line corresponds to IRFs in the case of the modified Taylor rule that includes corporate spreads with parameter $\psi_3 = 0.1$.

investments, and labor drop less when spreads are included in the policy rule than in the standard case. Moreover, the differentials are bigger when the economy faces the default shock than when the TFP shock hits it.

Finally, we compare IRFs to the bank default shock between the model with the standard Taylor rule and the model with the modified Taylor rule that includes corporate spreads. Figure 7 shows the results. Findings are in line with the results above – including spreads to the Taylor rule mitigates the effect of banking default shock on the economy.

Overall, the evidence in this section showed that including spreads in the Taylor rule mitigates the negative consequences of the shocks. However, it is not clear that the effects of including spreads are welfare-improving since the analysis above does not consider volatilities. In addition, there may be better ways to mitigate the consequences of the shocks by targeting inflation stricter or by increasing the weight of the output gap in the Taylor rule. We conduct a formal welfare analysis in the next subsection.

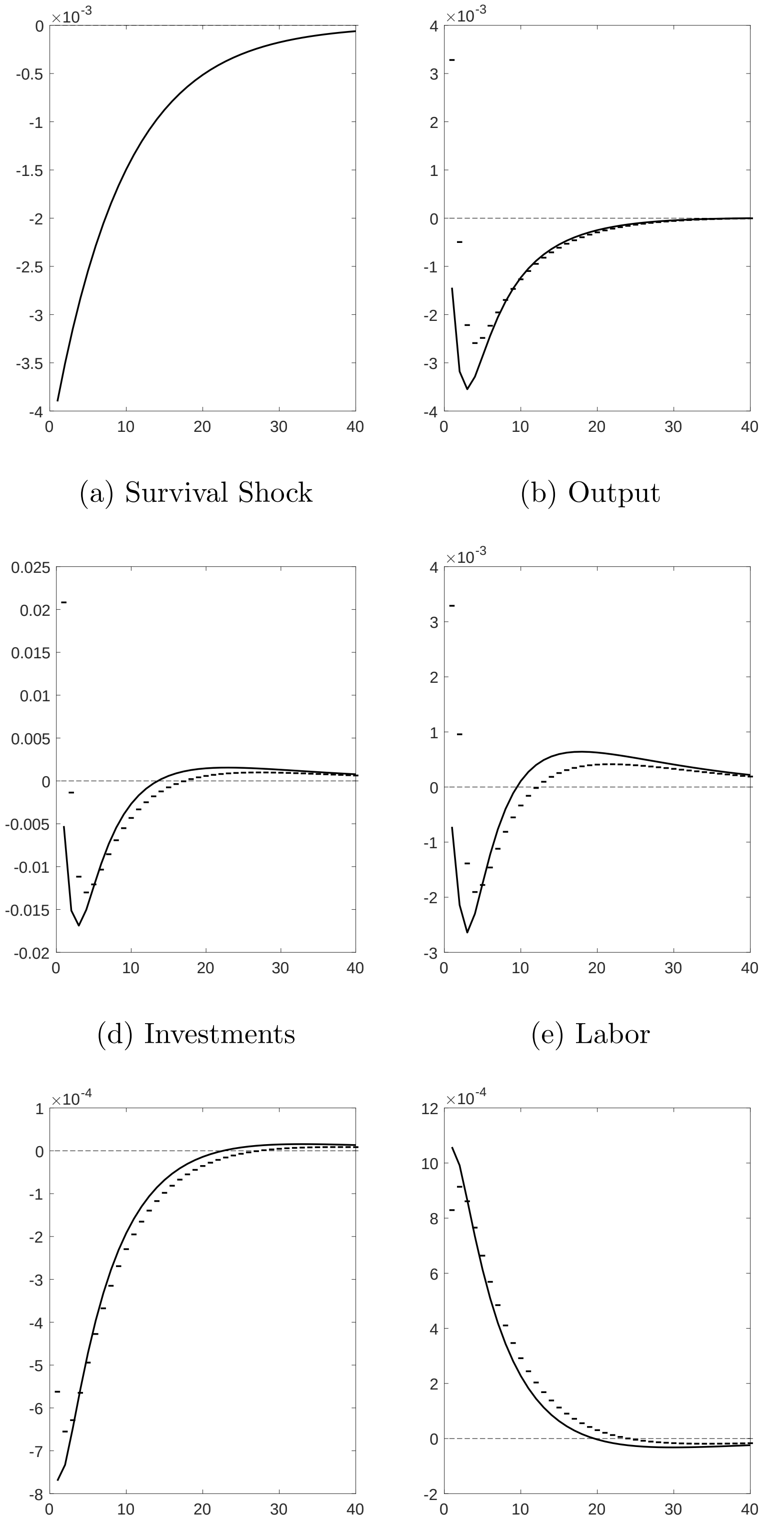
5.3 Welfare analysis

We compare welfare losses due to TFP, firm default, and bank default shocks for different values of Taylor rule parameters. We change the value of the inflation parameter from 1.5 to 2, the value of the output gap parameter from 0.3 to 0.7, and the value of the spread parameter from 0 to 1.

Figure 8 shows the results of the welfare analysis in response to a negative TFP shock. Panel (a) shows the welfare losses across different inflation and spread parameters. For low values of the spread parameter it is welfare-improving to target both inflation and spreads but for higher values of the spread parameter targeting inflation is no longer welfare-improving. It shows that potentially central banks can pay more attention to financial markets than to prices even when they react to productivity shocks.

Panel (b) shows the welfare losses across different output and spread parameters. Although for low values of the output parameter, it is welfare-improving to include spreads, the first-best is to increase the output parameter without including spreads in

Figure 6: Impulse Response Functions to a Corporate Default Shock with Spreads



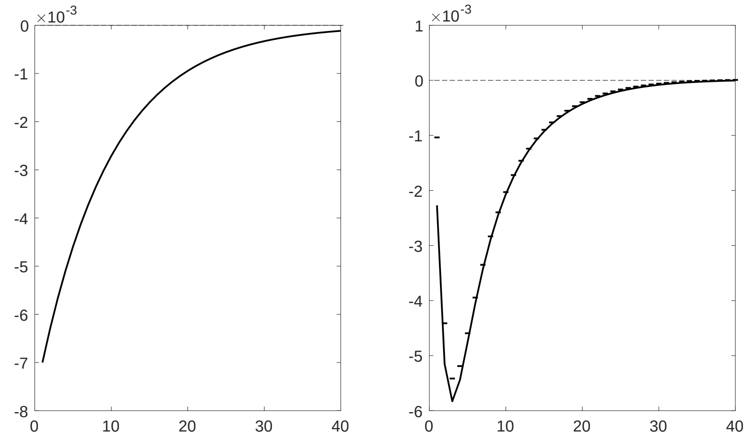
(a) Survival Shock (b) Output (c) Consumption

(d) Investments (e) Labor (f) Leverage

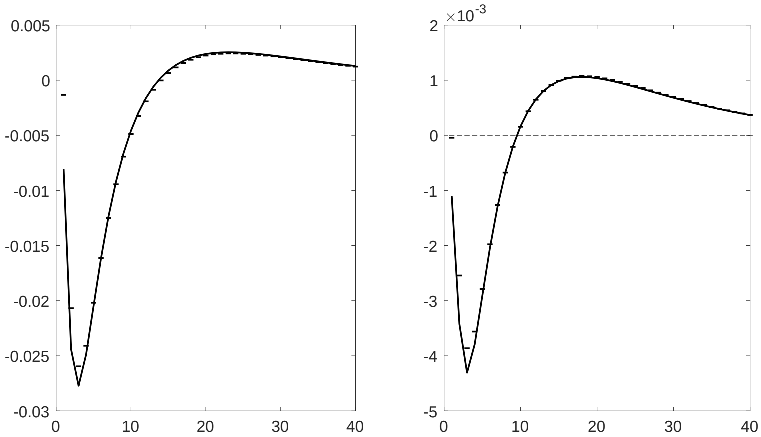
(g) Survival Rate (h) Corporate Spreads (i) Inflation

Note: This figure provides impulse response functions of the model key variables to one-standard-deviation positive corporate default shock. The solid line shows IRFs in the case of the standard Taylor rule, while the dashed line corresponds to IRFs in the case of the modified Taylor rule that includes corporate spreads with parameter $\psi_3 = 0.1$.

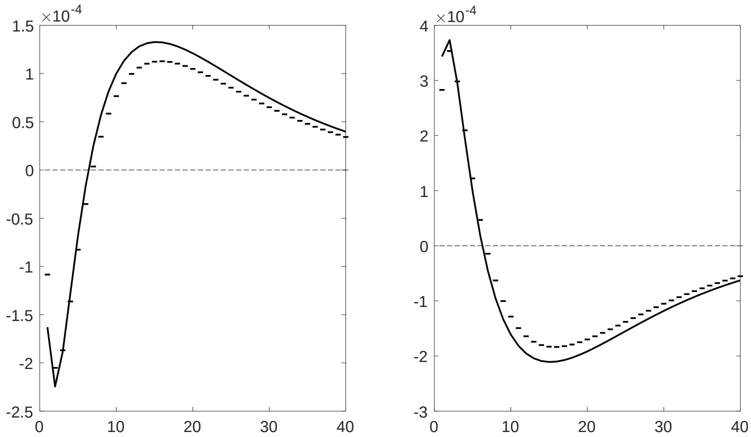
Figure 7: Impulse Response Functions to a Bank Default Shock with Spreads



(a) Bank Survival Shock (b) Output (c) Consumption



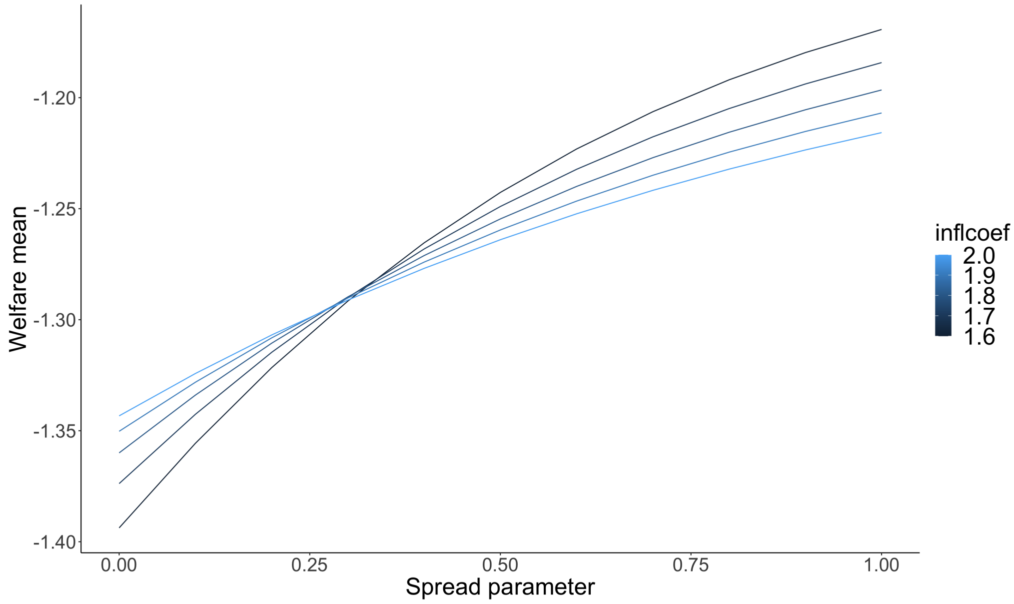
(d) Investments (e) Labor (f) Leverage



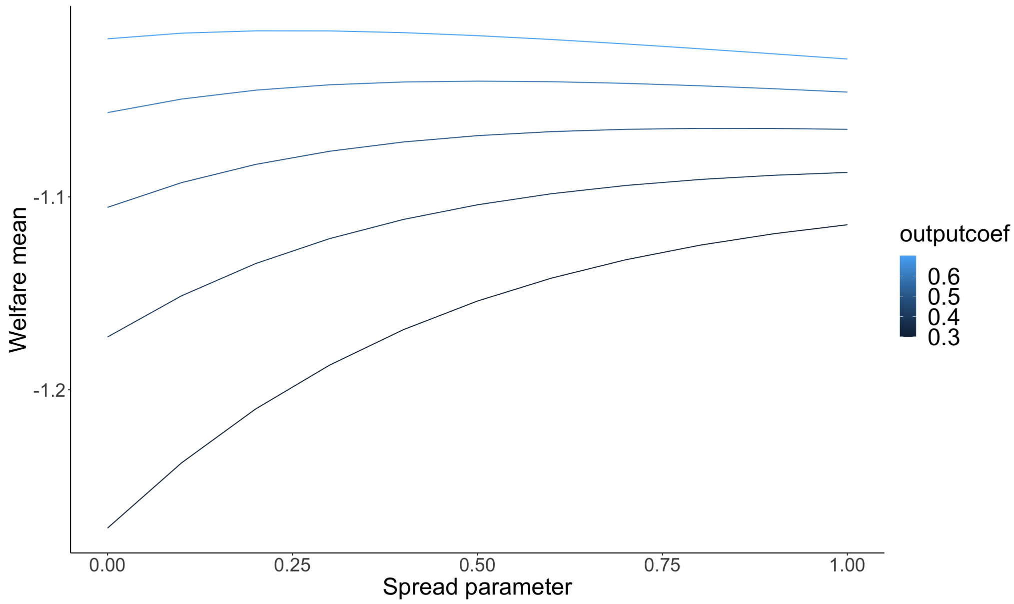
(g) Survival Rate (h) Corporate Spreads (i) Inflation

Note: This figure provides impulse response functions of the model key variables to one-standard-deviation positive bank default shock. The solid line shows IRFs in the case of the standard Taylor rule, while the dashed line corresponds to IRFs in the case of the modified Taylor rule that includes corporate spreads with parameter $\psi_3 = 0.1$.

Figure 8: Welfare Losses due to a Negative TFP Shock for Different Taylor Rule Parameters



(a) Inflation vs Spreads



(b) Output vs Spreads

Note: This figure provides welfare losses due to a negative productivity shock for different values of Taylor rule parameters. The welfare losses are obtained by taking a second-order Taylor approximation of households' welfare in the model. Panel (a) shows the welfare losses across different inflation and spread parameters, whereas Panel (b) shows the welfare losses across different output and spread parameters.

the Taylor rule. This result speaks to the fact that targeting more variables distracts central banks from their main goal. In the case of recession, the main goal is to stabilize the economy – hence, central banks should stabilize the output gap, rather than increase their attention to the financial markets.

Figure 9 shows the results of the welfare analysis in response to a shock that increases the default rates of the economy. Not surprisingly, Panel (a) shows that it is always welfare-improving to target corporate spreads, and even for low values of corporate spread parameter, it becomes beneficial to replace inflation with corporate spreads in the policy rule.

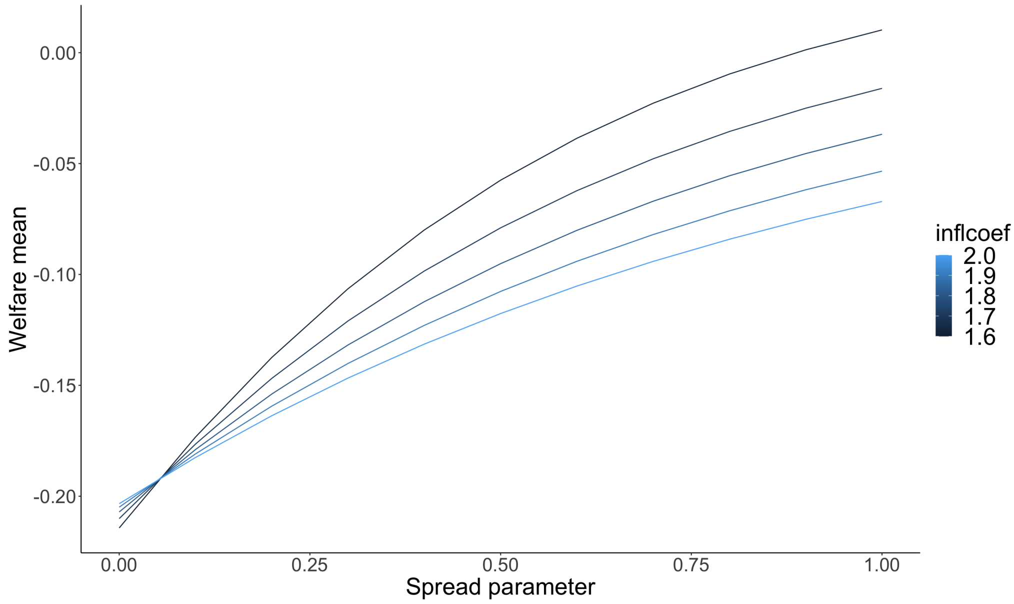
Panel (b) results indicate that when addressing the default shock, it is beneficial to increase both the output and spread parameters in Taylor rule for low values of the spread parameter. The reason is that high defaults decrease production due to shortages of producers and recovery deadweight losses. However, for larger values of the spread parameter, it becomes welfare-improving to exclude the output gap from the Taylor rule.

Figure 10 shows the results of the welfare analysis in response to a shock that increases the default rates of banks of the economy. Panel (a) shows that it is welfare-improving to target corporate spreads, and for higher values of corporate spread parameter, it becomes beneficial to replace inflation with corporate spreads in the policy rule.

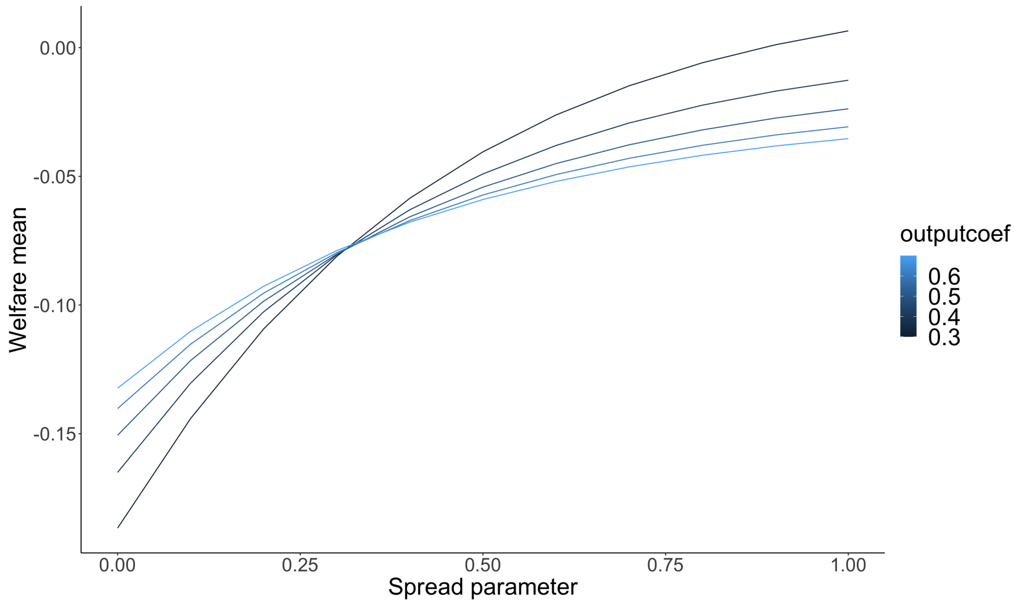
Panel (b) results show that it is beneficial to increase both the output gap and corporate spread parameter when addressing bank default shocks. Targeting corporate spreads helps to mitigate the impact of high spreads on banks' assets. Targeting the output gap helps to reduce deadweight losses from bank defaults.

Results in this section show that targeting spreads is welfare-improving if the economy is hit by firm or bank default shocks. When the economy is hit by the negative TFP shock, it is beneficial to increase the output gap parameter rather than include spreads in the Taylor rule. However, it is welfare-improving to stop targeting inflation and target corporate spreads instead when addressing any type of shock.

Figure 9: Welfare Losses due to a Default Shock for Different Taylor Rule Parameters



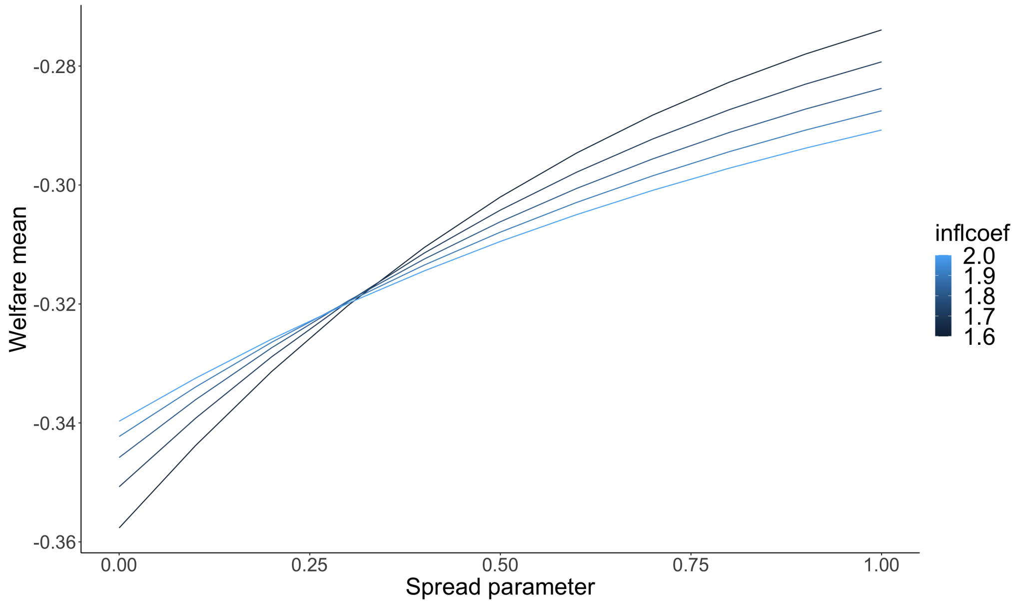
(a) Inflation vs Spreads



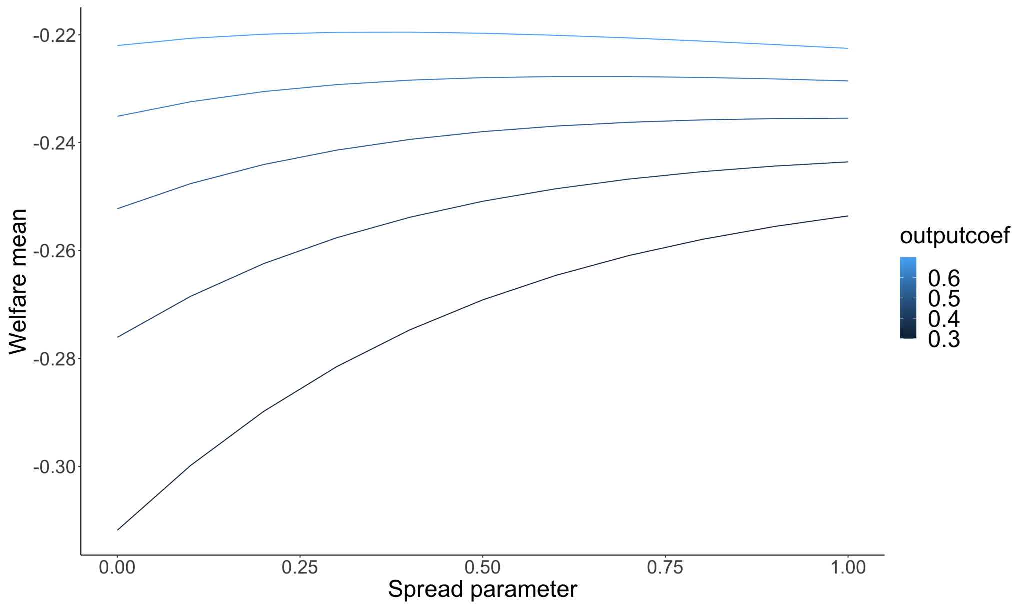
(b) Output vs Spreads

Note: This figure provides welfare losses due to a default shock for different values of Taylor rule parameters. The welfare losses are obtained by taking a second-order Taylor approximation of households' welfare in the model. Panel (a) shows the welfare losses across different inflation and spread parameters, whereas Panel (b) shows the welfare losses across different output and spread parameters.

Figure 10: Welfare Losses due to a Bank Default Shock for Different Taylor Rule Parameters



(a) Inflation vs Spreads



(b) Output vs Spreads

Note: This figure provides welfare losses due to a bank default shock for different values of Taylor rule parameters. The welfare losses are obtained by taking a second-order Taylor approximation of households' welfare in the model. Panel (a) shows the welfare losses across different inflation and spread parameters, whereas Panel (b) shows the welfare losses across different output and spread parameters.

6 Conclusion

In this paper, we provide theoretical evidence that including credit spreads to the monetary policy rule is welfare-improving when mitigating the impact of corporate or banking default shocks. We also show that including spreads increases welfare and mitigates the negative consequences even when a negative productivity shock hits the economy, but it is sub-optimal to increasing the weight of the output gap parameter in Taylor rule.

Our results have important implications for monetary policy. Since 2008 and especially during the Covid-19 recovery, the Fed was cautious in stabilizing inflation and output gap when credit spreads were high. We provide a rationale for considering corporate spreads in the policy rule and show welfare implications of such a policy.

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