Effects of different financial frictions on households*

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Abstract

This study examines how different types of financial frictions influence household wealth and consumption in response to a contractionary monetary policy shock. The analysis considers two key frictions: those affecting production firms and those related to household borrowing, both incorporated into a HANK model. The results suggest that frictions in the productive sector have a stronger impact on wealth inequality, whereas frictions in household borrowing lead to greater consumption dispersion relative to the counterfactual scenario. This divergence primarily arises from dynamics around the zero-wealth threshold, particularly the behavior of the household borrowing spread.

1 Introduction

Although more than a decade has passed since the burst of the real estate bubble, the effects of the Great Financial Crisis remain tangible in economic research. Two branches of literature have drawn particular attention from academics interested in macro models to better understand the causes and effects of such events.

One concerns the implications of considering heterogeneous households as opposed to standard New Keynesian (NK) models, where a Representative Agent (RA) exists. This change in perspective is mostly motivated by the rising inequalities experienced not only in the United States, but also in almost all advanced economies. Although this phenomenon has been ongoing for more than 40 years,[1] the 2008 financial crisis exacerbated this process. RA models offer a significant benefit as they can be potentially

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[1] Piketty (2017) provides a thorough review of the recent inequality history, especially in advanced economies.

solved analytically. However, it is important to note that the RA assumption is an extreme simplification, which becomes even more stringent when a larger proportion of households fall under the "Hand-to-Mouth" (HtM) category. To address this issue, more complex models are necessary. A favorable trade-off can be found in the form of Two-Agents New Keynesian (TANK) models. These models incorporate two distinct types of households: HtM and non-HtM. This approach maintains a relatively straightforward model while still yielding significant implications for overall economic dynamics and the transmission of monetary policy. Nonetheless, it is important to note that these models do not permit an analysis of changes in the distribution of household wealth. In contrast, full-fledged Heterogeneous Agents New Keynesian (HANK) models encompass multiple households that exhibit varying consumption and saving behaviors.

The other area of interest pertains to exploring amplification mechanisms within theoretical frameworks that could account for significant fluctuations in variables, even following a moderate aggregate shock. A prevalent assumption in conventional Real Business Cycle (RBC) and NK models is the notion of a frictionless economy, where financial intermediaries are almost nonexistent or simply transfer liquidity without impediments, ensuring that funds consistently reach individuals capable of optimizing their returns. Despite their relative simplicity, these models have proven to be effective in approximating historical business cycle statistics. However, they often fall short in explaining the magnitude and persistence of aggregate shock effects. The assumption of perfectly functioning financial markets, while convenient, is not realistic, particularly during times of financial crisis and credit rationing. The emergence of theories concerning imperfect financial markets can be traced back nearly a century ago (e.g., Fisher, 1933), in the aftermath of another disruptive financial crisis, the 1929 stock market crash. Although models capable of elucidating such dynamics have been formulated since the 1970s (e.g., Akerlof, 1970), they may not have garnered sufficient attention: until the advent of the Great Recession, financial crises were considered either relics of the past or primarily afflicting underdeveloped economies. However, since 2008, an increasing number of scholars have reevaluated the significance of financial frictions. They have sought to integrate existing mechanisms and introduce novel model features that could more effectively explain how a relatively minor disturbance can give rise to profound and enduring effects.

There is also a growing body of literature focusing on the impact of monetary policy shocks on household inequality. Coibion et al. (2017) is probably one of the most influential empirical contribution. Through the analysis of data from the Consumer Expenditure Survey (CEX) on consumption and income, the authors establish that contractionary monetary policies have significant effects, resulting in heightened levels of income, labor earnings, consumption, and total expenditure inequality. From a modeling perspective, the seminal paper by Kaplan et al. (2018) is probably one of the most important in demonstrating how monetary policy transmission mechanisms act very differently in a

HANK model compared to the relative RANK and TANK versions. However, to date, few works have dealt with monetary shock effects on household behavior in an environment with financial frictions.

This study seeks to assess the implications of a conventional contractionary monetary policy shock (i.e., a rise in the nominal interest rate by the central bank) on the distribution of wealth and consumption patterns across households, depending on the type of financial friction considered in the model. I analyze two types of frictions: frictions on the ability of productive firms to raise external funds, and frictions on the ability of households to obtain loans. In both cases, the severity of these frictions is directly proportional to the spread between the relevant interest rate (gross return on capital in the case of frictions on firms, loan rate for frictions on households) and the risk-free rate. Consequently, when these interest rate differentials expand, a financial accelerator is triggered, intensifying the impact of the aggregate shock. Empirical evidence from recent studies demonstrates a positive correlation between these spreads and inequality indices, specifically consumption dispersion measures.[2] Faccini et al. (2024) examine household data from Denmark and discover that higher spreads are connected to decreased consumption spending for indebted households, while the association is positive for wealthier households. They also construct an aggregate measure of the consumption-income elasticity that varies over time as a function of how households move across the wealth distribution and as a function of changes in the consumer credit spread. The index appears volatile and countercyclical, with its movements largely influenced by variations in net worth and, in particular, shifts in the consumer credit spread. Ferlaino (2025) employs a Local Projection regression following the approach of Jordà (2005) and demonstrates that an increase in the corporate spread—specifically, the GZ spread developed by Gilchrist and Zakrajšek (2012)—is associated with greater consumption inequality in the US.

Starting from these premises, I build a HANK model featuring asset market incompleteness, idiosyncratic income risk, sticky prices, and two potential sources of financial frictions that come into play, depending on the case. It is important to highlight that my objective is not to provide precise quantitative outcomes, as the model's asset heterogeneity is monodimensional.[3] Instead, my approach focuses on a qualitative analysis to examine how household distributions evolve following a contractionary monetary shock in a specific economic context.. Concerning frictions on productive firms, I resort to a financial accelerator similar to that proposed by Bernanke et al. (1999), which is one of the most seminal and recurring in the financial friction literature. In the case of friction

[2]The empirical literature often relies on consumption inequality as a preferred metric, thanks to the quarterly data on the US provided by the CEX. On the other hand, extrapolating wealth dynamics presents greater difficulty due to the triennial nature of the Survey of Consumer Finances.

[3]Accurate quantitative results are best suited for HANK models featuring two different assets (usually liquid and illiquid) as in Kaplan et al. (2018) or Luetticke (2021), since only with this kind of structure it is possible to target "wealthy hand-to-mouth" households.

on household borrowing ability, I take cues from the work of Cúrdia and Woodford (2016) and posit that the spread between deposit and loan interest rates is directly proportional to a non-decreasing convex function of the aggregate household debt in the economy: an increase in household debt leads to a corresponding expansion in this interest rate differential.[4] As the mechanisms and complexities of the two financial accelerators differ, the magnitude of the impulse responses could be different. Hence, in order to facilitate a fair comparison, I opt not to apply the same monetary shock to both cases. Instead, I employ two distinct magnitudes that yield comparable fluctuations in output.[5] However, the key findings hold even under the same shock magnitude.

The main result is that the type of friction is important for changes in savings and consumption. The difference in inequality fluctuations measures are predominantly driven by household decisions in proximity to the zero-wealth threshold.[6] The contractionary monetary policy results in a reduction in labor income, which constitutes the primary source of earnings for poorer households. Individuals at the lower end of the distribution use their savings or opt to borrow funds to smooth consumption. In the presence of financial frictions within firms, the household borrowing premium remains constant, resulting in household borrowings being relatively more affordable than in the alternative scenario. Agents can move in a larger quantity to the bottom of the distribution, leading to a significant rise in wealth inequality. However, the impact on consumption is relatively smaller as agents can better smooth their consumption through borrowed liquidity. On the other hand, under financial frictions on households, the household borrowing premium increases after a monetary contraction. Consequently, fewer households are able to borrow, resulting in a deterioration of consumption smoothing. Moreover, borrower households experience even lower levels of consumption due to the higher interest rates on their debts. As a result, a larger share of households choose to remain HtM, preventing further descent down the distribution. This ultimately leads to a relatively lower Gini index for wealth but a higher one for consumption. Furthermore, the decomposition of aggregate consumption provides interesting insights on the dichotomy between direct and indirect effects introduced by Kaplan et al. (2018). The fluctuations in wages significantly contribute to consumption dynamics, which are further amplified by the presence of frictions within firms. Conversely, frictions within households play a pivotal role in accentuating the direct effects, primarily through fluctuations of the household borrowing premium.

This paper touches on different fields of macroeconomics. First, the model has roots in the literature concerning high heterogeneity among households, a path that started

[4] Cúrdia and Woodford (2016) suggests that the spread could potentially be affected by households defaulting on unsecured debts. Nevertheless, to ensure simplicity, this particular aspect is omitted from the model.

[5] Nevertheless, the persistence of the shock is the same in both cases.

[6] Both global wealth and consumption inequality are calculated as Gini indices.

at the end of the 1980s (Imrohoroğlu, 1989; Huggett, 1993; Aiyagari, 1994). Rising inequalities and the impact of the Great Recession have fueled interest in this field, leading to increased efforts by scholars to design algorithms that can handle models with higher degrees of complexity and heterogeneity (e.g., Bayer and Luetticke, 2020; Auclert et al., 2021).

Second, this paper fits within the branch that examines the implications of household heterogeneity for monetary policy. Kaplan et al. (2018) is one of the most important contributions to the field, proving that household heterogeneity is fundamental in understanding monetary policy transmission. Nonetheless, concerns about monetary policy mechanisms with household heterogeneity were at the center of a blooming body of literature in recent years (e.g., Auclert, 2019; Luetticke, 2021). A thorough survey on this topic can be found in Colciago et al. (2019).

Third, my findings contribute to expanding the vast literature on financial frictions. Most frictions are built around the concept of asymmetric information between the lender-household and borrower-firm (e.g., Akerlof, 1970; Stiglitz and Weiss, 1981; Bernanke et al., 1999). Another common feature is the idea that a "moral hazard" exists that prevents the credit market from being frictionless (e.g., Holmstrom and Tirole, 1997; Gertler and Karadi, 2011; Farhi and Tirole, 2012). Papers on household borrowing frictions usually focus on unsecured loans and credit tightening (e.g., Iacoviello, 2005; Chatterjee et al., 2007; Cúrdia and Woodford, 2016). The survey by Brunnermeier et al. (2012) provides an excellent summary of the state-of-the-art in this branch of the economic literature.

In contrast, the theoretical literature on the impact of aggregate shocks on heterogeneous households within a framework of financial frictions is still in its early stages (e.g., Guerrieri and Lorenzoni, 2017, Nakajima and Ríos-Rull, 2019, Fernández-Villaverde et al., 2023, and Chiang and Żoch, 2022). In the context of monetary policy, Faccini et al. (2024) examine the impact of an increase in the nominal risk-free rate, along with other aggregate shocks, on aggregate variables and the consumption distribution, when financial intermediaries' moral hazard influences the household borrowing rate. In contrast, Ferlaino (2024) investigates how monetary policy impacts heterogeneous households in a model featuring a financial accelerator caused by a leveraged production sector.

Differently from what this study seeks to accomplish, none of the papers cited above inspect whether movements in inequality measures could depend on the types of frictions considered in the economy and, if that is the case, what is the reason behind the different responses.

The remainder of this paper is organized as follows. Section 2 outlines the model. Section 3 explains the calibration strategy. Section 4 displays results. Section 5 gives summary conclusions.

2 The model

To obtain a better comparison between the two financial frictions, I do not compare two different models (one for each friction). Instead, I build a model incorporating both frictions so that the starting point for the analysis (i.e., the steady state) is the same. I then turn on one friction or the other and compare the impulse responses.[7] The model comprises households, financial intermediaries, a production sector, a central bank, and the government. Households consume, earn income (from either labor or profit, according to their household type), save, and borrow in a liquid asset. This asset yields an interest rate, that is augmented by a borrowing penalty in case of loans. There are two types of financial intermediaries: commercial banks, which intermediate household borrowings, and investment banks, which intermediate firm borrowings. The production sector produces goods and capital. The central bank is in charge of monetary policy and sets the nominal interest rate, whereas the government acts as fiscal authority and chooses how to finance government spending. The behavior of each agent is explained in detail below.[8]

2.1 Households

There is a continuum of ex-ante identical households of measure one indexed by $i \in [0, 1]$. They are infinitely lived, have time-separable preferences with a time discount factor β.

Following Bayer et al. (2019), I assume households have Greenwood–Hercowitz–Huffman (GHH) preferences (Greenwood et al., 1988) and maximize the discounted sum of utility:

$$V = E_0 \max_{\{c_{it}, l_{it}\}} \sum_{t=0}^{\infty} \beta^t u\left(c_{it} - G(h_{it}, l_{it})\right) \ . \tag{1}$$

where c_{it} is consumption for household i and $G(h_{it}, l_{it})$ is a function of productivity, h_{it}, and labor supplied, l_{it}, representing household leisure.

Assuming GHH preferences instead of separable preferences has two major advantages and one flaw. First, from a computational perspective, it simplifies the numerical analysis. Second, as explained by Auclert et al. (2023), this prevents the model from generating an excessive Marginal Propensity to Earns (MPE), especially for households with high Marginal Propensity to consume (MPC), since GHH preferences dampen wealth effects on labor supply. However, using GHH preferences in models with household heterogeneity translates into higher fiscal and monetary multipliers. The latter should not be a problem

[7]Because the two frictions are based on an interest rate spread fluctuating endogenously, the "active" friction, depending on the case, is the one for which the spread varies over time. To "shut off" a friction, I fix the relative spread.

[8]The core structure of the model is based on the 1-asset HANK version presented in Bayer et al. (2019).

in this model because both the scenarios compared in this analysis would be affected by this issue.[9]

The felicity function features Constant Relative Risk Aversion (CRRA):

$$u(x_{it}) = \frac{x_{it}^{1-\xi}}{1-\xi} \ , \tag{2}$$

where $\xi \geq 0$ is the risk-aversion parameter, and $x_{it} = (c_{it} - G(h_{it}, l_{it}))$ is household i's composite demand for goods consumption and leisure. The function G measures the disutility from work.

Goods consumption bundles differentiated goods j according to a Dixit–Stiglitz aggregator:

$$c_{it} = \left(\int c_{ijt}^{\frac{\eta-1}{\eta}} \, dj \right)^{\frac{\eta}{\eta-1}} \ . \tag{3}$$

Each of these differentiated goods is offered at price p_{jt}, so that for the aggregate price level, $P_t = \left(\int p_{jt}^{1-\eta} dj \right)^{\frac{1}{1-\eta}}$, the demand for each of the varieties is given by:

$$c_{ijt} = \left(\frac{p_{jt}}{P_t} \right)^{-\eta} c_{it} \ . \tag{4}$$

The disutility of work, $G(h_{it}, l_{it})$, determines a household's labor supply given the aggregate wage rate, W_t , and a labor income tax, τ, through the first-order condition:

$$\frac{\partial G(h_{it}, l_{it})}{\partial l_{it}} = (1-\tau) W_t h_{it} \ . \tag{5}$$

Assuming that G has a constant elasticity with respect to labor, I can write:

$$\frac{\partial G(h_{it}, l_{it})}{\partial l_{it}} = (1+\gamma) \frac{G(h_{it}, l_{it})}{l_{it}} \ , \tag{6}$$

with $\gamma > 0$ being the Frisch elasticity of labor supply. The expression of the composite good can be simplified, making use of (5) and (6):

$$x_{it} = c_{it} - G(h_{it}, l_{it}) = c_{it} - \frac{(1-\tau) W_t h_{it} l_{it}}{1+\gamma} \ . \tag{7}$$

Since the Frisch elasticity of labor supply is a constant parameter, the disutility of labor is always a constant fraction of labor income. Therefore, in both the household budget constraint and its felicity function, only after-tax income enters, and neither

[9] Auclert et al. (2023) call it the "New Keynesian models trilemma". Regarding HANK models, choosing separable preferences delivers consistent MPC and multipliers but not MPE. On the other hand, choosing GHH preferences delivers consistent MPC and MPE but not multipliers. One solution proposed by the authors is to consider a HANK model with separable preferences and sticky wages. As interesting as it may be as a model integration, I believe that for the time being, such a complication is not necessary to reach the main results of this study.

hours worked nor productivity appears separately. This implies that, as suggested by Bayer et al. (2019), it can be assumed that $G(h_{it}, l_{it}) = h_{it}\frac{l_{it}^{1+\gamma}}{1+\gamma}$ without further loss of generality, as long as we treat the empirical distribution of income as a calibration target. This functional form simplifies the household problem, as h_{it} drops out from the first-order condition, and all households supply the same number of hours $l_{it} = L(W_t)$. Total effective labor input, $\int l_{it}h_{it}di$, is therefore equal to $L(W_t)$ since $\int h_{it}di = 1$. [10]

There are two types of household: workers and rentiers. Workers supply labor, L_t, in the production sector and have positive idiosyncratic labor productivity, $h_{it} > 0$. Their income is $W_t h_{it} L_t$. Rentiers have zero labor productivity, $h_{it} = 0$, but collect a proportional share of total profits generated from the production sector, Π_t. Idiosyncratic labor productivity h_{it} follows an exogenous Markov chain according to the following first-order autoregressive process and a fixed probability of transition between the worker and rentier state:

$$h_{it} = \begin{cases} exp(\rho_h log(h_{it-1}) + \epsilon_{it}^h) & \text{with probability } 1-\zeta \text{ if } h_{it-1} \neq 0 \\ 1 & \text{with probability } \iota \text{ if } h_{it-1} = 0 \\ 0 & \text{else} \end{cases} \tag{8}$$

with $\epsilon_{it}^h \sim N(0, \sigma_h)$. The parameter $\zeta \in (0,1)$ is the probability that a worker becomes a rentier and $\iota \in (0,1)$ is the probability that a rentier becomes a worker. As stated above, workers that become rentiers leave the labor market ($h_{it} = 0$), while rentiers that become workers are endowed with median productivity ($h_{it} = 1$).[11] Workers and rentiers pay the same level of taxation,τ, on their income.

The asset market is incomplete: there are no Arrow-Debreu state-contingent securities; households self-insure themselves only through savings in a non-state contingent risk-free liquid asset, a_{it}, and they can borrow up to an exogenous borrowing limit. The household i budget constraint is:

$$c_{it} + a_{it+1} = \left(\frac{R_t^I}{\pi_t}\right) a_{it} + (1-\tau)(W_t h_{it} L_t + \mathbf{I}_{h_{it}=0}\Pi_t) \; , \qquad a_{it} \geq \underline{a} \; , \tag{9}$$

where $\mathbf{I}_{h_{it}=0}$ takes value 1 if household i is a rentier, or 0 otherwise. On the left-hand side, we have households' expenditure, that is, consumption, c_{it} and 1-year-maturity savings, a_{it+1}. The right-hand side corresponds to households' total earnings, that is, the work/rent income net of taxes, $(1-\tau)(W_t h_{it} L_t + \mathbf{I}_{h_{it}=0}\Pi_t)$, plus earnings (expenses) from savings (borrowings) in the liquid asset, $\left(\frac{R_t^I}{\pi_t}\right) a_{it}$. π_t is the gross inflation rate, while R_t^I is the gross nominal return on liquid assets. Borrowing households pay a "penalty", ω_t^H,

[10] More specifically, deriving the FOC with respect to labor of the households' optimization problem, making use of the new assumed $G(h_{it}, l_{it})$, and combining it with (5), we obtain $l_{it} = [(1-\tau)W_t]^{\frac{1}{\gamma}} = L_t$, since l_{it} depends only on aggregate variables.

[11] Appendix A contains details on the transition matrix for household productivity.

on the interest rate when they ask for a loan. Therefore, R_t^I has two definitions based on household i's wealth:

$$R_t^I = \begin{cases} R_t & \text{if } a_{it} \geq 0 \\ R_t(1+\omega_t^H) & \text{if } a_{it} < 0 \end{cases} \tag{10}$$

According to (7), total goods consumption can be expressed as $c_{it} = x_{it} + \frac{(1-\tau)W_t h_{it} l_{it}}{1+\gamma}$. By substituting this equation into (9), I can rewrite the household budget constraint in terms of composite consumption, x_{it}:

$$x_{it} + a_{it+1} = \left(\frac{R_t^I}{\pi_t}\right) a_{it} + (1-\tau)\left(\frac{\gamma}{1+\gamma} W_t h_{it} L_t + \mathbf{I}_{h_{it}=0}\Pi_t\right) , \qquad a_{it} \geq \underline{a} \ . \tag{11}$$

Equation (11) states that, in this model, what matters for households is the intertemporal allocation of composite consumption, x_{it}, rather than total goods consumption, c_{it}.

The model tracks only net household financial positions. This means that households cannot save and borrow simultaneously. Aggregate liquidity, $A_t = \int a_{it} di$, comprises household savings, and borrowings, B_t. In turn, households can save in three types of deposits that yield the same interest rate: deposits directed to commercial banks and used for household loans, D_t^H, deposits directed to investment banks and used for firm loans, D_t^F, and government bonds, D_t^G. Therefore, I can write the aggregate level of liquidity in the hands of households as:

$$A_t = D_t^H + D_t^F + D_t^G - B_t \ . \tag{12}$$

Since these three saving instruments yield the same interest rate, households are completely indifferent to their portfolio composition.[12]

2.2 Financial intermediaries

Financial intermediaries collect deposits from households and promise returns equal to the risk-free interest rate. There are two types of intermediaries: commercial banks, which specialize in intermediations among households, and investment banks, which specialize in intermediation between households and the production sector.[13] These two types of financial intermediaries define the different types of financial frictions introduced in the

[12]For sake of simplicity, I assume that the portfolio composition of any saver household is the same, and equal to the aggregate level of the three saving instruments.

[13]This is obviously an abuse of terminology if we consider the real meaning of commercial and investment banks, but the idea is to give intuitive names to intermediaries that could clearly distinguish the functions of the two types of bank.

model. First, I explain how commercial banks act before moving to investment banks.

2.2.1 Commercial Banks - Financial frictions on households

Commercial banks act similarly to the financial intermediaries in Cúrdia and Woodford (2016). I assume that banks can lend at most an amount that suffices to allow them to repay what they own to their depositors, considering the higher loan rate that households must pay when borrowing. This implies:

$$R_t(1+\omega_t^H)B_t = R_t D_t^H \ . \tag{13}$$

Furthermore, when originating loans, commercial banks burn resources according to a non-decreasing, weakly convex function of the aggregate level of household debt, $\Xi_t(B_t)$. Therefore, end-of-the-period profits for commercial banks are:

$$\Pi_t^{com} = D_t^H - B_t - \Xi_t(B_t) \ . \tag{14}$$

Using (13), (14) can be rewritten as:

$$\Pi_t^{com} = \omega_t^H B_t - \Xi_t(B_t) \ . \tag{15}$$

Since commercial banks are in perfect competition, a bank chooses B_t that maximizes profits, leading to the F.O.C.:

$$\omega_t^H = \Xi_t'(B_t) \ , \tag{16}$$

with the function $\Xi_t(B_t) = \tilde{\Xi} B_t^{\eta^{FF}}$, with $\tilde{\Xi}$ and η^{FF} being calibrated parameters.

Result (16) directly links the penalty on household borrowings, ω_t^H, to the aggregate level of household debt.[14] An increase in household indebtedness economy-wide results in a higher borrowing penalty, causing further depression in economic activities.

2.2.2 Investment Banks - Financial frictions on firms

Investment banks collect deposits from households and promise returns equal to the real risk-free interest rate, R/π. For ease of display, I assume that the production sector is run by entrepreneurs, who are a mass-zero group of managers who are entitled to all the profits generated in the production sector and rebate them to rentier households. Investment banks and entrepreneurs are responsible for the other financial friction considered in this

[14] It is worth noting that empirical data usually show a higher degree of indebtedness in richer households, who can borrow more and at lower rates using as collateral their accumulated wealth (which, most of the time, is illiquid). However, we should keep in mind that this is a relatively simple model of net financial positions; therefore, it is impossible (and out of the scope of this study) to take track of such dynamics.

model. Following Bernanke et al. (1999), I assume a continuum of entrepreneurs, indexed by j. Entrepreneur j acquires capital, K_j, from capital producers at the end of period t which is used at time $t+1$. To buy capital for production, entrepreneurs rely on two type of financing: internal financing (equity), N_j, and external financing (debt), D_j^F, borrowed from investment banks.

Entrepreneur j's balance sheet at period $t+1$ is:

$$q_t K_{jt+1} = N_{jt+1} + D_{jt+1}^F \ , \tag{17}$$

where q is the price of capital during the purchasing period.

One prerequisite for the financial accelerator to work is that entrepreneurs are not indifferent to the composition of their balance sheets; that is, external financing is more expensive than internal financing. To do so, I introduce a "Costly State Verification" (CSV) problem à la Townsend (1979) in which lenders (investment banks) must pay a fixed auditing cost in order to observe the realized returns of borrowers (entrepreneurs). A relatively higher demand for debt increases auditing costs, resulting in a lower level of aggregate capital obtained for production.

Entrepreneurs repay investment banks with a portion of their realized returns on capital. In this framework, entrepreneurs are risk-neutral, whereas households are risk-averse. This implies a loan contract in which entrepreneurs absorb any aggregate risk on the realization of their profits. I also assume the existence of an idiosyncratic shock to entrepreneur j, ω_j^F,[15] on the gross return on aggregate capital, R^K. The idiosyncratic shock ω^F has a log normal distribution of mean $E(\omega^F) = 1$ that is i.i.d. across time and entrepreneurs, with a continuous and once differentiable c.d.f., $F(\omega^F)$.[16]

The optimal contract for investment banks is:

$$\bar{\omega}_{jt+1}^F R_{t+1}^K q_t K_{jt+1} = Z_{jt+1} D_{jt+1}^F \ , \tag{18}$$

where Z_j is the gross non-default loan rate and $\bar{\omega}_j^F$ is the threshold value for entrepreneur j such that, for $\omega_{jt+1}^F \geq \bar{\omega}_{jt+1}^F$, entrepreneur j repays $Z_{jt+1} D_{jt+1}$ to banks and retains $\omega_{jt+1}^F R_{t+1}^K q_t K_{jt+1} - Z_{jt+1} D_{jt+1}$. In the case of $\omega_{jt+1}^F < \bar{\omega}_{jt+1}^F$, instead, she cannot repay and defaults on her debt, obtaining nothing. Since entrepreneurs' future realizations of capital returns are only known by entrepreneurs ex-post, investment banks must pay a fixed auditing cost, μ, to recover what is left of entrepreneur j's activity after default, obtaining $(1-\mu)\omega_{jt+1}^F R_{t+1}^K q_t K_{jt+1}$.

Because of the optimal contract, investment banks should receive an expected return

[15] As noted by Christiano et al. (2014), ω^F could be thought of as the idiosyncratic risk in actual business ventures: in the hands of some entrepreneurs, a given amount of raw capital is a great success, while in other cases may be not.

[16] Appendix B.1 provides analytical expressions for $F(\omega^F)$ and other functions used in the following equations.

equal to the opportunity cost of their funds. By assumption, they hold a perfectly safe portfolio (i.e., they are able to perfectly diversify the idiosyncratic risk involved in lending), and the opportunity cost for investment banks is the real gross risk-free rate, R/π. It follows that the participation constraint for investment banks that must be satisfied in each period $t+1$ is:

$$[1 - F(\bar{\omega}^F_{jt+1})] Z_{jt+1} D_{jt+1} + (1-\mu) \int_0^{\bar{\omega}^F_{jt+1}} \omega^F_j dF(\omega^F_j) R^K_{t+1} q_t K_{jt+1} \geq \frac{R_{t+1}}{\pi_{t+1}} D_{jt+1} \ , \quad (19)$$

where $F(\bar{\omega}^F_j)$ is entrepreneur j default probability. Since financial markets are in perfect competition, (19) must hold with equality. The first term on the left-hand side of (19) represents the revenues received by investment banks from the fraction of entrepreneurs that do not default, whereas the second term is what investment banks can collect from defaulting entrepreneurs after paying monitoring costs.

Following the notation proposed in Christiano et al. (2014), I combine (17), (18), and (19) to write the following relationship:

$$EFP_{jt+1} = f\left(\bar{\omega}^F_{jt+1}, LEV_{jt+1}\right) \ , \ \text{with} \ f'(LEV_{jt+1}) > 0 \ . \quad (20)$$

where EFP is the "External Finance Premium" that Bernanke et al. (1999) define as the ratio between the return on capital and the real risk-free rate, $R^K/(R/\pi)$, and $LEV = qK/N$ is entrepreneur j's leverage. The EFP can be considered a measure of the cost of external funds for the entrepreneur and, therefore, as a proxy for the strength of financial frictions. The $\left(\bar{\omega}^F_{jt+1}, LEV_{jt+1}\right)$ combinations that satisfy (20) define a menu of state $(t+1)$-contingent standard debt contracts offered to entrepreneur j, who chooses the contract that maximizes its objective.

In Appendix B.2, I illustrate the entrepreneur j's optimization problem, which provides three important outcomes. First, the EFP increases monotonically with LEV. This means that entrepreneurs with a higher level of leverage pay a higher EFP. Second, the threshold value for entrepreneur j's default, $\bar{\omega}^F_j$, is endogenously defined by the EFP. Third, the fact that $\bar{\omega}^F_j$ depends only on the aggregate variables (R, R^K and π) implies that every entrepreneur will choose the same firm structure, that is, $\bar{\omega}^F$ and LEV. Therefore, it is possible to drop superscript j in the notation and consider a representative entrepreneur.

The other fundamental equation for the functioning of this financial accelerator is the law of motion for entrepreneurs' equity, which is expressed as follows:

$$N_{t+1} = \gamma^F \left[q_{t-1} R^K_t K_t - \frac{R_t}{\pi_t} D_t - \mu G(\bar{\omega}^F_t) q_{t-1} R^K_t K_t \right] \ . \quad (21)$$

Equation (21) states that entrepreneurs' equity after the production process at time t

is equal to the gross return on capital net of the loan repayment and auditing costs (which are borne by entrepreneurs because they are risk-neutral). Parameter γ^F represents the share of surviving entrepreneurs who bring their equity to the production process from one period to the next. Conversely, the share of entrepreneurs $1 - \gamma^F$ dies and consumes equity at time t (we can think of this as entrepreneurial consumption). As explained by Carlstrom et al. (2016), this assumption avoids excessive entrepreneurs' self-financing in the long run.

Note that in (21) I did not included entrepreneurial labor, as usual in the literature (e.g., Bernanke et al., 1999, Christiano et al., 2014). The assumption of entrepreneurial labor was introduced mainly to justify the initial amount of equity for new entrepreneurs that take the place of the dead ones. However, to keep the model as simple as possible, I follow Carlstrom et al. (2016), assuming that new entrepreneurs' initial equity comes from a lump-sum transfer from existing entrepreneurs. Even so, since the funding can be arbitrarily small and since only aggregate equity matters, this transfer can be neglected in equation (21).[17]

Alternatively, (21) can be written in a more compact form as:

$$N_{t+1} = \gamma^F \left[1 - \Gamma(\bar{\omega}_t^F)\right] R_t^K q_{t-1} K_t \ , \tag{22}$$

where $\left[1 - \Gamma(\bar{\omega}_t^F)\right]$ is the share of capital returns to which the non-defaulting entrepreneurs are entitled.[18] Equation (22), together with (20), explain this financial accelerator mechanism. Equation (20) states that an increase in entrepreneurs' leverage increases also the EFP. At the same time, (22) tells that an increase in the EFP increases $\bar{\omega}^F$ as well, negatively affecting entrepreneurs' equity level for the next period and, therefore, impacting the aggregate leverage.

2.3 Intermediate-goods producers

Intermediate-goods producers adopt a standard Cobb-Douglas production function with constant returns to scale, employing aggregate capital, K, supplied by entrepreneurs and labor, L, from workers:

$$Y_t = z_t L_t^{\alpha} K_t^{1-\alpha} \ , \tag{23}$$

where z is the Total Factor Productivity (TFP).

TFP follows a first-order autoregressive process of type:

$$log(z_t) = \rho_z log(z_{t-1}) + \epsilon_t^z \ , \tag{24}$$

[17] Bernanke et al. (1999) keep the share of income going to entrepreneurial labor at a very low level (on the order of 0.01), therefore neglecting this income sounds as a reasonable model simplification.

[18] See Appendix B.2

with ϵ_t^z following a normal distribution with mean 0 and variance σ^z.

Intermediate goods producers sell their production to resellers at a relative price MC_t. Therefore, their profit optimization is given by:

$$\Pi_t^{IG} = MC_t z_t L_t^{\alpha} K_t^{1-\alpha} - w_t L_t - r_t^K K_t \ . \tag{25}$$

Since they are in perfect competition, their profit optimization problem returns the wage paid per unit of labor and the rent paid per unit of capital:

$$W_t = \alpha MC_t z_t \left(\frac{K_t}{L_t}\right)^{(1-\alpha)} \ , \tag{26}$$

$$r_t^K = (1-\alpha)\, MC_t z_t \left(\frac{L_t}{K_t}\right)^{\alpha} \ . \tag{27}$$

2.4 Resellers

Resellers are agents assigned to differentiate intermediate goods and set prices. Price adjustment costs follow a Rotemberg (1982) setup, and resellers preserve entrepreneurial characteristics.[19] The demand for the differentiated good g is:

$$y_{gt} = \left(\frac{p_{gt}}{P_t}\right)^{-\eta} Y_t \ , \tag{28}$$

where $\eta > 1$ is the elasticity of substitution and p_g is the price at which good g is purchased.

Given (28) and the quadratic costs of price adjustment, the resellers maximize:

$$E_0 \sum_{t=0}^{\infty} \beta^t Y_t \left\{ \left(\frac{p_{gt}}{P_t} - MC_t\right) \left(\frac{p_{gt}}{P_t}\right)^{-\eta} - \frac{\eta}{2\kappa} \left(log \frac{p_{gt}}{p_{gt-1}}\right)^2 \right\} \ , \tag{29}$$

with a time-constant discount factor.[20]

The New Keynesian Phillips Curve (NKPC) derived from the F.O.C. for price setting is as follows:

$$log(\pi_t) = \beta E_t \left[log(\pi_{t+1}) \frac{Y_{t+1}}{Y_t} \right] + \kappa \left(MC_t - \frac{\eta - 1}{\eta} \right) \ , \tag{30}$$

[19] Bayer et al. (2019) make the further assumption that price setting is delegated to a mass-zero group of households (managers) that are risk neutral and compensated by a share in profits. Since in my model the whole production sector is run by entrepreneurs that, by assumption, are risk neutral and entitled to all the profits generated in this sector, I do no need to make this further assumption.

[20] As explained by Bayer et al. (2019), only the steady state value of the discount factor matters in the resellers' problem, due to the fact that I calibrate to a zero inflation steady state, the same value for the discount factor of managers and households and approximate the aggregate dynamics linearly. This assumption simplifies the notation, since fluctuations in stochastic discount factors are virtually irrelevant.

where π_t is the gross inflation rate defined as $\frac{P_t}{P_{t-1}}$.

2.5 Capital producers

After production at time t, entrepreneurs sell depreciated capital to capital producers at a price q_t. They refurbish depreciated capital at no cost,[21] and uses goods as investment inputs, I_t, to produce new capital, $\Delta K_{t+1} = K_{t+1} - K_t$, subject to quadratic adjustment costs. Finally, they resell the newly produced capital to entrepreneurs before entering the next period (therefore still at price q_t). The law of motion for capital producers is:

$$I_t = \Delta K_{t+1} + \frac{\phi}{2}\left(\frac{\Delta K_{t+1}}{K_t}\right)^2 K_t + \delta K_t \ . \tag{31}$$

where δ is the depreciation rate for capital.

Then, they maximize their profits, $q_t \Delta K_{t+1} - I_t$, w.r.t. newly produced capital, ΔK_{t+1}. This optimization problem delivers the optimal capital price:

$$q_t = 1 + \phi \frac{\Delta K_{t+1}}{K_t} \ . \tag{32}$$

Equation (32) ensures that if the level of aggregate capital increases over time, so does its price.

It follows that entrepreneurs' return on capital does not depend only on goods production, but also on fluctuations in capital price; since entrepreneurs buy capital at the end of the period, with the price of that period, they see their capital at the beginning of the next period appreciated (depreciated) if q increases (decreases). The gross return on capital employed at time t can be written as:

$$R_t^K q_{t-1} K_t = r_t^K K_t + q_t K_t (1-\delta) \ , \tag{33}$$

where the first term on the right-hand side is the marginal productivity of capital derived in (27), and the second term represents eventual capital gains (or losses) net of depreciation. I can rearrange and finally derive the gross interest rate of capital as:

$$R_t^K = \frac{r_t^K + q_t(1-\delta)}{q_{t-1}} \ . \tag{34}$$

2.6 Final-goods producers

Final-goods producers are perfectly competitive, buy differentiated goods from resellers at a given price, and produce a single homogeneous final good that is used for consump-

[21]The "no cost" assumption does not mean that δK is refurbished for free. Capital producers still need to buy the exact amount of I necessary to refurbish depreciated capital, but do not waste any further resources in this process. In fact, the law of motion for capital producers in the steady state (when $\Delta K = 0$) is $I = \delta K$.

tion, government spending, and investment. The optimization problem of final-goods producers is:

$$\max_{\{Y_t, y_{gt} \in [0,1]\}} P_t Y_t - \int_0^1 p_{gt} y_{gt} dg \ , \tag{35}$$

subject to the following Constant Elasticity of Substitution (CES) function:

$$Y_t = \left(\int_0^1 (y_{gt})^{\left(\frac{\eta-1}{\eta}\right)} dg \right)^{\left(\frac{\eta}{\eta-1}\right)} . \tag{36}$$

From the zero-profit condition, the price index of the final good is:

$$P_t = \left(\int_0^1 (p_{gt})^{(1-\eta)} \right)^{\left(\frac{1}{1-\eta}\right)} . \tag{37}$$

2.7 Central bank

The central bank is responsible for the monetary policy. It sets the gross nominal risk-free interest rate, R_t, reacting to the deviation from steady state inflation, and engages interest rate smoothing. The Taylor-type rule employed by the central bank is as follows:

$$\frac{R_{t+1}}{\bar{R}} = \left(\frac{R_t}{\bar{R}} \right)^{\rho_R} \left(\frac{\pi_t}{\bar{\pi}} \right)^{(1-\rho_R)\rho_\pi} \epsilon_t^R \ , \tag{38}$$

where ϵ_t^R is the monetary policy shock defined as $log(\epsilon_t^R) \sim N(0, \sigma_R)$. The parameter $\rho_R \geq 0$ rules the interest rate smoothing (if $\rho_R = 0$, the next-period interest rate depends only on inflation), whereas ρ_π captures the magnitude of the central bank's response to inflation fluctuations: the larger ρ_π, the stronger the central bank reaction (for the case limit $\rho_\pi \to \infty$, the inflation is perfectly stabilized at its steady state level).

2.8 Government

The government acts as fiscal authority. It determines the level of public expenditure, G_t, tax revenues, T_t and issuance of new bonds, D_{t+1}^G. Its budget constraint is given by:

$$D_{t+1}^G = \left(\frac{R_t}{\pi_t} \right) D_t^G + G_t - T_t \ , \tag{39}$$

where T_t are the taxes collected from both workers and rentier households:

$$T_t = \tau \left[\int W_t h_{it} L_t d\Theta_t(a,h) + \mathbf{I}_{h_{it}=0} \Pi_t \right] \ , \tag{40}$$

and $\Theta_t(a,h)$the joint distribution of liquid assets and productivity across households on date t.

Bond issuance is regulated by the following rules:

$$\frac{D_{t+1}^G}{\bar{D}^G} = \left(\frac{D_t^G \frac{R_t}{\pi_t}}{\bar{D}^G \frac{\bar{R}}{\bar{\pi}}} \right)^{\rho_{gov}} \quad . \tag{41}$$

Coefficient ρ_{gov} captures how fast the government wants to balance its budget. When $\rho_{gov} \to 0$, the government aims to balance its budget by adjusting spending. Instead, when $\rho_{gov} \to 1$, the government is willing to roll over most of the outstanding debt.

2.9 Market clearing

The liquid asset market clears when:

$$\int a^*(a,h)\Theta_t(a,h)dadh = A_t \ , \tag{42}$$

where $a^*(a,h)$ is the optimal saving policy function of the household.

The market for capital clears for (31) and (32), while the labor market clears for (26).

Finally, good market clearing, which holds by Walras' law when other markets are clear, is defined as:

$$Y_t \left(1 - \frac{\eta}{2\kappa} \left(log(\pi_t) \right)^2 \right) = C_t + G_t + I_t + C_t^E + \mu G(\bar{\omega}_t^F) R_t^K q_{t-1} K_t + \Upsilon_t \ , \tag{43}$$

where on the left-hand side we have total output net of quadratic costs of price adjustment. On the right-hand side, apart from household good consumption, public expenditure and investments, we also find entrepreneurial consumption, C^E (due to dying entrepreneurs), auditing costs for investment banks, and resources used for household loans, $\Upsilon_t = \Xi_t(B_t) + \omega_t^H B_t$.[22]

2.10 Numerical implementation

To solve the model, I follow the solution proposed in Bayer and Luetticke (2020). Since the joint distribution, Θ_t, is an infinite-dimensional object (and therefore not computable), it is discretized and represented by its histogram, a finite-dimensional object. I solve the household's policy function using the Endogenous Grid-point Method (EGM) developed by Carroll (2006), iterating over the first-order condition and approximating the idiosyncratic productivity process using a discrete Markov chain with three states using the Tauchen (1986) method. The log grid for liquid assets comprises of 100 points. I solve for aggregate dynamics by first-order perturbation around the steady state, as in Reiter

[22] Similarly to Kaplan et al. (2018), the last two terms in (43) can be considered as expenses for "financial services".

(2009). The joint distribution is represented by a bi-dimensional matrix (capital K does not display heterogeneity) with a total of 400 grid points, maintaining a sufficiently low computational time.

3 Calibration

The model is calibrated on the US economy, and because the focus is on conventional monetary policy, business cycle moments are targeted on the *Great Moderation* (i.e. 1985-2007). Periods in the model represent quarters; consequently, the following values for the calibrated parameters are intended quarterly, unless otherwise specified. Table 1 provides a list of calibrated parameters for the model, whereas Table 2 displays the key moments of the wealth distribution used as targets and examines how well the model replicates them.

3.1 Households

For the households' utility function, I assume the coefficient of relative risk aversion $\xi = 4$, as in Bayer et al. (2019). I set the Frisch elasticity of labor supply $\gamma = 1$, in line with the results of Chetty et al. (2011). The intertemporal discount factor, β, is equal to 0.988, so that deposits in investment banks are sufficient to have a leverage for entrepreneurs of 2, the same value used by Bernanke et al. (1999) in their model. The borrowing limit, $\underline{a}$, is set such that 16% of households have a negative wealth position, a value in line with empirical data from the Survey of Consumer Finances (SCF) 1983–2007 (Luetticke, 2021).

The calibration of the productivity transition matrix, which determines how households move between the worker and rentier states, aims to provide a distribution of wealth consistent with empirical data. As in Luetticke (2021), I assume that the probability of becoming a rentier is the same for workers independent of their labor productivity, and that once they become workers again, they start with median productivity. The probability of leaving the rentier state is $\iota = 0.0625$, following the findings of Guvenen et al. (2014) on the probability of dropping out of the top 1% income group in the US. The probability of moving from the worker to the rentier state is set to $\zeta = 0.00115$, a value calibrated to obtain a Gini coefficient for wealth of 78% (in line with data from the SCF), which implies a share of rentier households equal to 1.8%. Regarding idiosyncratic income risk for labor productivity, I set autocorrelation $\rho_h = 0.98$ and standard deviation $\sigma_h = 0.06$, as estimated by Bayer et al. (2019).

Table 1: Calibrated parameters

Parameter	Value	Description
β	0.988	Discount factor
ξ	4	Relative risk aversion
γ	1	Frisch elasticity of labor
$\underline{a}$	-2.6	Borrowing constraint
ι	0.0625	Prob. of leaving entr. state
ζ	0.00115	Prob. become rentier
ρ_h	0.98	Persistence of idio. prod. shock
σ_h	0.06	SD if idio. prod. shock
α	0.7	Labor share of production
δ	1.35%	Depreciation rate
η	20	Elasticity of substitution
κ	0.09	Price stickiness
ϕ	7.5	Adjustment cost of capital
γ^F	0.986	Entr. surviving rate
ρ_z	0.95	TFP shock persistence
σ_z	0.87%	TFP shock SD
R	1.005	Nominal int. rate
ρ^R	0.8	Int. rate smoothing
ρ^π	1.5	Reaction to inflation
σ_R	0.25% - 0.14%	Monetary shock SD
τ	0.3	tax rate
ρ_{gov}	0.86	Auto-correlation of debt
η^{FF}	51.62	convex technology for HHs loans
$\tilde{\Xi}$	$1.26e^{29}$	comm. bank loans parameter
μ	0.12	Auditing costs
σ_ω	0.27	SD of the id. shock on entr.

Table 2: Wealth distribution moments

Target	Model	Data
Gini index (calibrated)	0.78	0.78
Share of borrowers (calibrated)	0.16	0.16
top 10% wealth	0.69	0.67

3.2 Financial intermediaries

I target the two spreads for the financial frictions to be equal to 2% p.a.. The reasons for this choice are twofold. First, it involves comparison purposes between the two scenarios. Second, they are the same values used in both Bernanke et al. (1999) and Cúrdia and Woodford (2016), allowing the model to be consistent with the existing literature.

Regarding commercial banks, I follow Cúrdia and Woodford (2016), assuming that a one-percent increase in the volume of credit increases the borrowing spread by one percentage point p.a.. Together with the targeted value $\omega^H = 0.005$, this implies $\eta^{FF} = 51.62$ and $\tilde{\Xi} = 1.26e^{29}$.

The parameters concerning financial frictions on firms are in the ballpark of Bernanke et al. (1999) calibrations; therefore, the auditing cost is $\mu = 0.12$ and the standard deviation of the idiosyncratic shock on the entrepreneur's returns is $\sigma_\omega = 0.27$, which are calibrated to have $EFP_t = 1.005$ when the corporate leverage is 2. The share of surviving entrepreneurs, γ^F, is calibrated such that, at steady state, the equity level in (22) is equal to the equity implied by (20).

3.3 Production Sector

The labor share of production (accounting for profits) and capital depreciation rate follow standard values in the literature and are set respectively to $\alpha = 0.7$ and $\delta = 1.35\%$. The mark-up is also standard, at 5%, which implies elasticity of substitution between goods varieties $\eta = 20$. The price stickiness parameter in the NKPC, $\kappa = 0.09$, is calibrated to generate a slope of the curve similar to the one that would arise in a model with sticky prices à la Calvo, with an average price duration of four quarters. The adjustment cost of capital parameter is calibrated to $\phi = 7.5$ to obtain investment-to-output volatility of 3 after a TFP shock, a standard value for U.S. data, in a scenario where none of the frictions are active.[23]

3.4 Central Bank and Government

Inflation at the steady state is set to 0, and the nominal (therefore real) interest rate on government bonds is 2%, a value in line with the real average federal funds rate for the Great Moderation period. I impose the same interest rate on all types of liquid savings (i.e., bonds and bank deposits); otherwise, households would choose to invest only in one asset or the other. Regarding the Taylor rule adopted by the Central Bank, the parameter for interest rate smoothing is $\rho_R = 0.8$, according to findings by Clarida et al. (2000), whereas the reaction to inflation fluctuations from the steady state is $\rho_\pi = 1.5$, which is

[23] The TFP considered for this calibration has a standard deviation of $\sigma_z = 0.01$ and a persistence parameter of $\rho_z = 0.95$.

a common value in the macroeconomic literature.

For comparison purposes, I apply two different magnitudes for the monetary policy shock in the two scenarios. The standard deviation of the monetary policy shock for the case with financial frictions on household borrowing ability is $\sigma_R = 0.25\%$. I then calibrate the shock for the other scenario to have a similar fluctuations in output between the two cases, delivering a parameter $\sigma_R = 0.14\%$ quarterly. The persistence of the shock is zero, implying that it is a one-time innovation.

The taxes set by the government are proportional to labor income and profits, with a tax rate $\tau = 0.3$ that targets the ratio of government spending to GDP to a standard value in the New Keynesian literature, approximately $G/Y = 20\%$. Since I am using a fiscal policy rule similar to the one adopted by Bayer et al. (2019), I also follow their estimation and set $\rho_B = 0.86$. This implies that most of the fiscal dynamics goes through government debt, with public spending adjusting to re-stabilize debt to its steady state level.

4 Results

Before moving to inequality analyses, I examine aggregate fluctuations following the contractionary monetary policy shock. These results are not only useful for checking the consistency of my findings with the related literature, but also provide hints on differences at the idiosyncratic level between the two scenarios.

4.1 Aggregate fluctuations

As mentioned in Section 3.4, I assume two different magnitudes for monetary contraction. As a matter of fact, the two financial frictions are different in their mechanism complexity, with the one affecting firms being more complex and delivering a higher level of financial acceleration. Therefore, I believe that a fairer comparison would be between two shocks that have similar effects on the output, rather than between two identical shocks. However, as Appendix E shows, considering the same magnitude for the monetary policy shock does not substantially change the main findings of this study.

Figure 1 shows the responses for output, Y, and investment, I.[24] In the first year, the drop in output is almost identical in both scenarios, as intended. When considering active frictions on household borrowings, the recovery is more rapid and it slightly overshoots, whereas for frictions on firms the value remains below the steady state for the whole period considered in the figure. The investment level falls slightly more when considering financial frictions on firms, and its overshooting is considerably weaker and more short-lived than the alternative scenario considered in this analysis. Financial frictions on firms

[24]More aggregate impulse responses can be found in Appendix D.

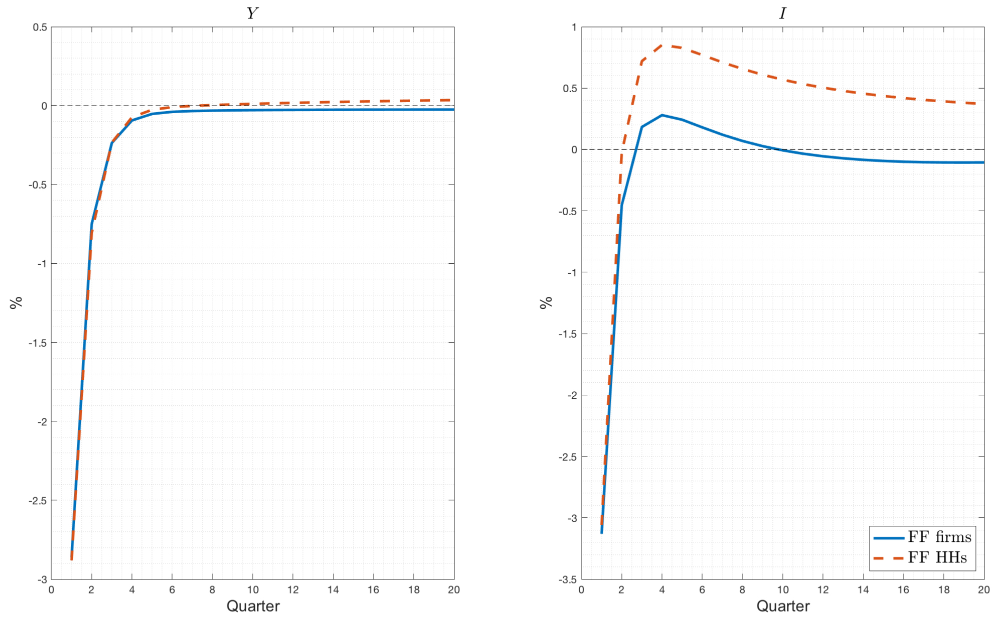

Figure 1: Impulse response to a monetary contraction for aggregate variables.

Note: monetary shock $\epsilon^R = 0.0025$ for active financial frictions on household borrowing, $\epsilon^R = 0.0014$ otherwise. The blue line refers to an economy with financial frictions on firms, the red dashed one when frictions are on households.

seem to generate a more pronounced impact on production-related variables even after a relatively weaker monetary contraction.

Consumption and labor dynamics are displayed in Figure 2. Goods consumption, C, falls relatively more on-impact when considering active frictions on households. In the first nine quarters, the goods consumption response is lower but then overshoots and overtakes IRF values for the comparative scenario. Recall that goods consumption can be expressed as a function of composite consumption, X, and labor, L. The right-hand side graph in Figure 2 shows that labor dynamics are fairly similar in the two scenarios. Therefore, the difference in responses occurring in C is almost entirely due to what occurs at the composite consumption level. Under active financial frictions on firms, X falls on-impact and then strongly overshoots, beginning its reversion to the steady state value almost immediately. Conversely, composite consumption under active financial frictions on households exhibits a relatively much greater fall on impact. It follows that household borrowing frictions imply a relatively more powerful reaction at the consumption level. In this scenario, it takes the impulse response of X five quarters to overshoot, but then it keeps increasing for the remaining period considered in the figure. Approximately nine quarters after the shock, the value of composite consumption in this case exceeds that of frictions on the production sector. This is the same timing as that in the responses for goods consumption. This outcome is a consequence of the fact that, as mentioned above, labor dynamics are virtually similar in the two models. Given this result, and in light of the implications of (11), I focus on the dynamics of X rather than C to better understand

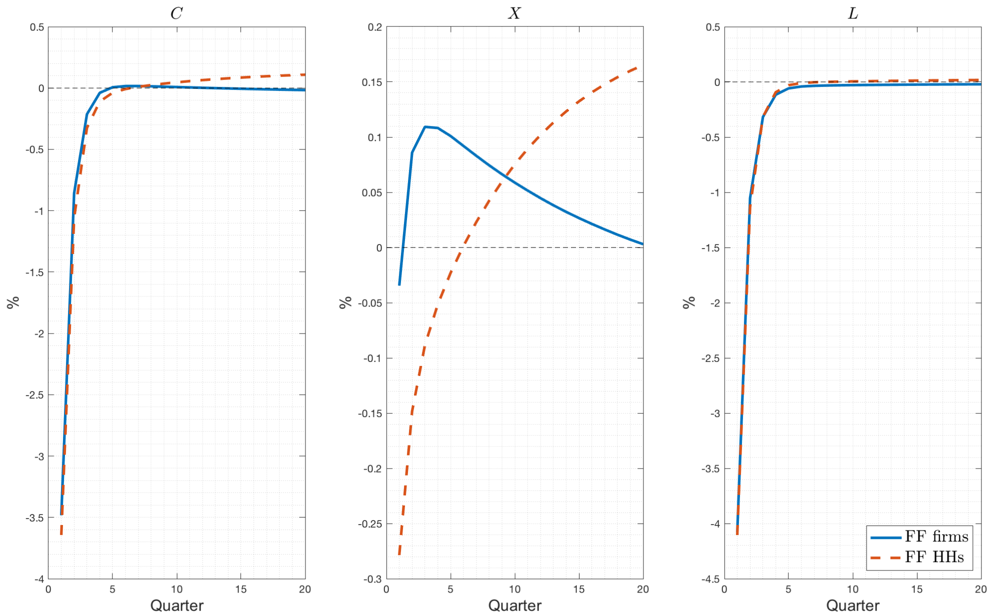

Figure 2: Impulse response to a monetary contraction for aggregate variables.
Note: monetary shock $\epsilon^R = 0.0025$ for active financial frictions on household borrowing, $\epsilon^R = 0.0014$ otherwise. The blue line refers to an economy with financial frictions on firms, the red dashed one when frictions are on households.

the effects of the two financial frictions on household consumption.[25] In Appendix F, I analyze goods consumption as well, demonstrating that the main findings remain valid.

4.2 Wealth and consumption inequality

Employing the Gini index of inequality for wealth and composite consumption, I now answer the initial question posed in this paper, that is, whether financial frictions affect household distribution of wealth and consumption differently after a contractionary monetary policy shock. The evolution of the indices for the two cases, the blue solid and red dashed lines, are shown in Figure 3.

The Gini indices for both wealth and consumption increase following a contraction in monetary policy in both scenarios under consideration. The Gini index for wealth displays a hump-shaped trajectory, whereas the Gini index for consumption starts to revert instantaneously to its equilibrium value. However, this reversion process is long-lasting for both indices.

A first important result emerges when examining which type of friction results in a more pronounced fluctuation in inequality for a given variable. Examination of the Gini index for wealth indicates that financial frictions affecting firms lead to a more

[25]It must be noted that the visual difference in terms of "curve behavior" between responses for X and C is mostly due to the magnitude of the fluctuations. For instance, if we focus on the on-impact difference between the two models, we observe a similar differential in both composite and goods consumption, but the order of magnitude of the Y-axis in Figure 2 is different for these two variables.

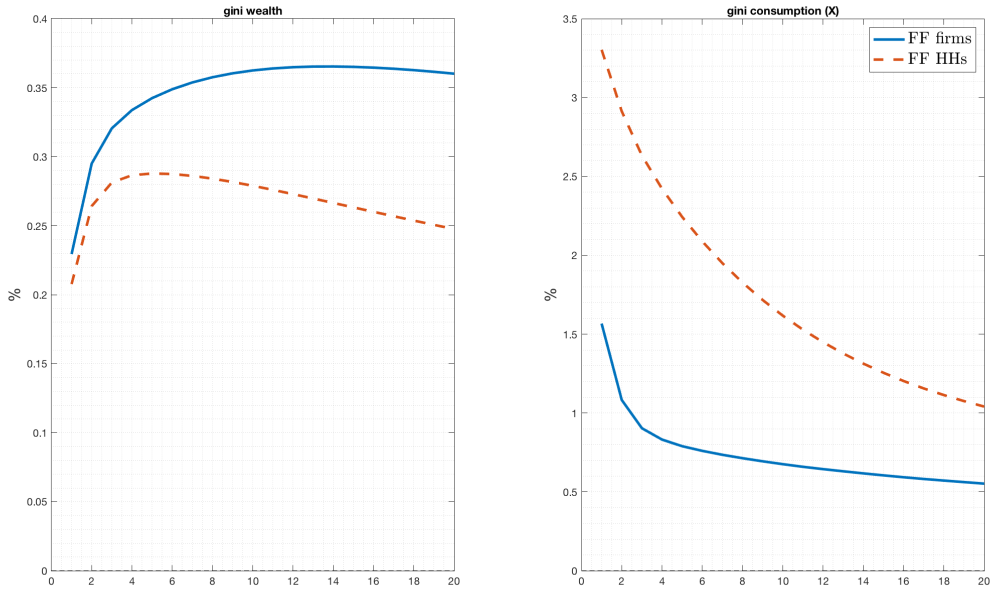

Figure 3: Impulse responses to a monetary contraction
for wealth and consumption inequality.

Note: monetary shock $\epsilon^R = 0.0025$ for active financial frictions on household borrowing, $\epsilon^R = 0.0014$ otherwise. The blue line refers to an economy with financial frictions on firms, the red dashed one when frictions are on households.

significant response. Conversely, when analyzing the Gini index for consumption, it is evident that financial frictions related to household borrowing have a greater influence. Therefore, the wealth distribution is more sensitive to frictions in the production sector of the economy, whereas the dispersion of consumption is more impacted by frictions that hinder households' capacity to borrow liquidity.

Despite its utility, the Gini index falls short in revealing how the dispersion of wealth and consumption occurs across various individuals. Therefore, to understand the dynamics underlying the different responses in these indices, I first examine the distribution of households based on specific proportions of wealth held by individuals. Subsequently, I delve into an analysis of consumption patterns.

4.3 Wealth dynamics

To investigate the dynamics of wealth inequality within households subsequent to the aggregate shock, I focus on three indicators that capture different aspects of household composition. These indicators encompass the share of households with borrowing obligations (i.e., those experiencing negative liquidity), the share of Hand-to-Mouth (HtM) households, and the percentage of wealth concentrated among the top 10% richest households in the distribution. The calibration of HtM households in this model is addressed in Appendix C.

The results of the IRFs for these three measures are displayed in Figure 4. Wealth

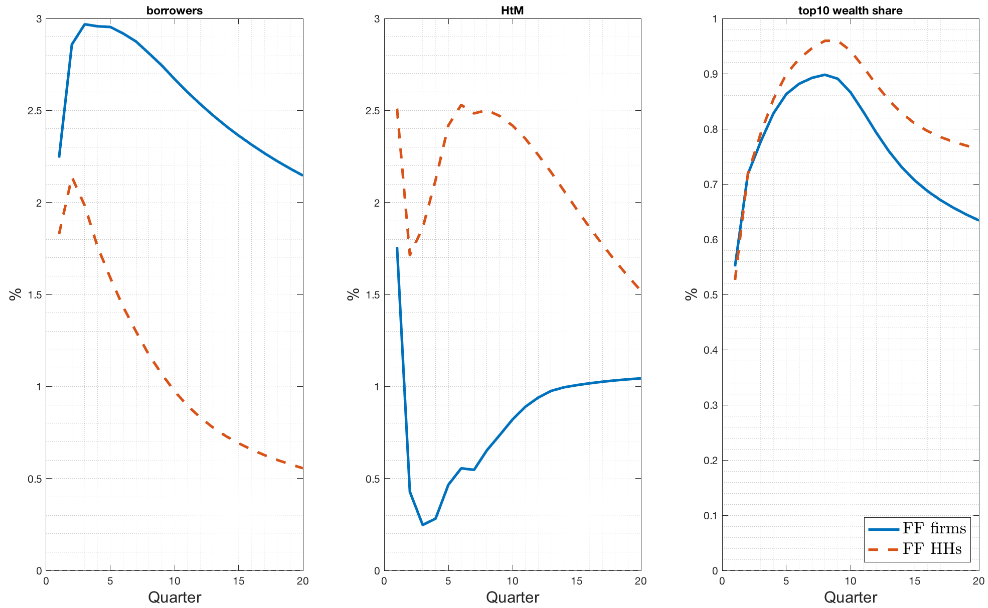

Figure 4: IRFs for the share of borrowing households, HtM households and wealth held by the top 10%

Note: monetary shock $\epsilon^R = 0.0025$ for active financial frictions on household borrowing, $\epsilon^R = 0.0014$ otherwise. The blue line refers to an economy with financial frictions on firms, the red one when frictions are on households.

held by the top 10% experiences a slightly higher increase on impact in the presence of active frictions on firms. However, the red dashed line, which represents fluctuations in case of active household borrowing frictions, surpasses the comparison scenario almost immediately and displays higher values for the remainder of the period depicted in the figure.

This dynamic is consistent with what happens both in terms of demand and supply of credit. Recall that in this model, all wealth held by households is liquid, and the richest top 10% holds almost 70% of all wealth in the economy. As a result, wealthier individuals benefit greatly from increases in the real interest rate, and they also serve as the main providers of credit. As shown in Figure D.1 in Appendix D, the real interest rate response is higher for financial frictions on households by construction. Therefore, richer households in this scenario are willing to take more credit because it yields relatively higher interests. Furthermore, firms in this model specification see their frictions shut off, resulting in a relative reduction in the cost of borrowing funds from households. It can be noted always in Figure D.1 that the quantity of debt demanded by productive firms, D^F, shows relatively higher responses when financial frictions on households are present, expect on impact, where the IRF for the case of financial frictions on firms is slightly higher.

Wealth fluctuations at the top of the distribution, then, would suggest a higher wealth inequality in the case of financial frictions on households throughout the majority of the initial five-year period, but that is not the case according to the Gini coefficient displayed in Figure 3. Therefore, this highlights the significance of the main shifts happening at the lower end of the distribution, where low-wealth households and borrowers are situated.

According to Figure 4, households that are either HtM or resorting to debt increase in number after a monetary contraction. Interestingly, the proportion of borrowers shows a more pronounced increase in cases of frictions related to firm borrowing, whereas the percentage of HtM households exhibits a relatively higher increase in cases of frictions related to household borrowing.

Household behavior near the zero-wealth threshold and fluctuations in the household loan rate provide a plausible explanation for these dynamics. Following a contractionary monetary shock, households experience deteriorating labor conditions, particularly affecting poorer households the most, as they heavily rely on labor income for consumption and debt repayment. Consequently, an increasing number of households find themselves at the bottom of the wealth distribution, either depleting their savings or accumulating more debt to smooth consumption. Financial frictions that exclusively impact productive firms lead to a scenario where borrowing for households becomes comparatively more affordable than when frictions directly affect households. This is due to the fixed loan premium, ω^H, in the former case, while it increases in the latter case, leading to higher household loan costs. Consequently, more households opt for borrowing when facing frictions on firms, while more remain near the zero-wealth threshold due to the deterrent effect of higher loan rates in presence of household borrowing frictions.

This interpretation aligns with the fluctuations observed in the Gini index for wealth in both scenarios, emphasizing the significance of the lower end of the distribution in generating disparities between the two cases. Moreover, it could also account for the dynamics observed at the consumption level. Households rely on their borrowing capacity to ensure a consistent level of consumption. If a larger share of agents are unable to borrow due to higher loan rates, this could result in a diminished ability to smooth consumption for a greater number of households (in comparison to a scenario with a fixed loan rate), consequently leading to a relatively higher dispersion in consumption. To determine the plausibility of this intuition, I proceed with an analysis of consumption dynamics.

4.4 Consumption dynamics

The decomposition of the impulse response of the aggregate consumption into average consumption responses for specific shares of the population provides valuable insights into the diverse consumption patterns observed after a contractionary monetary shock.[26]

[26] I choose to use average consumption fluctuations instead of absolute consumption fluctuations because I think they are better suited for comparisons between the two cases, but also for comparisons within the same case with respect to aggregate consumption fluctuations. Note that aggregate consumption is the case limit where the average consumption for the whole population is considered.

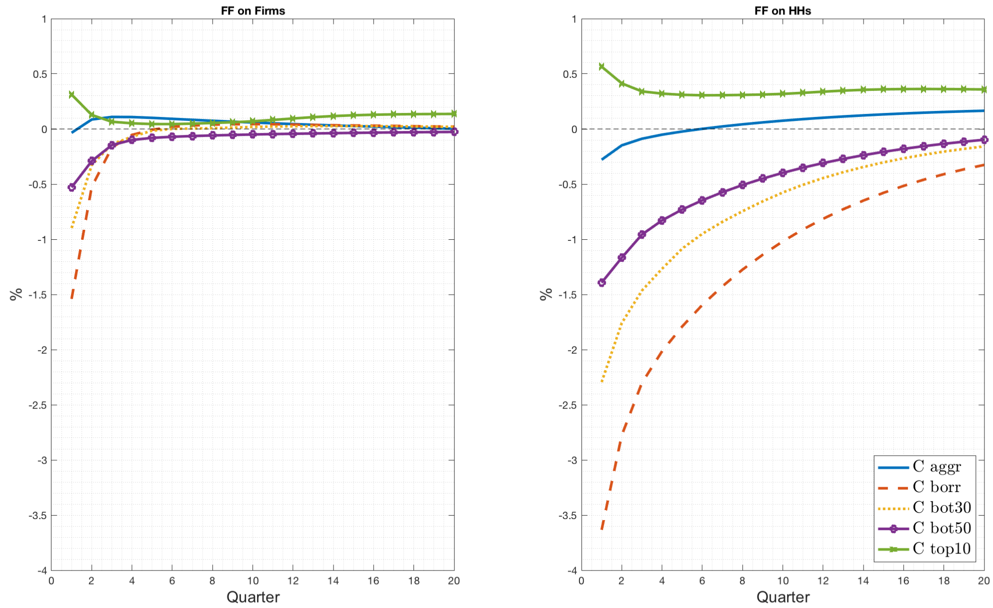

Figure 5: Average consumption f1or different shares of households.
Note: monetary shock $\epsilon^R = 0.0025$ for active financial frictions on household borrowing, $\epsilon^R = 0.0014$ otherwise.

The consumption decomposition for the case of financial frictions of firms is depicted on the left-hand side of Figure 5, while the right-hand side illustrates the counterfactual scenario of frictions on household borrowing.

Households situated at the top of the wealth distribution tend to exhibit higher consumption levels when financial frictions on households are present, partially explaining why the Gini index for consumption increases more in this case. Note, however, that when we compare the on-impact response of the top 10% with that of the borrowers' share, the magnitude of the former is significantly lower in both frictions scenarios, although more persistent over time. This trend is in line with the fact that affluent households are witnessing an uptick in their earnings, predominantly stemming from interest earned on savings, yet possess a lower MPC than their less wealthy counterparts. It is important to remember that under conditions of financial frictions on households, the real interest rate is higher by design. Therefore, it is expected to witness heightened consumption among the top 10% in this scenario, as their main source of income is financial.

Except differences in magnitudes mentioned above, the behavior of consumption at the top 10% is fairly similar. On the other hand, this does not seem the case when focusing on the lower half of the distribution. On impact, the decline in consumption for borrower households is roughly three times greater when financial frictions on households are present, compared to the situation for frictions on firms. This ratio diminishes as the percentage of households considered in the lower half of the wealth distribution increases, yet it remains significant. Upon analyzing the mean consumption of the whole bottom half of the population, it is evident that the immediate decline with household financial frictions is more than twice as high as in the alternative situation.[27]

Moreover, the contrast between the two model specifications reveals notable disparities in the persistence of the IRFs in the bottom half as well. Poorer households facing borrowing frictions not only witness a significant decline in average consumption at the outset, but also a notably sluggish convergence toward the steady state level. For instance, let us consider the dynamics for borrower households. In case of frictions only on the production sector, their average consumption overshoots after approximately one year. Conversely, if households confront constraints in their borrowing activities, their consumption never rebounds within the time-frame analyzed in Figure 5, that is, five years.[28]

The dynamics of consumption in proximity to the zero-wealth threshold can be explained by the behavior of the borrowing penalty, ω^H. Under financial frictions on firms, ω^H is fixed at its stead-state level. Consequently, a higher proportion of households choose to borrow money to ensure a more stable consumption pattern compared to the counterfactual situation where household borrowing is more expensive. Moreover, since they do not face frictions on borrowings, their consumption levels recover at a faster pace and are consistent with labor dynamics, given that their primary income source is labor earnings. Conversely, when there are financial frictions on households, ω^H rises following a monetary tightening and gradually returns to its original level, as illustrated in Figure D.1 in Appendix D. Similarly, the IRF for consumption displays a slow recovery process.

Differences in consumption responses offer insight into the dynamics near the zero-wealth boundary in Figure 4 and, therefore, in terms of consumption and wealth inequality. In presence of financial frictions on households, a greater number of households opt to remain HtM, while fewer households choose to borrow with respect to the counterfactual scenario, due to the fluctuation of the borrowing penalty. This results in reduced wealth inequality among the population, as a larger proportion of households opt not to fall to the very bottom of the wealth distributions, unlike the situation with a fixed ω^H. Conversely, an increase in HtM households leads to decreased consumption smoothing. In addition, individuals who choose to borrow end up consuming even less, as they must repay a higher interest rate, leading to greater consumption inequality compared to when there are frictions in the production sector. This clarifies both the lower Gini index for wealth and the higher Gini index for consumption in Figure 3 when households encounter frictions on borrowing.

[27] Greater household share values encompass the consumption of lesser shares. This implies that the mean consumption of the lowest 50% also encompasses the consumption of the lowest 30%, which in turn encompasses the consumption of borrowers.

[28] Extending the span for IRFs, the overshooting takes place roughly 55 quarters later.

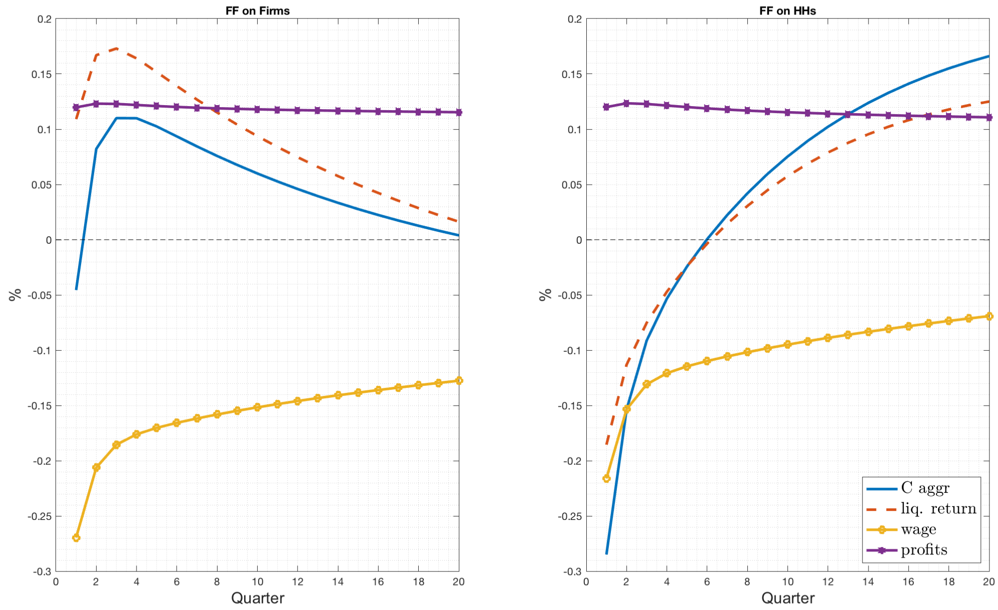

Figure 6: Consumption decomposition for relevant prices

Note: monetary shock $\epsilon^R = 0.0025$ for active financial frictions on household borrowing, $\epsilon^R = 0.0014$ otherwise. The graph on the left-hand side represents the decomposition for the case of friction on firms, while the one on the right-hand side represents the case of friction on household borrowing.

4.5 Consumption decomposition

In order to assess whether the rise in the household loan rate is the primary factor influencing the different household behavior near the zero-wealth threshold in the two comparative scenarios considered so far, I resort to the consumption decomposition approach outlined by Luetticke (2021). In order to decompose the monetary transmission mechanism, I express the total composite consumption as a series of household policy functions that are determined by the equilibrium prices relevant to household consumption decisions, based on the budget constraint (9). The household policy functions are represented by the sequence $\{\Omega_t\}_{t\geq 0}$, where $\Omega_t = \left\{ \frac{R_t^I}{\pi_t}, W_t, \Pi_t \right\}$. Therefore, the aggregate composite consumption can be written as:

$$X_t \left(\{\Omega_t\}_{t\geq 0} \right) = \int x_t \left(a, h; \{\Omega_t\}_{t\geq 0} \right) d\Theta_t, \tag{44}$$

where $\Theta_t \left(da, dh; \{\Omega_t\}_{t\geq 0} \right)$ is the joint distribution of liquid assets and idiosyncratic labor productivity. Totally differentiating (44), I decompose the total response to monetary shocks into parts explained by each single price.[29] Result are shown in Figure 6.

The profit contribution is very similar in both cases. The wage contribution exhibits a comparable pattern, albeit with greater strength in terms of magnitude when financial frictions are present within firms. This particular characteristic aligns with the concept

[29] A similar decomposition can be found also in Kaplan et al. (2018) and Auclert (2019).

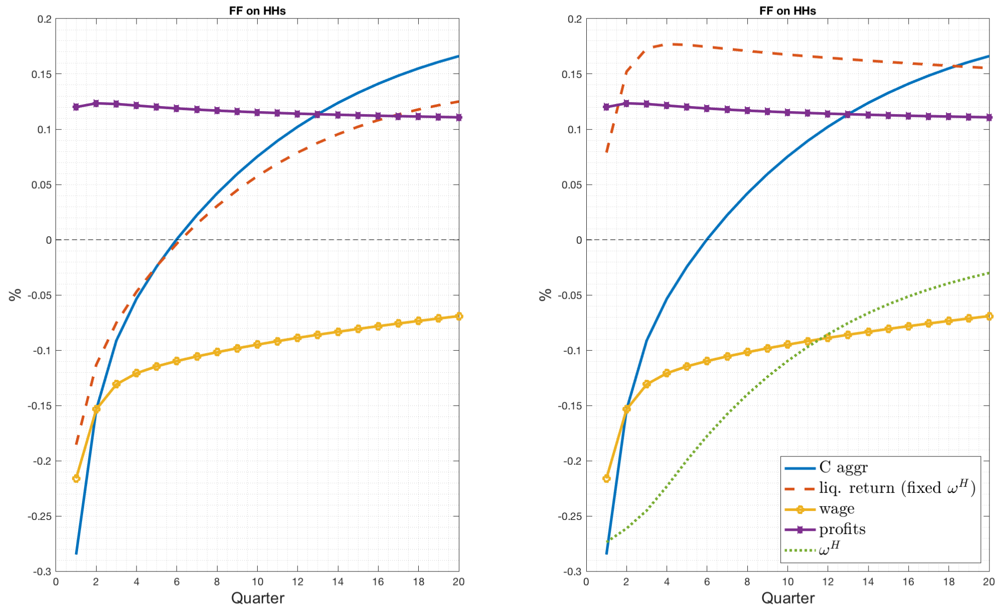

Figure 7: Consumption decomposition for relevant prices

Note: monetary shock $\epsilon^R = 0.0025$. The graph on the left-hand side represents the decomposition considering the household borrowing spread in the liquidity return. In the graph on the right-hand side, I consider the same case with the borrowing penalty (ω_t^H) as an individual variable.

of these frictions impacting the primary source of income for a considerable portion of the population, particularly those who are at the bottom of the distribution. The most noteworthy distinction between the two scenarios, as expected, lies in the shape and magnitude of the contribution from liquidity return. In case of financial frictions on firms, it is positive and hump-shaped. The exclusive liquidity of wealth in this model could explain this pattern, as rich households (who possess more liquid assets) benefit greatly from an increase in liquid return and compensate for the impact on poorer households. Conversely, when active financial constraints are imposed on households, the liquidity return contribution is notably negative for more than one year, with a magnitude and persistence more in line with that of the aggregate composite consumption.

It is important to highlight that in Figure 6, when referring to "liquidity return", I also consider the household loan spread for borrowing households, $(1 + \omega^H)$, and remember that ω^H is free to vary over time in the right-hand side of the figure, while it is fixed in the comparative scenario. Therefore, in order to evaluate the significance of this spread's impulse response, a further breakdown of the liquidity return is conducted, treating ω^H as an individual price. The outcomes of this analysis are presented in Figure 7.

When analyzed independently, the borrowing penalty emerges as a key factor in reducing consumption for active frictions on households. Interestingly, its impact on the overall composite consumption decline is found to be even more significant than the effect of wages for a period lasting at least two years following the aggregate shock. Hence, the varying household borrowing penalty plays a crucial role in shaping aggregate consumption, supporting the previous notion that most differences in wealth and consumption inequality between the two cases can be explained by household behavior surrounding the zero-wealth threshold.

Referring to the dichotomy proposed by Kaplan et al. (2018), it becomes possible to depict the results in terms of direct and indirect effects of monetary policy on household consumption. The presence of financial frictions within the production sector has a more significant influence on the indirect effects, particularly those associated with labor income, when compared to the counterfactual scenario. The wage component (yellow circled line) exhibits greater strength and persistence in the presence of active frictions and firms. This channel primarily contributes to the decline in composite consumption for this scenario, since profits and liquidity return contributions exert a positive influence for the period considered in Figure 6. On the other hand, financial frictions related to fluctuating household loan rates reassess the importance of direct effects in depressing consumption after a monetary contraction, primarily through changes in the borrowing penalty. It is important to underline, however, that significant indirect effects still exist in this context. The wage contribution remains a substantial factor in consumption reduction even with financial frictions on households.

In relation to direct effects, the behavior of the liquidity return contribution (net of the borrowing premium) in terms of response shape varies significantly. On impact, the contribution is marginally higher in the scenario in which there are frictions on firm borrowing. This can be observed by comparing the left-hand graph in Figure 6 with the right-hand one in Figure 7. The two responses reach their peak around the same time, with the former peaking in the third quarter and the latter in the fourth quarter. However, the rate of reversion differs significantly between the two. Reversion is much faster under firm financial frictions, whereas it is much slower under household frictions.[30] At first glance, this result may seem counter-intuitive. Financial frictions affecting household borrowing actually enhance the positive contribution of liquidity return in the long run, whereas the opposite happens when these frictions are shut off. Nevertheless, as explained in Section 4.3, this outcome is a logical consequence of the interplay between the demand and supply of borrowings in the production sector. First, most funds channeled to firms originate from the top 10% of households, who, as per the model's construction, are not impacted by the increase in the loan rate.[31] Second, under financial frictions on firms, entrepreneurs tend to resort to higher levels of debt initially, but subsequently aim to minimize their debt exposure due to higher costs associated with financial frictions.

[30]Extending the duration of the IRFs reveals that consumption undershooting occurs approximately 24 quarters after the shock under financial frictions on firms. In the comparative scenario, even after 100 periods, the response value remains higher than the initial impact value.

[31]Note that this model assumes net financial positions for household wealth. Therefore, households are restricted from simultaneously saving and borrowing funds.

Therefore, in the last case, there is a faster decrease in firms' demand for borrowing. Conversely, under active frictions on households, entrepreneurs exhibit a relatively stronger inclination toward debt utilization, resulting in a slower reduction in their demand for funds. Therefore, this enduring dynamic also appears to have long-lasting effects on aggregate composite consumption, primarily through the contribution of liquidity returns on the latter.

The robustness of the dynamics related to both Gini indices fluctuations and agents' behavior around the zero-wealth threshold appears to be unaffected by varying risk aversion levels among households. This is demonstrated in Figure G.7 in Appendix G, where a risk aversion value of $\xi = 2$ is considered in households' preferences. Similarly, in this particular case, the Gini index of wealth is relatively higher for active frictions on firms compared with the counterfactual scenario, whereas the opposite holds true for the Gini index of composite consumption, with higher values for financial frictions on households. The breakdown of aggregate consumption depicted in Figure G.8 confirms that indirect effects are magnified under financial frictions on firms, whereas financial frictions on households amplify the direct effect resulting from movements in ω^H.

Additionally, in Appendix G, I conduct robustness tests for various model specifications. I examine whether the outcomes remain consistent under extreme calibrations, such as a scenario with no quadratic costs for capital producers ($\phi = 0$), a situation where the government fixes its bond issuance at the steady state level ($\rho_{gov} = 0$), and a case where the government adjusts bond issuance also according to tax revenues. The key results appear to be robust across these alternative specifications.

5 Concluding remarks

By employing a HANK model that incorporates two distinct financial frictions affecting different economic agents, I show that these frictions have differing impacts on household wealth and consumption dynamics. Following a contractionary monetary policy shock, both wealth and consumption inequality rise, regardless of whether the friction operates at the firm or household level. However, key differences emerge: when financial frictions constrain firms, the Gini index for wealth reaches a higher level, whereas when frictions restrict household borrowing, consumption dispersion increases relatively more.

This divergence in behavior primarily stems from dynamics around the zero-wealth threshold, specifically the fluctuations in the household borrowing spread. The analysis of two distinct financial frictions in this study reveals differing implications for the direct and indirect effects of monetary policy on household consumption. In particular, firm-related frictions tend to amplify indirect effects, whereas household-related frictions exert a stronger influence on direct effects. Despite using a relatively simple model, this study provides interesting guidance in terms of the redistribution effects of monetary policy according to a possible state of the economy.

Even though wealth redistribution should not be a formal target for central banks, policymakers have undoubtedly been concerned with it over the last years, and recent findings have proven that this concern is also important from a macro-modeling point of view. Nonetheless, this study presents several potential avenues for future research. One such extension could involve analyzing these dynamics under unconventional monetary policy. Another promising direction in contemporary macroeconomic theory is the heterogeneity of productive firms, which could provide valuable insights into the role of financial frictions in the productive sector.

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Appendix

A Idiosyncratic productivity process and the joint distribution

Households can be workers, with productivity $h > 0$, or rentiers, , with $h = 0$, which means that they do not earn labor income but only profit income. Furthermore, I assume that there are three possible productivity realizations for workers: high productivity, h^H, median productivity, h^M, and low productivity, h^L. The Markov process generates the following transition matrix:

$$
h_t \quad \begin{array}{c} \\ \\ h^L \\ h^M \\ h^H \\ 0 \end{array}
\begin{array}{c}
h_{t+1} \\
\begin{array}{cccc} h^L & h^M & h^H & 0 \end{array} \\
\begin{bmatrix}
p_{LL}(1-\zeta) & p_{LM}(1-\zeta) & p_{LH}(1-\zeta) & \zeta \\
p_{ML}(1-\zeta) & p_{MM}(1-\zeta) & p_{MH}(1-\zeta) & \zeta \\
p_{HL}(1-\zeta) & p_{HM}(1-\zeta) & p_{HH}(1-\zeta) & \zeta \\
0 & \iota & 0 & 1-\iota
\end{bmatrix}
\end{array}
$$

with probabilities, p, determined using the Tauchen method. I follow other studies using this household distribution framework, such as Bayer et al. (2019) and Luetticke (2021), and assume that rentiers who become workers are endowed with the median productivity level ($h = 1$).

At the steady state, a joint distribution of households exists according to their wealth level, a, and their productivity, h. This joint distribution can be represented by the bi-dimensional matrix as follows:

$$
\text{prod. } h \quad
\begin{array}{c} h_m \\ \cdots \\ h_2 \\ h_1 \\ \\ \end{array}
\begin{array}{c}
\begin{bmatrix}
H_{m,1} & H_{m,2} & \cdots & H_{m,n} \\
\cdots & \cdots & \cdots & \cdots \\
H_{2,1} & H_{2,2} & \cdots & H_{2,n} \\
H_{1,1} & H_{1,2} & \cdots & H_{1,n}
\end{bmatrix} \\
\begin{array}{cccc} a_1 & a_2 & \cdots & a_n \end{array} \\
\\
\text{wealth } a
\end{array}
$$

where $H_{1,1}$ is the share of households with the lowest level of wealth and labor productivity (except for the last state $h_m = 0$, since in this model they are rentiers), and $\int Hdadh = 1$. As the vector indicating possible household wealth levels is composed of 100 entries, this joint distribution matrix comprises 400 grid points ($a_n = 100$ and $h_m = 4$).

B Investment banks optimal contract

B.1 Idiosyncratic shock on return on capital

Following Bernanke et al. (1999), I assume that the Idiosyncratic shock ω^F is distributed log-normally. i.e. $\omega^F \in [0, +\infty)$.[32] Using results from Appendix A.2 in Bernanke et al. (1999) I can write $F(\omega^F)$, $\Gamma(\omega^F)$ and $G(\omega^F)$ in the analytical expressions that I use in my code to solve the model:

$$F(\omega^F) = \Phi\left[\left(log(\bar{\omega}^F) + \frac{1}{2}\sigma^2_{\omega^F}\right)/\sigma_{\omega^F}\right] , \tag{A1}$$

$$\Gamma(\omega^F) = \Phi\left[\left(log(\bar{\omega}^F) - \frac{1}{2}\sigma^2_{\omega^F}\right)/\sigma_{\omega^F}\right] + \bar{\omega}^F\left\{1 - \Phi\left[\left(log(\bar{\omega}^F) + \frac{1}{2}\sigma^2_{\omega^F}\right)/\sigma_{\omega^F}\right]\right\} , \tag{A2}$$

$$G(\omega^F) = \Phi\left[\left(log(\bar{\omega}^F) + \frac{1}{2}\sigma^2_{\omega^F}\right)/\sigma_{\omega^F} - \sigma_{\omega^F}\right] , \tag{A3}$$

with $\Phi(\cdot)$ being the normal cumulative distribution function and σ_{ω^F} the standard deviation of the idiosyncratic shock on entrepreneurs' return on capital.

B.2 Investment banks' participation constraint and entrepreneur j's optimization problem

After substituting (18) and (17) into (19), I obtain:

$$[1-F(\bar{\omega}^F_{jt+1})]\bar{\omega}^F_{jt+1}R^K_{t+1}q_tK_{jt+1}+(1-\mu)\int_0^{\bar{\omega}^F_{jt+1}}\omega^F_j dF(\omega^F_j)R^K_{t+1}q_tK_{jt+1} = \frac{R_{t+1}}{\pi_{t+1}}(q_tK_{jt+1}-N_{jt+1}) . \tag{A4}$$

Divide everything by $R^R_{t+1}q_tK_{jt+1}$:

$$\frac{R^K_{t+1}}{\frac{R_{t+1}}{\pi_{t+1}}}\left([1 - F(\bar{\omega}^F_{jt+1})]\bar{\omega}^F_{jt+1} + (1-\mu)\int_0^{\bar{\omega}^F_{jt+1}}\omega^F_j dF(\omega^F_j)\right) = \left(1 - \frac{N_{jt+1}}{q_tK_{jt+1}}\right) . \tag{A5}$$

Following the notation used in Bernanke et al. (1999) and Christiano et al. (2014):

[32] Note that other kinds of distribution with values greater or equal to 0 could be used as well. Here I choose to adapt the same distribution to give a sense of continuity between the two studies.

$$\Gamma(\bar{\omega}_j^F) \equiv \int_0^{\bar{\omega}_j^F} \omega_j^F dF(\omega_j^F) + \bar{\omega}_j^F \int_{\bar{\omega}_j^F}^{\infty} dF(\omega_j^F) \,, \qquad \mu G(\bar{\omega}_j^F) \equiv \mu \int_0^{\bar{\omega}_j^F} \omega_j^F dF(\omega_j^F) \,, \quad \text{(A6)}$$

where $\Gamma(\bar{\omega}_j^F)$ is the expected gross share of profits going to the lender and $\mu G(\bar{\omega}_j^F)$ is the expected monitoring cost paid by the lender. $\Gamma(\bar{\omega}_j^F)$ can be rewritten as:

$$\Gamma(\bar{\omega}_j^F) = G(\bar{\omega}_j^F) + \bar{\omega}_j^F \left[1 - F(\bar{\omega}_j^F)\right] \,. \quad \text{(A7)}$$

I can now use (A6) and (A7) in (A5) and rearrange to finally obtain:

$$\frac{R_{t+1}^K}{\left(\dfrac{R_{t+1}}{\pi_{t+1}}\right)} = \frac{1}{\Gamma(\bar{\omega}_{jt+1}^F) - \mu G(\bar{\omega}_{jt+1}^F)} \left(1 - \frac{N_{jt+1}}{q_t K_{jt+1}}\right) \,, \quad \text{(A8)}$$

where $\Gamma(\bar{\omega}_{jt+1}^F) - \mu G(\bar{\omega}_{jt+1}^F)$ is the share of entrepreneur j's profits going to the lender (as loan repayment), net of auditing costs.

Equation (A8) is the complete version of (20), which explain the function underlying $f\left(\bar{\omega}_{jt+1}^F, LEV_{jt+1}\right)$. For a higher level of entrepreneur leverage, the EFP increases, raising the return on capital. However, it also increases the probability of an entrepreneur's default, thereby increasing the net share of profit demanded by investment banks as loan repayment, resulting in higher financing costs for entrepreneurs. To see in detail how this mechanism works, I show the entrepreneur j's optimization problem below.

According to the optimal contract set by investment banks, entrepreneur j's expected return can be expressed as:

$$E_t \left\{ \int_{\bar{\omega}_{jt+1}^F}^{\infty} \omega_j^F dF(\omega_j^F) R_{t+1}^K q_t K_{jt+1} - (1 - F(\bar{\omega}_j^F)) R_{t+1}^K q_t K_{jt+1} \right\} \,, \quad \text{(A9)}$$

with expectations taken with respect to the realization of R_{t+1}^K. The first term of (A9) represents the entrepreneur's profit when she does not default on debt, while the second term is the amount of profits that she uses to repay the lender. Following the notation used above, and considering that the entrepreneur's return is subject to the participation constraint (19), I write entrepreneur j's optimal contracting problem as:

$$\begin{aligned} &\max_{\{K_{jt+1}, \bar{\omega}_{jt+1}^F\}} E_t \left\{ \left[1 - \Gamma(\bar{\omega}_{jt+1}^F)\right] R_{t+1}^K q_t K_{jt+1} \right\} \,, \\ &s.t. \quad \frac{R_{t+1}}{\pi_{t+1}} (q_t K_{jt+1} - N_{jt+1}) = \left[\Gamma(\bar{\omega}_{jt+1}^F) - \mu G(\bar{\omega}_{jt+1}^F)\right] R_{t+1}^K q_t K_{jt+1} \,. \end{aligned} \quad \text{(A10)}$$

Deriving F.O.C. I obtain:

$$w.r.t.\ \ \omega^F_{jt+1}: \quad -\Gamma'(\bar{\omega}^F_{jt+1}) + \lambda_{jt+1}\left[\Gamma'(\bar{\omega}^F_{jt+1}) - \mu G'(\bar{\omega}^F_{jt+1})\right] = 0\ , \tag{A11}$$

$$w.r.t.\ \ K_{jt+1}: \quad E_t\left\{\left[1-\Gamma(\bar{\omega}^F_{jt+1})\right]R^K_{t+1} - \lambda_{jt+1}\left[\frac{R_{t+1}}{\pi_{t+1}} - \left(\Gamma(\bar{\omega}^F_{jt+1}) - \mu G(\bar{\omega}^F_{jt+1})R^K_{t+1}\right)\right]\right\} = 0\ , \tag{A12}$$

$$w.r.t.\ \ \lambda_{jt+1}: \quad E_t\left\{\frac{R_{t+1}}{\pi_{t+1}}(q_t K_{jt+1} - N_{jt+1}) - \left[\Gamma(\bar{\omega}^F_{jt+1}) - \mu G(\bar{\omega}^F_{jt+1})\right]R^K_{t+1} q_t K_{jt+1}\right\} = 0\ , \tag{A13}$$

where λ_j is the Lagrangian multiplier for entrepreneur j's problem. By rearranging (A11), it is possible to express λ_{jt+1} as a function of only $\bar{\omega}^F_{jt+1}$. Furthermore, rearranging (A12):

$$E_t\left\{\frac{R^K_{t+1}}{\frac{R_{t+1}}{\pi_{t+1}}}\right\} = \frac{\lambda_{jt+1}}{\left[1-\Gamma(\bar{\omega}^F_{jt+1}) + \lambda_{jt+1}\left(\Gamma(\bar{\omega}^F_{jt+1}) - \mu G(\bar{\omega}^F_{jt+1})\right)\right]}\ . \tag{A14}$$

It can be proven that there is a monotonically increasing relationship between the EFP and $\bar{\omega}^F_j$. According to (A8), we can extend this relationship between the EFP and the leverage level of j, assessing that a higher entrepreneur's leverage implies a higher EFP.[33]

Furthermore, it is clear from (A14) that $\bar{\omega}^F_j$ is determined only by aggregate variables. Thus, any entrepreneur chooses the same threshold $\bar{\omega}^F$ for the idiosyncratic shock on capital returns, below which they default, and the same leverage level.[34] This result allows to consider only the aggregate variables in the production sector part of the model, since every entrepreneur has the same firm structure.

C Who are the Hand-to-Mouth?

In standard TANK models (e.g., Galí et al., 2007 or Bilbiie, 2008) the share of HtM (or *rule-of-thumb*) households is externally determined, usually implying by construction that those households have zero wealth and exclusively spend their current income. Within HANK economies, households choose their optimal level of wealth and consumption endogenously in each period. This dynamics decision-making process allows for variations in the proportions of HtM households following aggregate shocks. In the HANK model proposed by Kaplan and Violante (2014), households are defined as HtM whenever they

[33] See Appendix A.1 in Bernanke et al. (1999) for proofs.

[34] According to (A8), leverage is a function of the EFP (composed of only aggregate variables) and $\bar{\omega}^F_j$. If $\bar{\omega}^F_j$ depends only on aggregate variables (since it is a function of the EFP, according to (A14)), then the same can be said for the leverage.

choose to either have zero liquid wealth or to lie at the credit limit. Due to technicalities of my model constructions, I employ a slighlty different definition of HtM. First, because I am already studying the fluctuation of the share of borrower households, I will not include agents who have reached their borrowing limit when calculating the HtM share. Second, given that the grid used to compute the wealth distribution is not evenly spaced and contains several grid points in close proximity to the zero-wealth threshold, households are classified as HtM if they possess zero or near-zero wealth, that is, a positive amount of wealth that does not surpass the half of minimum possible quarterly labor income realization (a threshold in line with Kaplan and Violante, 2014). The results are fairly similar when exclusively considering zero-wealth households as HtM.

D Impulse responses of MP contractionary shock

Figure D.1 show several aggregate variables impulse responses for the monetary policy shock considered in the baseline model. This integrate Impulse Response Functions (IRFs) present in Figure 1 and Figure 2 in the main text.

E Impulse responses of MP contractionary shock - Same shock magnitude

Below, I show the main aggregate and inequality fluctuations when the monetary shock magnitude used to produce IRFs is the same in both scenarios. The main findings relative to inequality fluctuations are qualitatively similar to that in the baseline model, where I consider two different shock magnitudes that have the same effect on output.

F Consumption inequality analysis for goods consumption C

In this section, I show the fluctuations in the Gini index and share averages for total goods consumption, C, for the baseline model. Also in this case, when financial frictions on households are active, the changes in the Gini index are stronger, as show in Figure F.1. This can be explained by Figure F.2: while fluctuations of aggregate C are similar in the two scenarios, average consumption for top e bottom shares of households are more scattered in the case of financial frictions on households.

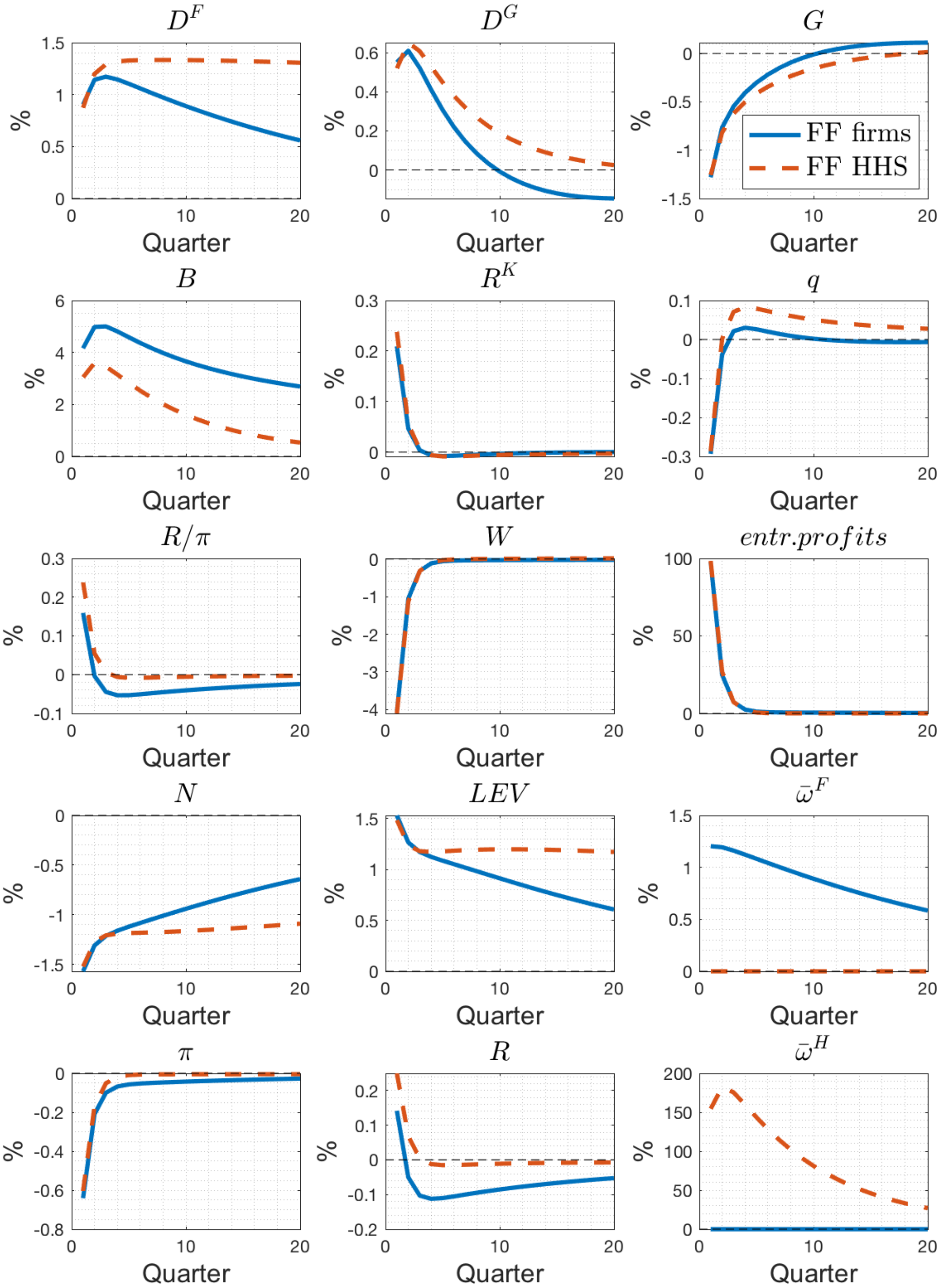

Figure D.1: Impulse response to a monetary contraction for aggregate variables

Note: monetary shock $\epsilon^R = 0.0025$ for active financial frictions on household borrowing, $\epsilon^R = 0.0014$ otherwise. The blue line refers to an economy with financial frictions on firms, the red one when frictions are on households.

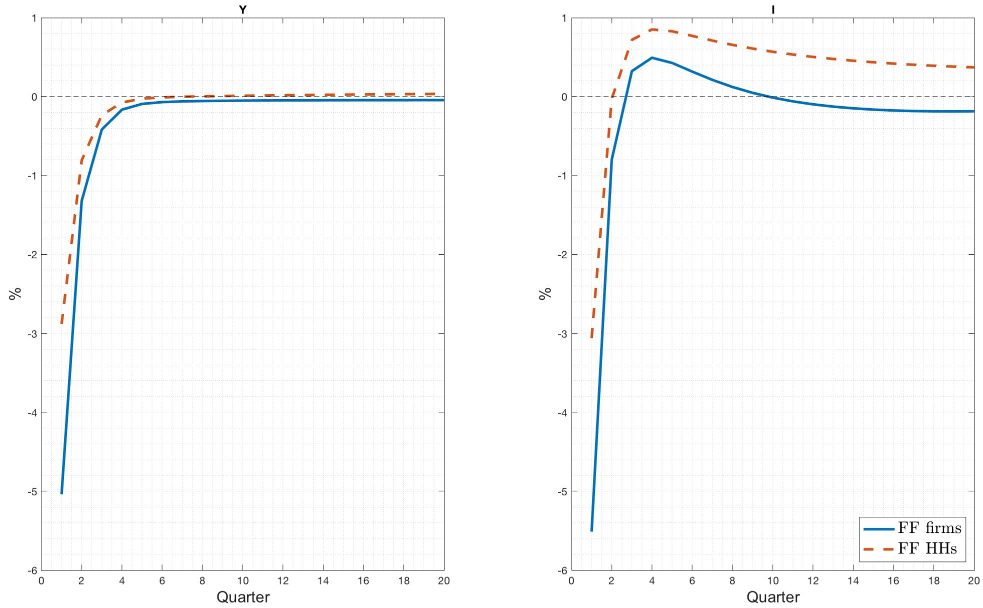

Figure E.1: Impulse response to a monetary contraction for aggregate variables

Note: monetary shock is $\epsilon^R = 0.0025$ in both the scenarios. The blue line refers to an economy with financial frictions on firms, the red one when frictions are on households.

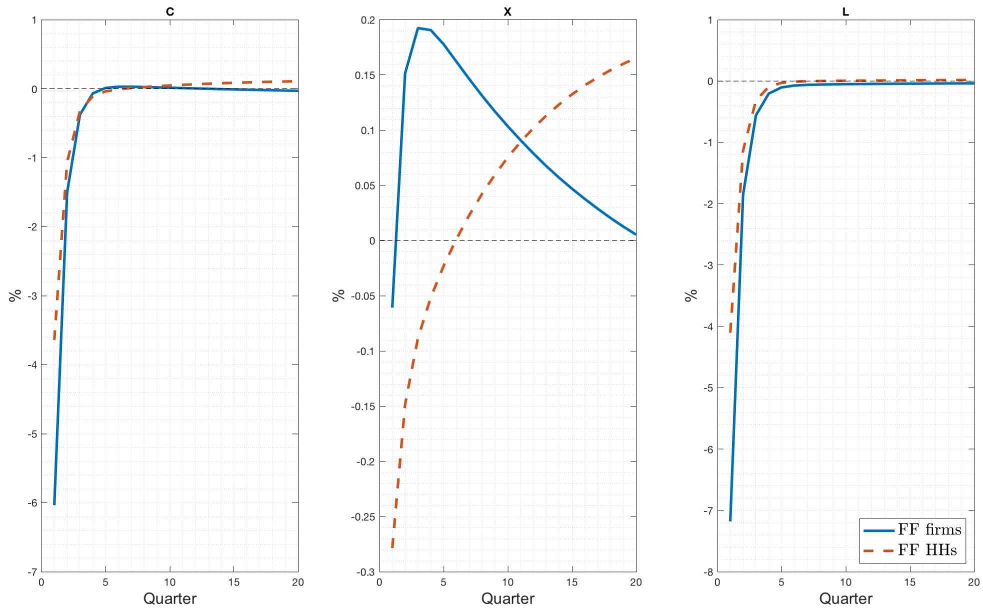

Figure E.2: Impulse response to a monetary contraction for aggregate variables

Note: monetary shock is $\epsilon^R = 0.0025$ in both the scenarios. The blue line refers to an economy with financial frictions on firms, the red one when frictions are on households.

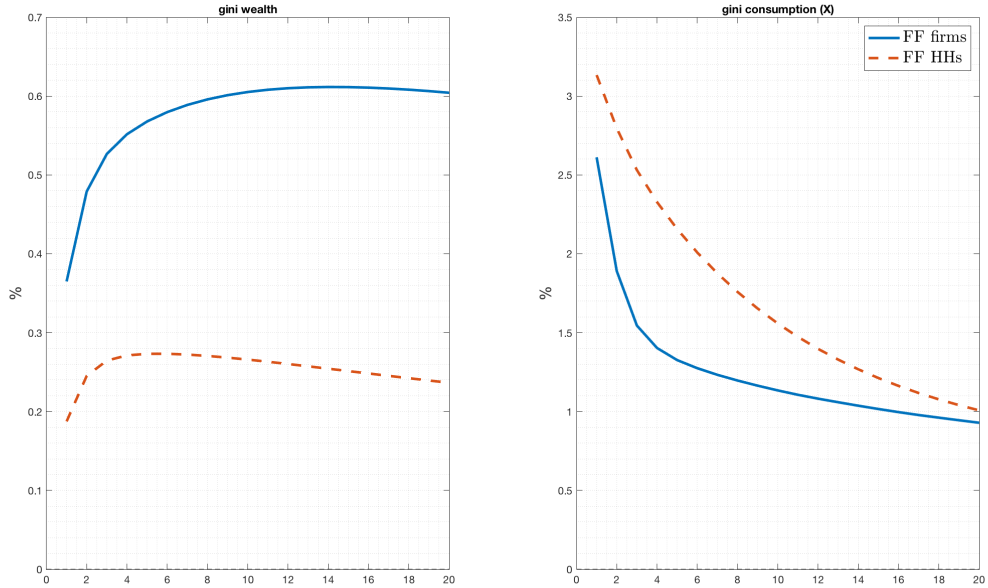

Figure E.3: Impulse responses to a monetary contraction
for wealth and consumption inequality.

Note: monetary shock $\epsilon^R = 0.0025$. The blue line refers to an economy with financial frictions on firms, the red one when frictions are on households.

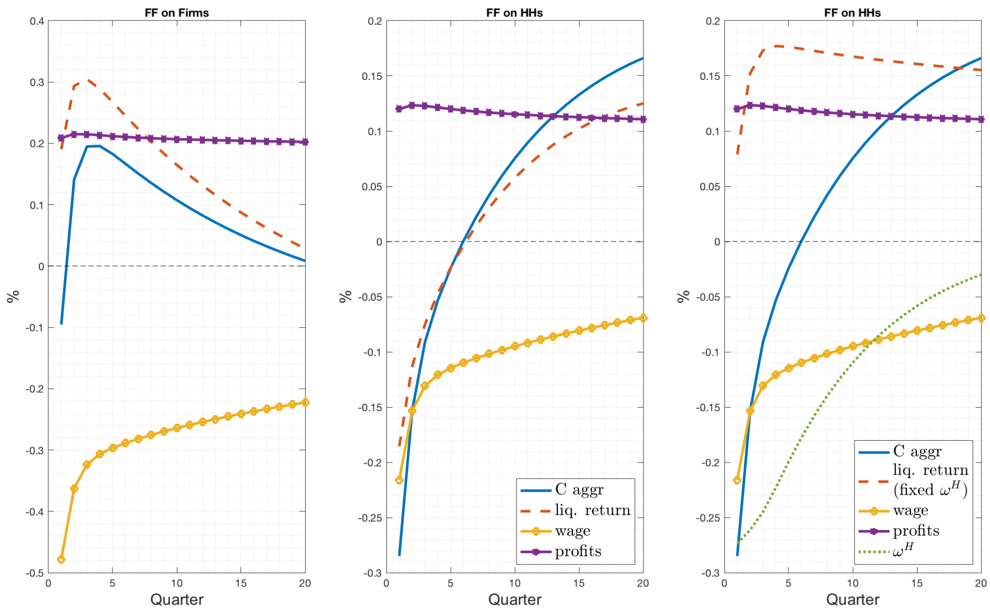

Figure E.4: Consumption decomposition for relevant prices

Note: monetary shock $\epsilon^R = 0.0025$. The graph on the left-hand side represents the decomposition for the case of frictions on firms and the other two represent the case of frictions on household borrowing. In the graph on the right-hand side, I consider the borrowing penalty ω_t^H as an individual variable.

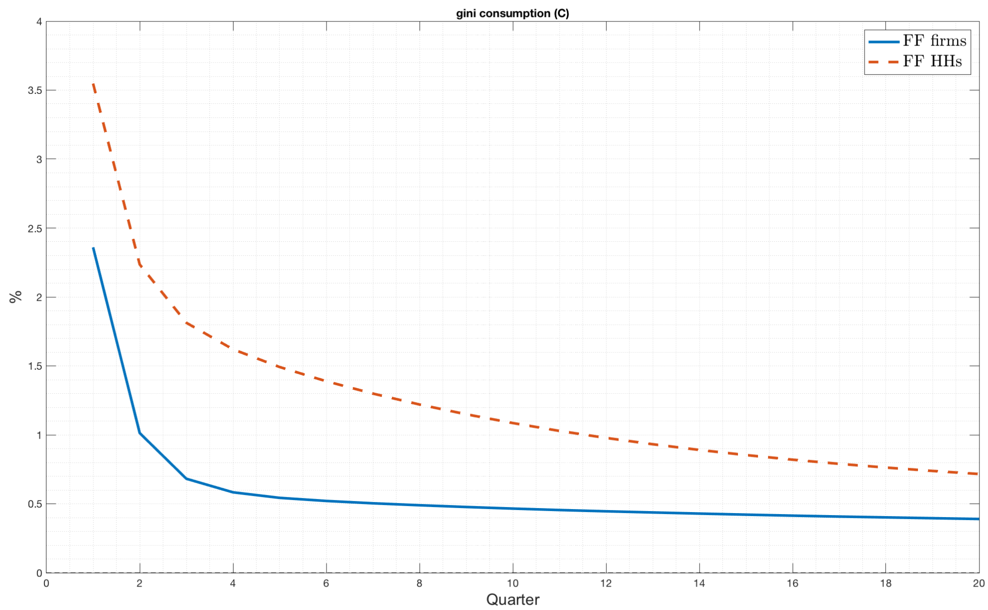

Figure F.1: Impulse responses to a monetary contraction for consumption inequality.

Note: monetary shock $\epsilon^R = 0.0025$ for active financial frictions on household borrowing, $\epsilon^R = 0.0014$ otherwise. The blue line refers to an economy with financial frictions on firms, the red one when frictions are on households.

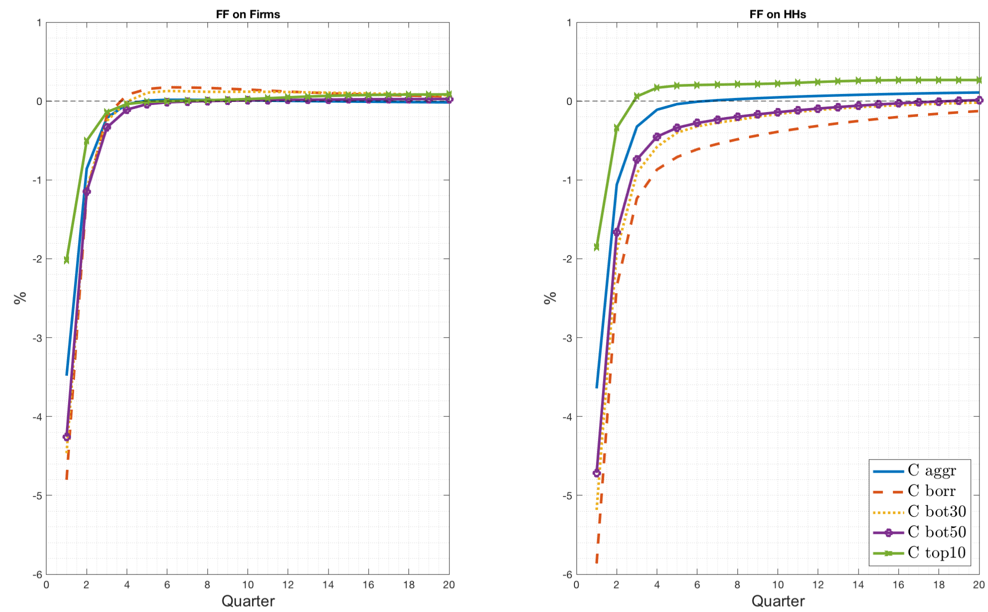

Figure F.2: Average consumption fluctuation for different shares of households.

Note: monetary shock $\epsilon^R = 0.0025$ for active financial frictions on household borrowing, $\epsilon^R = 0.0014$ otherwise.

G Robustness checks

In this section, I show the Gini indices and consumption decomposition according to prices for different variants of the baseline model. Figure G.1 and Figure G.2 show results when the parameter regulating the fiscal policy, ρ_{gov}, is equal to zero. Figure G.3 and Figure G.4 display results for the case limit of no quadratic costs for capital producer, that is, $\phi = 0$.

Since I employ a HANK model, the Ricardian equivalence does not hold, and changes in fiscal policies could have significant effects. A modified version of equation (41) is taken into account, which also reacts to government tax revenues, T. Following the approach of Bayer et al. (2019), the alternative bond issuance rule is:

$$\frac{D^G_{t+1}}{\bar{D}^G} = \left(\frac{D^G_t \frac{R_t}{\pi_t}}{\bar{D}^G \frac{\bar{R}}{\bar{\pi}}}\right)^{\rho_{gov}} \left(\frac{T_t}{\bar{T}}\right)^{-\rho^T}, \tag{A15}$$

with ρ^T being the parameter determining the extent to which the rule is influenced by deviations in tax revenue from its steady state. When $\rho^T = 0$, the rule corresponds to equation (41). In this analysis, I assume a value of $\rho^T = 1$, indicating that the government responds actively to fluctuations in tax revenues. For example, if an adverse aggregate shock leads to a decrease in tax revenues, the government responds by increasing debt issuance to sustain higher public spending. Results are shown in Figure G.5 and Figure G.6.

I also consider a model in which I change the parameter for households' risk aversion, ξ. In the baseline calibrations, I assume $\xi = 4$ as in Bayer et al. (2019), but other models in the HANK literature(e.g., Auclert et al., 2021), assume a lower risk aversion for households. Therefore, in Figure G.7 and Figure G.8, I present the results when assuming a model with $\xi = 2$. In this case, however, to match wealth distribution moments, I need to change other parameters, such as β, ζ and $\underline{a}$.

The main findings of the baseline model, that is, relatively higher wealth inequality for financial frictions on firms, relatively higher consumption inequality for financial frictions on households, and the relevance of the borrowing penalty ω^H for this dynamics, are robust to these changes in parameterization.

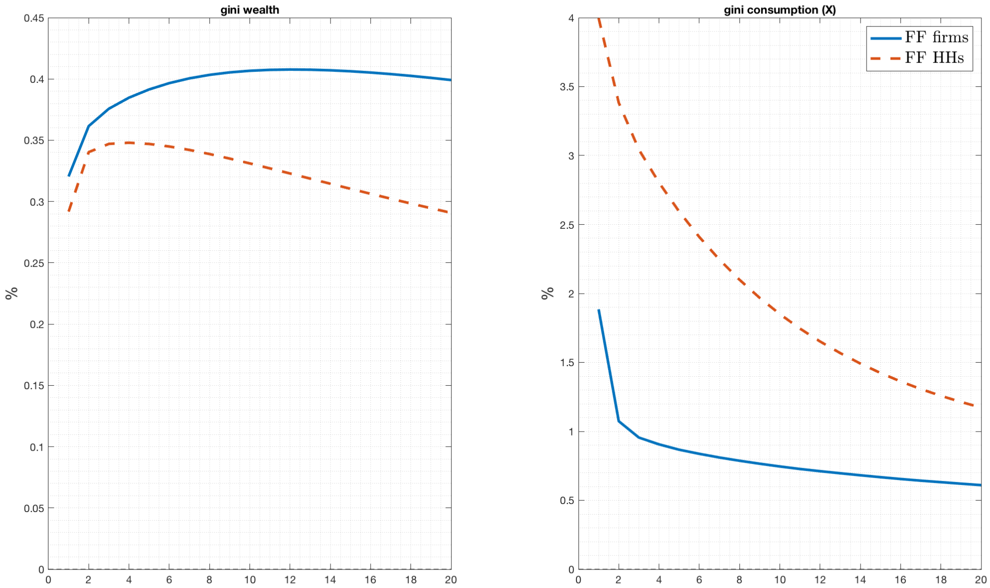

Figure G.1: Impulse responses to a monetary contraction
for wealth and consumption inequality, $\rho_{gov} = 0$.

Note: monetary shock $\epsilon^R = 0.0025$ for active financial frictions on household borrowing, $\epsilon^R = 0.0014$ otherwise. The blue line refers to an economy with financial frictions on firms, the red one when frictions are on households.

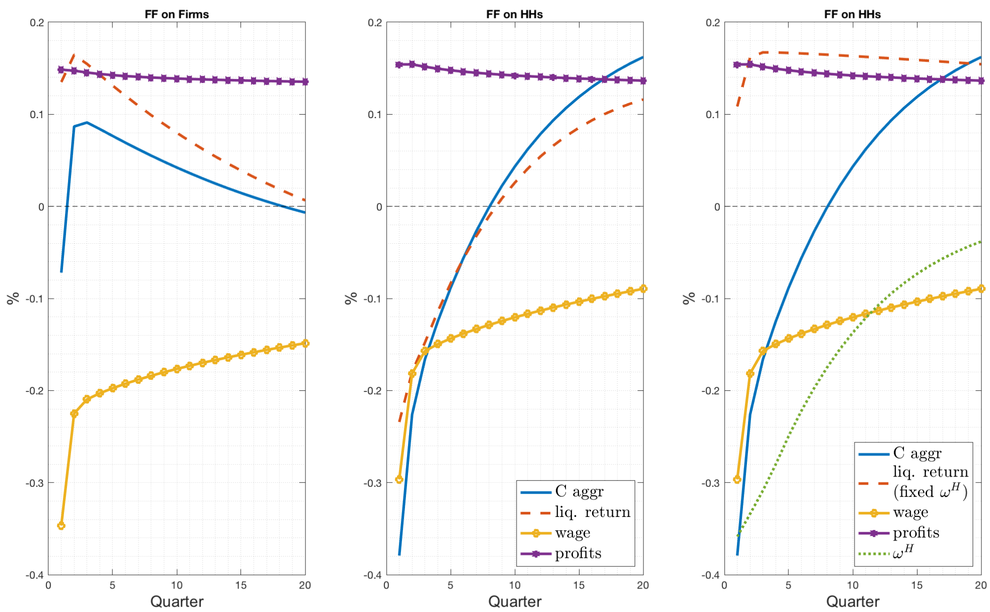

Figure G.2: Consumption decomposition for relevant prices, $\rho_{gov} = 0$

Note: monetary shock $\epsilon^R = 0.0025$. The graph on the left-hand side represents the decomposition for the case of frictions on firms and the other two represent the case of frictions on household borrowing. In the graph on the right-hand side, I consider the borrowing penalty ω_t^H as an individual variable.

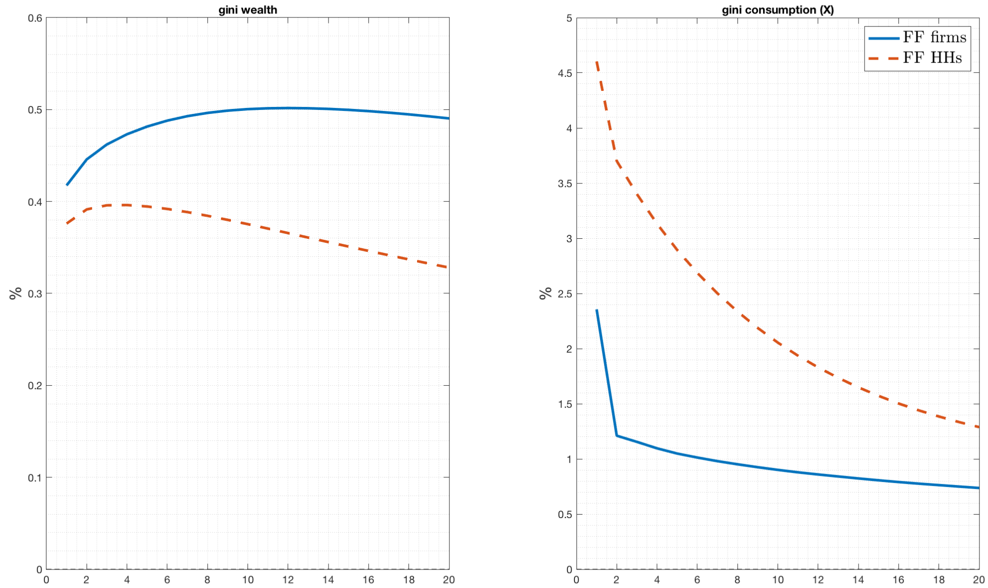

Figure G.3: Impulse responses to a monetary contraction
for wealth and consumption inequality, $\phi = 0$.

Note: monetary shock $\epsilon^R = 0.0025$ for active financial frictions on household borrowing, $\epsilon^R = 0.0014$ otherwise. The blue line refers to an economy with financial frictions on firms, the red one when frictions are on households.

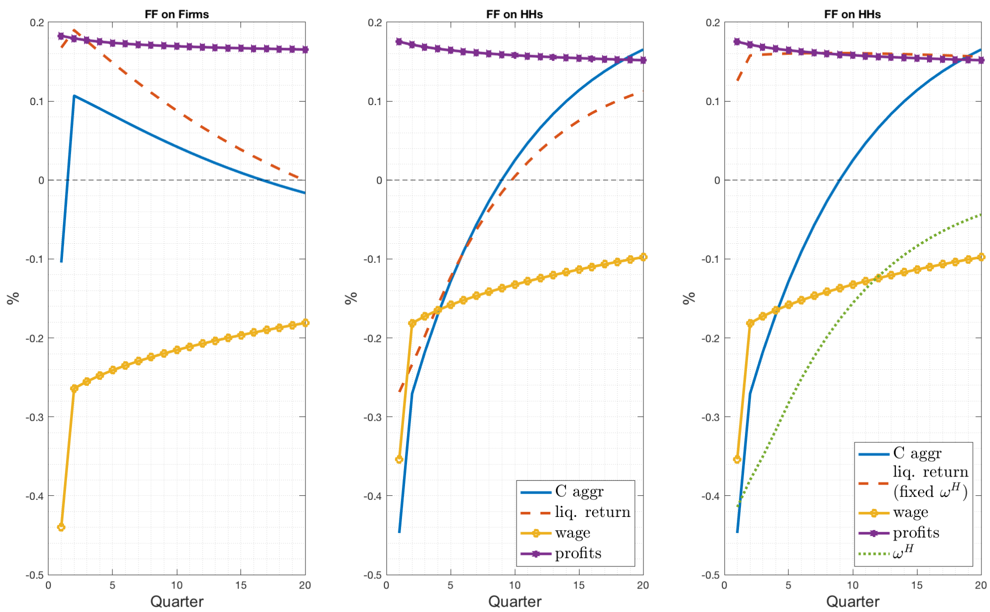

Figure G.4: Consumption decomposition for relevant prices, $\phi = 0$

Note: monetary shock $\epsilon^R = 0.0025$. The graph on the left-hand side represents the decomposition for the case of frictions on firms and the other two represent the case of frictions on household borrowing. In the graph on the right-hand side, I consider the borrowing penalty ω_t^H as an individual variable.

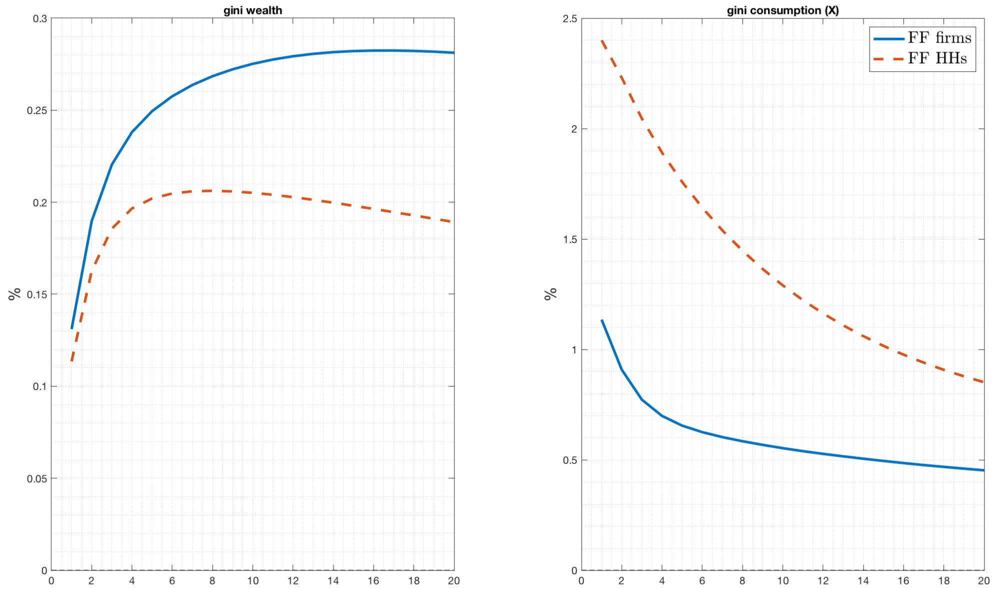

Figure G.5: Impulse responses to a monetary contraction for wealth and consumption inequality, government reacts to tax revenues.

Note: monetary shock $\epsilon^R = 0.0025$ for active financial frictions on household borrowing, $\epsilon^R = 0.0014$ otherwise. The blue line refers to an economy with financial frictions on firms, the red one when frictions are on households.

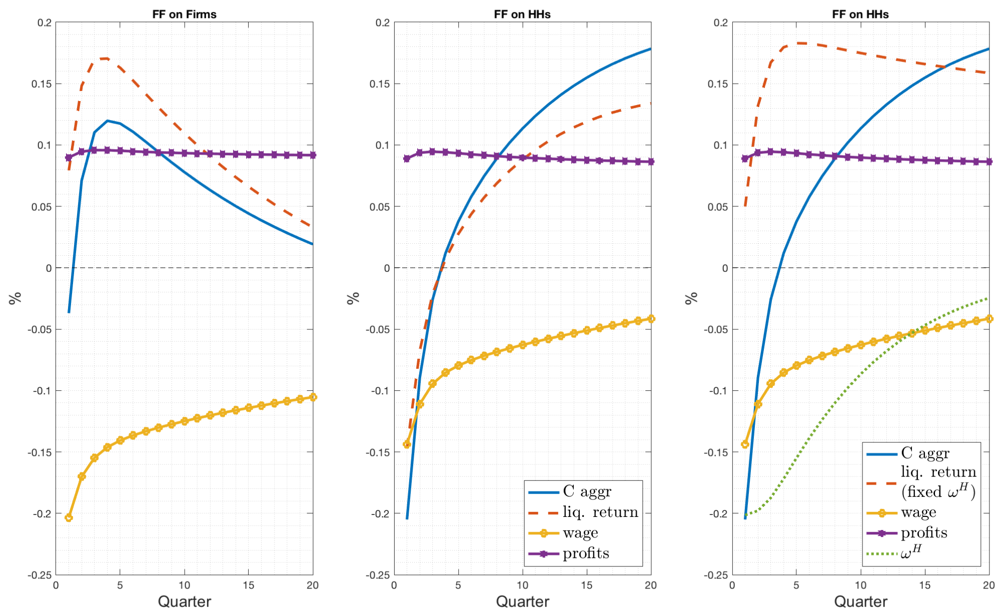

Figure G.6: Consumption decomposition for relevant prices, government reacts to tax revenues.

Note: monetary shock $\epsilon^R = 0.0025$. The graph on the left-hand side represents the decomposition for the case of frictions on firms and the other two represent the case of frictions on household borrowing. In the graph on the right-hand side, I consider the borrowing penalty ω_t^H as an individual variable.

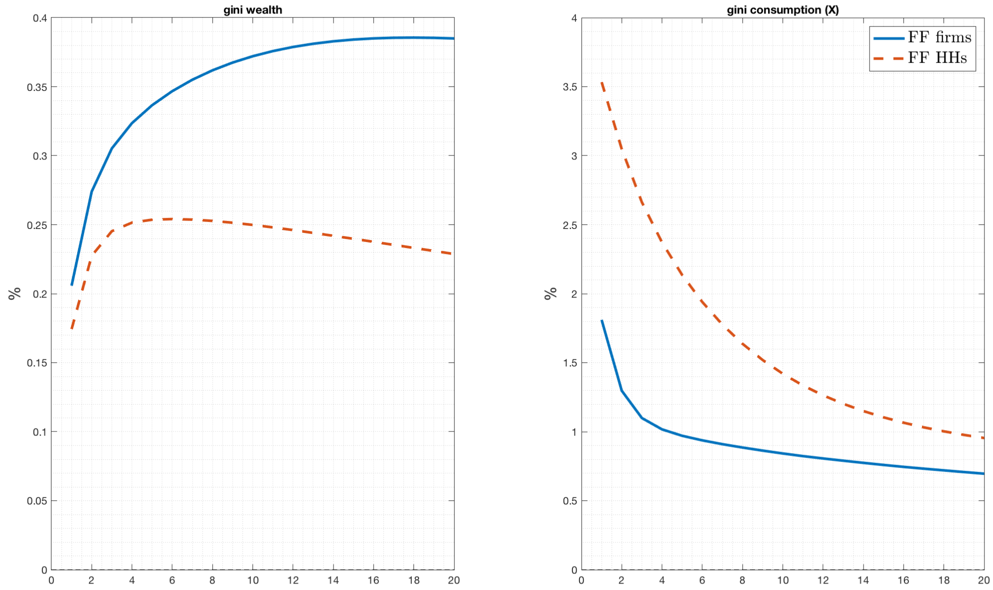

Figure G.7: Impulse responses to a monetary contraction for wealth and consumption inequality, $\xi = 2$.

Note: monetary shock $\epsilon^R = 0.0025$ for active financial frictions on household borrowing, $\epsilon^R = 0.0014$ otherwise. The blue line refers to an economy with financial frictions on firms, the red one when frictions are on households.

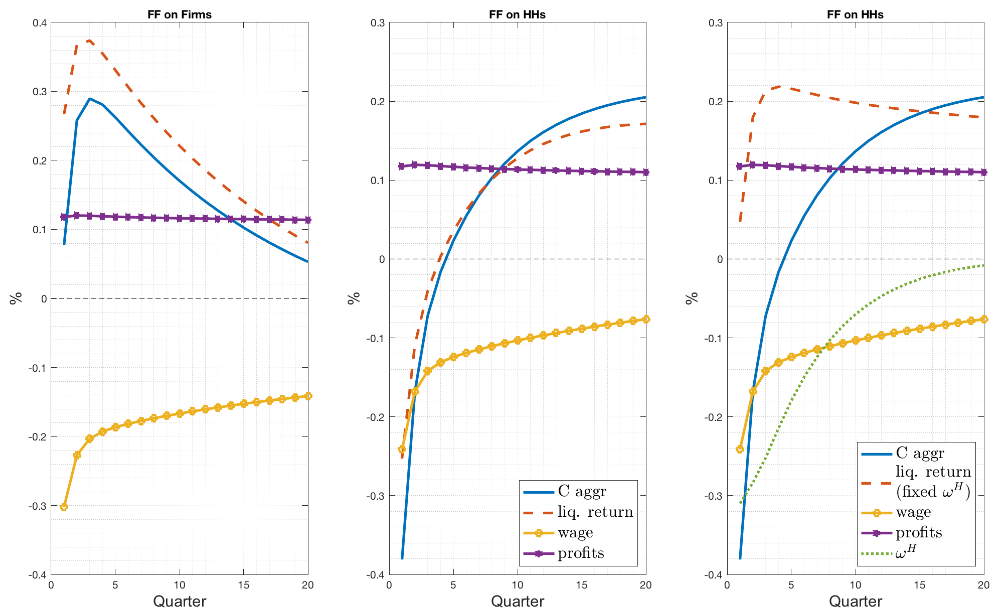

Figure G.8: Consumption decomposition for relevant prices, $\xi = 2$

Note: monetary shock $\epsilon^R = 0.0025$. The graph on the left-hand side represents the decomposition for the case of frictions on firms and the other two represent the case of frictions on household borrowing. In the graph on the right-hand side, I consider the borrowing penalty ω_t^H as an individual variable.