WORKING paper

BANQUE DE FRANCE
EUROSYSTÈME

On the Distributional Effects of Conventional Monetary Policy and Forward Guidance

Giacomo Mangiante[1] and Pascal Meichtry[2]

July 2025, WP #996

Abstract

This paper investigates the distributional effects of conventional monetary policy and forward guidance. Using a structural VAR model, we estimate their impact on macroeconomic aggregates and consumption inequality in the United States. While aggregate real and financial variables respond similarly to both policy tools, their effects on consumption inequality diverge significantly. Conventional monetary policy shocks lead to countercyclical inequality, whereas forward guidance announcements result in a procyclical response, driven by heterogeneous reactions across the household spending distribution. We rationalize these contrasting outcomes both empirically and through a tractable New Keynesian model featuring household heterogeneity and government redistribution. In the model, a fiscal adjustment that differs in timing and magnitude induces a sharper decline in consumption among financially constrained households following conventional rate hikes but a more muted effect under forward guidance. These findings highlight the importance of accounting for the distributional consequences of different monetary policy tools and emphasize the critical role of fiscal policy in shaping inequality dynamics.

Keywords: Household Heterogeneity, Forward Guidance, Inequality, Monetary Policy, Hand-to-Mouth, Fiscal Transfers

JEL classification: D31, E21, E52, E58, E62

[1] Bank of Italy, mangiante.giacomo@gmail.com

[2] Banque de France, pascal.meichtry@banque-france.fr

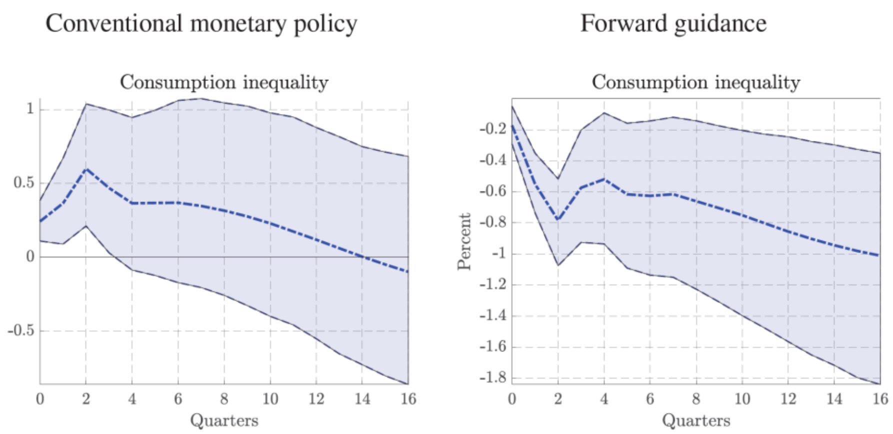
We would like to thank Florin Bilbiie and Jean-Paul Renne for their valuable comments and guidance. We are also grateful to Benjamin Born for serving as a discussant and for his helpful feedback. We are particularly indebted to Felipe Alves and Greg Kaplan for sharing their model codes, and to Brent Bundick, Refet Gürkaynak, and Eric Swanson for providing their data on monetary policy surprises. We are also grateful to Philippe Bacchetta, Michael D. Bauer, Pau Belda, Kenza Benhima, Hannah Engljähringer, Axelle Ferriere, Aeimit Lakdawala, Riccardo M. Masolo, Silvia Miranda-Agrippino, Salvatore Nisticò, Oliver Pfäuti, Anna Rogantini Picco, Ricardo Reis, Fabian Seyrich, Andreas Tischbirek, Sarah Zoi, and numerous seminar and conference participants for helpful comments and suggestions.

NON-TECHNICAL SUMMARY

In recent years, the debate over how monetary policy shapes inequality has gained momentum. While the effects of conventional interest rate changes on household consumption and income have been widely studied, less is known about the distributional consequences of unconventional tools. Gaining a clearer understanding of how different monetary instruments affect households beyond their aggregate impact is crucial for designing effective and optimal policy strategies.

This paper compares the distributional effects of conventional monetary policy (CMP) and forward guidance (FG) on consumption. Using U.S. household-level survey data and a time series model that disentangles these two policy tools, we first examine their impact on aggregate macroeconomic outcomes and the distribution of household consumption. While both CMP and FG generate similar aggregate real and financial responses, they have opposite effects on consumption inequality. A conventional interest rate hike raises inequality by disproportionately affecting low-consumption households, whereas an anticipated rate hike via FG tends to reduce inequality by affecting higher-consumption households more.

Figure: Impulse responses of household consumption inequality to U.S. monetary policy shocks



Notes: The figure displays the cumulated responses of consumption dispersion across U.S. households to a conventional monetary policy shock (left) and a forward guidance shock (right). Consumption inequality is measured by the cross-sectional standard deviation of real household consumption. Impulse responses are from a VAR model using quarterly data from 1991Q3 to 2019Q2. Shaded areas represent 68% confidence intervals.

We highlight the central role of fiscal policy in explaining the divergent effects of monetary policy tools on consumption inequality. Interest rate hikes influence government borrowing costs by increasing debt servicing expenses or lowering the market value of newly issued bonds. In response, fiscal authorities may adjust transfer payments to households in an effort to stabilize public finances. Following a CMP shock, government transfers to households decline sharply, disproportionately affecting financially constrained households and exacerbating the rise in inequality. In contrast, FG postpones both the interest rate increase and the resulting fiscal adjustment, leading to smaller reductions in transfers and more muted distributional consequences.

To formalize these mechanisms, we develop a tractable New Keynesian model featuring two household types: savers and hand-to-mouth consumers. The model includes fiscal redistribution via lump-sum transfers that respond endogenously to both public debt levels and the state of the business cycle. Consistent with the empirical evidence, the model demonstrates that the timing of interest rate changes directly affects the government's debt burden, which in turn drives the fiscal response. The fiscal channel ultimately determines the opposing effects of CMP and FG shocks on consumption inequality.

Sur les effets distributionnels de la politique monétaire conventionnelle et de la forward guidance

RÉSUMÉ

Cet article étudie les effets distributionnels de la politique monétaire conventionnelle et de la *forward guidance*. À l'aide d'un modèle VAR structurel, nous estimons leur impact sur les agrégats macroéconomiques ainsi que sur l'inégalité de consommation aux États-Unis. Alors que les variables réelles et financières agrégées réagissent de manière similaire aux deux instruments monétaires, leurs effets sur l'inégalité de consommation divergent fortement. Les chocs de politique monétaire conventionnelle entraînent une inégalité contracyclique, tandis que les annonces de *forward guidance* produisent une réponse procyclique, en raison de réactions hétérogènes selon la distribution des dépenses des ménages. Nous expliquons ces résultats contrastés à la fois de manière empirique et théorique à l'aide d'un modèle néo-keynésien analytique intégrant des ménages hétérogènes et une politique publique de redistribution. Dans ce cadre, un ajustement fiscal, qui diffère selon le calendrier et l'ampleur, provoque une baisse plus marquée de la consommation des ménages financièrement contraints à la suite d'une hausse conventionnelle des taux d'intérêt, tandis que l'effet est plus modéré en cas de *forward guidance*. Ces résultats soulignent l'importance de prendre en compte les conséquences distributionnelles des différents instruments de politique monétaire et mettent en évidence le rôle crucial de la politique budgétaire dans la dynamique des inégalités.

Mots-clés : hétérogénéité des ménages, forward guidance, inégalité, politique monétaire, contraintes de liquidité, transferts fiscaux

1 Introduction

The relationship between monetary policy and inequality has become a core topic in macroeconomics in recent years. At the same time, the policy tools available to monetary authorities to achieve their mandates have expanded in scope and complexity. While the distributional effects of conventional monetary policy (CMP) have been extensively studied in the literature, the implications of unconventional tools such as forward guidance (FG) remain less explored.[1] Understanding the various channels through which different types of monetary policy affect households and firms beyond the standard aggregate macroeconomic effects has become particularly important in the post-COVID-19 period, during which inflation has reached historically high levels. To effectively tackle such a surge in prices, monetary authorities need to determine the optimal set of policies to implement, and this decision cannot overlook the second-order effects of specific policy tools.

This paper empirically and theoretically investigates the distributional effects of FG in comparison to CMP. We first document that while both policies similarly impact aggregate macroeconomic variables, they induce opposite movements in the cross-sectional distribution of household consumption: a contractionary interest rate shock today increases consumption inequality, while an announcement of a future interest rate hike reduces it. We highlight the role of fiscal transfers in this context and reveal differences in their responses to each type of shock. Second, we develop a simple two-agent New Keynesian (TANK) model with heterogeneous households to rationalize our empirical findings and to illustrate the crucial role of transfers and fiscal redistribution in shaping the cyclical behavior of inequality.

Our first contribution is to assess the macroeconomic and distributional implications of CMP and FG empirically. We exploit U.S. household-level survey data from the Consumer Expenditure Survey (CEX) to construct a measure of consumption inequality, defined as the cross-sectional standard deviation of real consumption across households. We include this measure along with macroeconomic and financial variables in a standard vector autoregressive (VAR) model, using monetary policy factors extracted by Swanson (2021) from high-frequency asset price movements to disentangle the impact of the two policies.

Our empirical analysis uncovers three key findings on the effects of CMP and FG. First, aggregate macroeconomic variables show *similar* and significant responses to both policies. A contractionary shock of either type leads to a persistent decline in real output, while inflation gradually falls after a few quarters. Second, consumption inequality is *countercyclical* following a CMP shock, but *procyclical* after a FG announcement. The reaction is immediate in both cases, but more pronounced and persistent under FG. Third,

[1] For CMP, see Coibion, Gorodnichenko, Kueng, and Silvia (2017), Mumtaz and Theophilopoulou (2017), Guerello (2018); Samarina and Nguyen (2024) and Furceri, Loungani, and Zdzienicka (2018). For FG, see Colciago, Samarina, and de Haan (2019) for a comprehensive summary of the existing evidence.

the opposite inequality responses are driven by the differential sensitivity of the two tails of the consumption distribution to each contractionary shock. Households at the *bottom* of the distribution disproportionately reduce their spending in response to a CMP shock, leading to an increase in inequality. In contrast, following a FG shock, it is the *top* of the distribution that reduces consumption significantly, thereby lowering inequality.

To further investigate the transmission of these shocks, we introduce a potential rationale for the observed divergence in inequality responses. Prior literature highlights multiple channels through which monetary policy affects household consumption and inequality, including differences in income sources across households. This paper focuses on the often-overlooked role of the fiscal response to monetary policy in shaping inequality through indirect income effects. Specifically, government bonds used to finance public expenditures are highly sensitive to interest rate changes. A monetary tightening can lead to higher debt servicing costs or reduce the market price of newly issued bonds as yields rise. To manage the public budget under these conditions, fiscal authorities can adjust transfer payments to households.[2] Transfers play a key role in shaping individual spending behavior, particularly among low-income households, as they directly impact disposable income and consumption patterns. As a result, fiscal adjustments can amplify or mitigate the distributional effects of monetary policy, contributing to variations in consumption inequality.

Using transfer income received by households as a proxy for the government's response to monetary shocks in our VAR model, we find that CMP and FG announcements involve significantly different fiscal adjustments. In particular, aggregate transfers decline following a conventional shock, a pattern that is also reflected in the transfer income of low-consumption households. Given the importance of these transfers for financially constrained households, our findings illustrate the significance of fiscal adjustments for individual consumption decisions and thus for the cyclical nature of consumption inequality.

Our second main contribution is to provide a theoretical framework that rationalizes the empirical findings. We build an analytical TANK model with heterogeneity in household income following Bilbiie (2008, 2020) and fiscal redistribution. The setup features savers who can smooth consumption over time and hand-to-mouth agents who consume their entire income in each period. Households of the latter type are financially constrained due to their lack of access to asset markets, making their individual income highly sensitive to monetary policy changes. A fiscal authority aims to attenuate income fluctuations through a specific policy mix, combining a redistribution of firm profits across households with a lump-sum

[2] Dibiasi, Mikosch, Sarferaz, and Steinbach (2024) and Breitenlechner, Geiger, and Klein (2024) provide evidence that government officials view transfer payments as a crucial tool for rebalancing the budget following an increase in debt servicing costs.

transfer scheme.[3] Together, these fiscal instruments endogenously determine the inequality response to monetary shocks.

We use the model to derive a set of analytical results. First, we obtain a closed-form solution for consumption inequality as a function of expected real interest rates and government transfers. This allows us to formally characterize the condition under which any *arbitrary* transfer function can generate the observed asymmetry in inequality responses to CMP and FG shocks. Building on this insight, we propose a specific transfer rule, consisting of a debt-driven component that responds to changes in the government budget and a cyclical component that links transfers to fluctuations in aggregate output.

We calibrate the model to the U.S. economy and show that it broadly replicates the empirical observations on the distributional effects of monetary policy. The timing of the policy rate change influences interest payments on public debt, which in turn determines the fiscal response. After a contemporaneous hike in the interest rate, the government's debt burden rises immediately, triggering an instant fiscal adjustment that reduces transfers and disproportionately affects financially constrained households. In contrast, after a FG shock, the actual rate hike and thus the higher debt servicing costs occur in the future, leading the fiscal authority to only partially adjust transfers. These differences in the timing and magnitude of fiscal adjustments ultimately drive the opposing responses of consumption inequality after CMP and FG shocks.

Central banks worldwide have responded to the recent inflation surge by significantly increasing interest rates and applying a diverse mix of policy tools, while governments have introduced fiscal transfers to cushion households against rising energy costs. Against this backdrop, our paper sheds new light on the interplay between monetary and fiscal policy, emphasizing that the timing and magnitude of fiscal adjustments in response to central bank actions are crucial for mitigating the adverse distributional effects of monetary policy. At the same time, inequality itself influences how monetary policy is transmitted, underscoring the importance of incorporating distributional considerations into the broader policy framework. More broadly, our results highlight the value of tractable heterogeneous-agent models in analyzing the redistributive effects of monetary policy and providing insights into the household dynamics that drive these outcomes.

Related literature. This paper contributes to three strands of the literature. First, the results complement the large body of empirical evidence on the effects of monetary policy on

[3] Heathcote, Perri, and Violante (2010) document for the U.S. that public transfers are particularly important to stabilize income variations and compress inequality for households at the bottom of the income distribution.

consumption and income inequality.[4] Using the same survey data as this paper and various dispersion measures, Coibion et al. (2017) show that consumption and income inequality in the U.S. respond countercyclically to contractionary monetary policy shocks. This result has been confirmed for the United Kingdom (Mumtaz & Theophilopoulou, 2017) and, in the case of income inequality, for the euro area (Guerello, 2018; Samarina & Nguyen, 2024) as well as for a panel of 32 advanced and emerging economies (Furceri et al., 2018). However, other studies find (weakly) procyclical responses, notably for consumption inequality in the U.S. (Chang & Schorfheide, 2024) or income inequality in the U.S. and the United Kingdom (Cloyne, Ferreira, & Surico, 2020). In contrast, consumption inequality in Japan shows only a minor response to monetary policy shocks (Inui, Sudo, & Yamada, 2017).

Turning to the distributional consequences of unconventional policies, the empirical evidence is much scarcer and sometimes yields conflicting conclusions. Most studies focus on large-scale asset purchases as part of quantitative easing programs. For instance, Guerello (2018) and Lenza and Slacalek (2024) provide evidence that quantitative easing reduced the income dispersion in several European countries, while Montecino and Epstein (2015) and Mumtaz and Theophilopoulou (2017) find the opposite for the U.S. and the United Kingdom, respectively. Saiki and Frost (2014) document that expansionary unconventional policy measures in Japan led to an increase in income inequality, while Inui et al. (2017) find no significant effects.

We extend this literature by analyzing the aggregate and distributional responses to FG in comparison to CMP for the case of the U.S. economy. To the best of our knowledge, this paper is the first to empirically examine the separate impact of this unconventional policy tool on the distribution of household consumption.

Second, we draw on the literature that uses high-frequency asset price movements around monetary policy events to identify monetary shocks (Altavilla, Brugnolini, Gürkaynak, Motto, & Ragusa, 2019; Andrade & Ferroni, 2021; Bundick & Smith, 2020; Ferreira, 2022; Gertler & Karadi, 2015; Gürkaynak, Sack, & Swanson, 2005; Jarociński & Karadi, 2020; Kuttner, 2001; Lakdawala, 2019).[5] The general idea is to extract the surprise component of policy actions on days with monetary policy announcements. To disentangle CMP shocks from FG shocks, we use the monetary policy surprises computed by Swanson (2021). These are further decomposed into different factors which measure unexpected variations in asset prices at short, intermediate, and long maturities, respectively. We complement the existing studies on

[4]See Attanasio and Pistaferri (2016) for a discussion about the evolution of U.S. consumption inequality and a comparison with trends in income inequality. Moreover, Colciago et al. (2019) provide a recent summary of empirical evidence and theoretical literature regarding the relationship between (unconventional) monetary policy and income and wealth inequality.

[5]See Ramey (2016) for a comprehensive overview of alternative identification approaches for monetary policy and other shocks.

the macroeconomic effects of FG (e.g., Bundick & Smith, 2020; Ferreira, 2022; Lakdawala, 2019) by investigating its distributional implications.

Third, this paper also contributes to the growing literature on the transmission of monetary policy in heterogeneous-agent models. Part of this literature studies the propagation of CMP and the interaction with different household characteristics (e.g., Auclert, 2019; Auclert, Rognlie, & Straub, 2020; Kaplan, Moll, & Violante, 2018; Luetticke, 2021). Other work focuses specifically on the transmission of FG and addresses the magnitude of its aggregate effects (Acharya & Dogra, 2020; Bilbiie, 2024; Farhi & Werning, 2019; Ferrante & Paustian, 2019; Hagedorn, Luo, Manovskii, & Mitman, 2019; McKay, Nakamura, & Steinsson, 2016; Werning, 2015).

Our paper is particularly related to studies that highlight how fiscal policy – whether through transfers or the redistribution of monopolistic firms' profits – responds to monetary policy changes. As shown in two-agent models by Bilbiie (2008, 2020, 2024) or Bilbiie, Känzig, and Surico (2022), the extent to which fiscal redistribution leads to a procyclical or countercyclical inequality response is critical for several key mechanisms, such as the transmission of monetary policy to aggregate demand or the effectiveness of FG. The latter thereby crucially depends on the degree of countercyclical transfers, as illustrated by Gerke, Giesen, and Scheer (2020). The importance of the government's response is also well-known in fully-fledged heterogeneous-agent models. Kaplan et al. (2018) show that the nature of the fiscal response to a monetary policy shock considerably shapes its macroeconomic effects. Kaplan, Moll, and Violante (2016) extend the analysis to FG shocks, while Evans (2022) emphasizes that various profit distribution schemes substantially influence the sensitivity of income and consumption to monetary shocks.

We contribute to the literature on heterogeneous-agent models by studying how the interplay between monetary and fiscal policy affects consumption dispersion following shocks to the policy rate. Our two-agent model allows us to derive analytical solutions and dynamic variable responses to illustrate the relevance of fiscal redistribution for shock propagation and the cyclicality of inequality.

Outline. The remainder of the paper is organized as follows. Section 2 describes the data and the empirical specification that we adopt to evaluate the effects of monetary shocks on consumption inequality. It also shows the main results of the empirical analysis. In Section 3, we outline the theoretical model and study analytically its key equilibrium conditions. 4 introduces a transfer function example and presents the resulting impulse responses. Section 5 explores the policy implications of our findings. Finally, Section 6 concludes.

2 Empirical analysis

2.1 Data and identification

2.1.1 Macroeconomic and financial variables

Our empirical analysis focuses on the U.S. economy. The main macroeconomic and financial variables for the baseline model are the real Gross Domestic Product (GDP), the GDP price deflator, the Excess Bond Premium (EBP) from Gilchrist and Zakrajsek (2012), the Federal Funds Rate (FFR), and the 2-year constant-maturity Treasury yield. All these data series are taken from the FRED database operated by the Federal Reserve Bank of St. Louis, except for the EBP data, which are from the Federal Reserve System website. In addition, we use as an aggregate fiscal transfer measure the total government social benefits to persons, as reported by the Bureau of Economic Analysis, deflated by the CPI for all urban consumers (CPI-U) from FRED.[6] This data series is in line with those used in comparable studies (e.g., Amberg, Jansson, Klein, & Picco, 2022; Coibion et al., 2017; Evans, 2022).

2.1.2 Household-level data

We construct a dispersion measure for consumption using data from the Consumer Expenditure Survey (CEX). The CEX, provided by the Bureau of Labor Statistics (BLS) since 1980, is the most comprehensive and granular data source on household consumption in the U.S. and is used for constructing U.S. CPI weights. The survey consists of two separate modules: the Interview Survey and the Diary Survey. The first provides information on up to 95% of a typical household's consumption expenditures, whereas the second covers only expenditures on small items from stores. In our analysis, we only use data from the Interview Survey.[7]

The CEX is a monthly rotating panel in which households are interviewed once per quarter for a maximum of five consecutive quarters. In each round, the respondents report their expenditures for the three months prior to the interview. In line with the literature, we aggregate monthly into quarterly expenditures to alleviate a few weaknesses in measuring inequality at higher frequencies. First, households sometimes tend to report values for past expenditures that are smoothed over time, which decreases the reliability of monthly data. Second, aggregation reduces sampling errors arising from the relatively small cross section compared to administrative-level data. Third, unusual or large one-time purchases can lead to biased estimates at the monthly level, while they are partially smoothed out at the quarterly level. Finally, a lower frequency better accounts for seasonal patterns.

[6] Government social benefits are part of the personal current transfer receipts and include Social Security, unemployment insurance, Medicare, Medicaid, veterans' benefits, and other federal and state programs.

[7] See Bee, Meyer, and Sullivan (2013) for an assessment of the quality of the consumer dataset and its limitations.

To construct a measure of consumption inequality, we closely follow the approach in Coibion et al. (2017).[8] Household consumption is defined as the sum of non-durable goods, services, and selected durable goods, such as household appliances, entertainment goods like televisions, and furniture. Large durable expenditures such as house and car purchases are excluded because they are considered investments rather than consumption. All nominal variables are deflated by the CPI-U and survey sample weights are consistently applied throughout. Real consumption is winsorized at the bottom and top one percent to mitigate the influence of outliers, and the series are seasonally adjusted. The baseline measure of inequality we compute is the cross-sectional standard deviation of real consumption across households.

We focus on consumption inequality rather than income or wealth inequality for several reasons. First, expenditure data are of higher quality, with the CEX specifically designed to collect information on household spending over time. While the BLS provides some measures of income and wealth, these are mainly imputed from expenditure and demographic data. Moreover, the consumption distribution serves as a good proxy for income and wealth distributions. Second, consumption is closely linked to households' well-being as it directly enters their utility functions. Consumption is the primary reason to earn income and accumulate wealth in the first place, and it tends to fluctuate less than either of these. This allows for a more consistent assessment of household disparities over time. Third, Coibion et al. (2017) show that contractionary monetary shocks have only a negligible impact on income inequality, whereas consumption responds strongly.

The CEX also reports data on total income from transfers at the household level. As a proxy for the government's response to monetary shocks, we compute the amount of transfer income received by the households at the bottom of the consumption distribution.[9] The series is deflated, seasonally adjusted, and winsorized, as for consumption inequality.

2.1.3 Monetary policy shocks

To identify the structural shocks relevant to our analysis, we draw on the concept of high-frequency identification. The objective is to monitor changes in market-based measures at dates with a policy event – so-called monetary policy surprises – to isolate the unexpected variation in monetary policy. These surprises can then be used to estimate unobserved factors that together explain variations in the market-based measure around the policy events.

[8]For a detailed description of the data cleaning procedure, see the appendix in Coibion et al. (2017).

[9]Following Coibion et al. (2017), transfer income includes Supplemental Security Income and Railroad Retirement before deductions, unemployment insurance, workers' compensation and veterans' benefits, public assistance, contributions from alimony and child support, and other monetary income (scholarships, fellowships, stipends, etc.). Most of these variables are only available until 2012.

We rely on different measures of U.S. monetary policy surprises and factors. In our baseline specification, we use the factors computed by Swanson (2021), who extends the high-frequency approach of Gürkaynak et al. (2005). Swanson collects changes in selected asset prices within a 30-minute window around each Federal Open Market Committee (FOMC) announcement between 1991 and 2019 and computes the first three principal components of those responses, which together describe the vast majority of market movements. Among all possible rotations of these principal components, he identifies one in which the first factor can be thought of as corresponding to changes in the Federal Funds Rate (or FFR), the second to changes in FG, and the third to changes in large-scale asset purchases (LSAPs).[10] These factors represent the three components of monetary policy with the most systematic impact on asset prices. Building on this, Swanson (2021) decomposes the changes in asset prices around FOMC announcements into a FFR factor, a FG factor, and a LSAP factor, each measuring surprises at short, intermediate, and long maturities, respectively.[11] In particular, the FG factor captures revisions in market expectations about the future path of policy rates that are orthogonal to the current policy surprise.

For our analysis, we use the first two factors (FFR and FG) as measures of the structural monetary shocks. The series are available at a daily frequency and we sum up the data points within each quarter to convert them to quarterly frequency.[12]

2.2 Econometric approach

We adopt a standard VAR specification with p lags:

$$y_t = B_0 + B_1 y_{t-1} + \ldots + B_p y_{t-p} + u_t \ , \tag{1}$$

where y_t is the vector of variables of dimension $n \times 1$, u_t the vector of reduced-form innovations with covariance matrix $\mathrm{Var}\,(u_t) = \Sigma_u$, B_0 is the vector of constant terms, and $B_1, ..., B_p$ are $n \times n$ coefficient matrices.

The structural form of the VAR model is given by

$$A_0 y_t = C_0 + C_1 y_{t-1} + \ldots + C_p y_{t-p} + \varepsilon_t, \quad \varepsilon_t \sim \mathcal{N}(0, \Sigma) \ , \tag{2}$$

[10] Swanson (2021) imposes three restrictions to identify the respective factors. First, changes in FG have no impact on the current FFR. Second, neither do changes in LSAPs. Third, LSAPs had only a minor impact before the zero lower bound period.

[11] The factor that captures surprise changes in the FFR is sometimes referred to as *target factor*, while the factor capturing FG changes is termed *path factor*. See, for instance, the seminal work by Gürkaynak et al. (2005).

[12] Using the alternative approach by Gertler and Karadi (2015), who cumulate the surprises on FOMC meeting days over the last 93 days and then take the quarterly averages, has a negligible impact on the results.

where $C_0 = A_0 B_0$ and $C_j = A_0 B_j$ for $j = 1, \ldots, p$. The reduced-form residuals are a function of the structural shocks $u_t = A_0^{-1} \varepsilon_t$. Therefore, it is possible to write the reduced-form variance-covariance matrix as $\mathbb{E}(u_t u_t') = \Sigma_u = A_0^{-1} A_0^{-1'}$.

The CMP and FG shocks are identified through a Cholesky factorization of the reduced-form variance-covariance matrix Σ_u. Following Coibion (2012) or Cloyne and Hürtgen (2016), the FFR and FG factors are directly incorporated into the VAR model and ordered first.[13] This allows all other variables in the system to contemporaneously respond to the shock.[14] Even more important, since FG shocks can be interpreted as news shocks, ordering the factor of interest first and applying a recursive identification strategy addresses potential invertibility concerns (see, Plagborg-Møller & Wolf, 2021, 2022).

The remaining variables included in the baseline model specification are: (i) real GDP; (ii) GDP price deflator; (iii) Excess Bond Premium; (iv) Federal Funds Rate; (v) 2-year Treasury yield; and (vi) consumption inequality measure.[15] The Excess Bond Premium, the FFR, and the Treasury yield enter the model in percentage points (ppt.), while the other variables are in log levels, transformed by multiplying their log value by 100. The data are at quarterly frequency for the period 1991-Q3 to 2019-Q2. We include three lags for each independent variable as indicated by the corrected Akaike information criterion (AICc).[16] Standard errors are computed using a residual-based moving block bootstrap, following Jentsch and Lunsford (2019), with block size set to 16.

2.3 Empirical results

2.3.1 Aggregate responses

We start by analyzing how the macroeconomic and financial variables react to CMP and FG shocks. The impulse responses to a one-standard-deviation increase in the respective factor are presented in Figure 1. The blue dashed lines represent the point estimates and the shaded areas are the 68 percent confidence bands based on 10,000 residual-based moving block bootstrap replications.

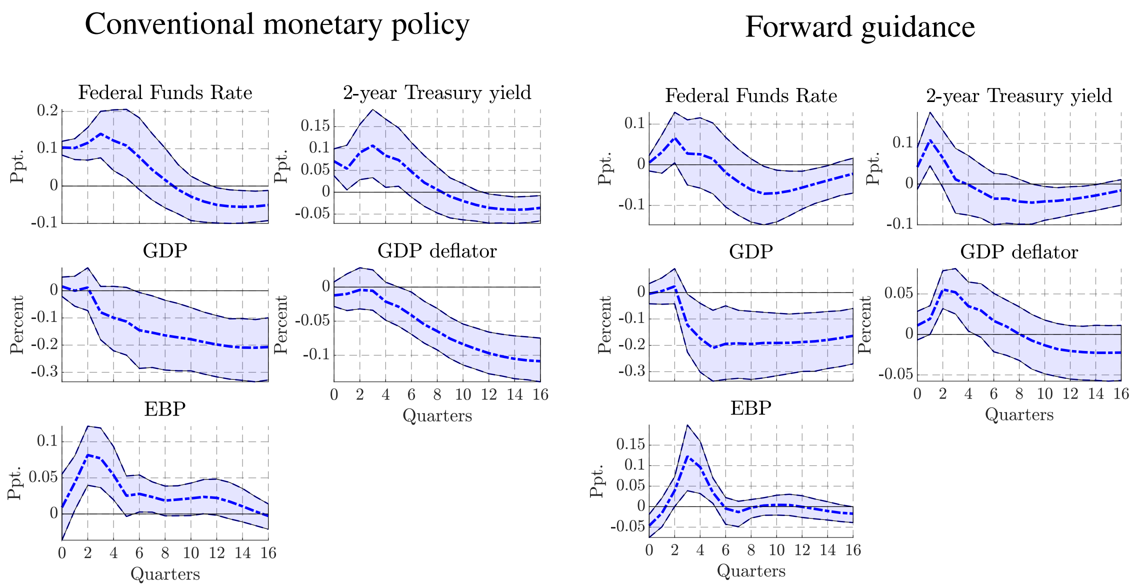
[13] The small sample size and the low frequency of the aggregate data limit the direct use of the factors as instrumental variables. For example, the first stage of a proxy VAR using the factors as external instruments for interest rates changes yields low F-statistics, in particular for the FG factor, indicating that the factors are weak instruments. This result also holds for alternative factors such as those discussed in Appendix A.

[14] Our results are insensitive to different orderings of the other variables in the VAR. The same applies when including one factor at a time, as the two factors are orthogonal to each other.

[15] Some authors advocate for using the 1-year Treasury yield instead of the FFR in setups like ours (see, among others, Gertler & Karadi, 2015; Jarociński & Karadi, 2020). A longer-term rate might have the advantage of remaining a valid measure of monetary policy even when nominal rates are close to or at the zero lower bound. However, our results barely change when substituting the 1-year Treasury rate for the FFR.

[16] When confronted with small samples like ours, the AICc outperforms the more common AIC. However, the impulse responses remain largely unchanged when using four lags, which is a standard choice in VAR models for monetary analysis with quarterly data.

Figure 1: Macroeconomic responses to monetary policy shocks



Notes: This figure depicts the impulse responses of macroeconomic variables to a one-standard-deviation increase in the target factor (left panel) and the path factor (right panel) of Swanson (2021). Impulse responses are from a VAR model using quarterly data for the period 1991Q3-2019Q2. Shaded areas represent 68% confidence intervals.

Following a contractionary CMP shock, the Federal Funds Rate increases as expected, while the impact on the 2-year Treasury yield is more muted. GDP and inflation start to decline persistently about a year after the shock, whereas the EBP signals tighter financial conditions. The magnitude and longer-term persistence of these responses closely align with findings in comparable studies such as Lakdawala (2019) and Ferreira (2022).

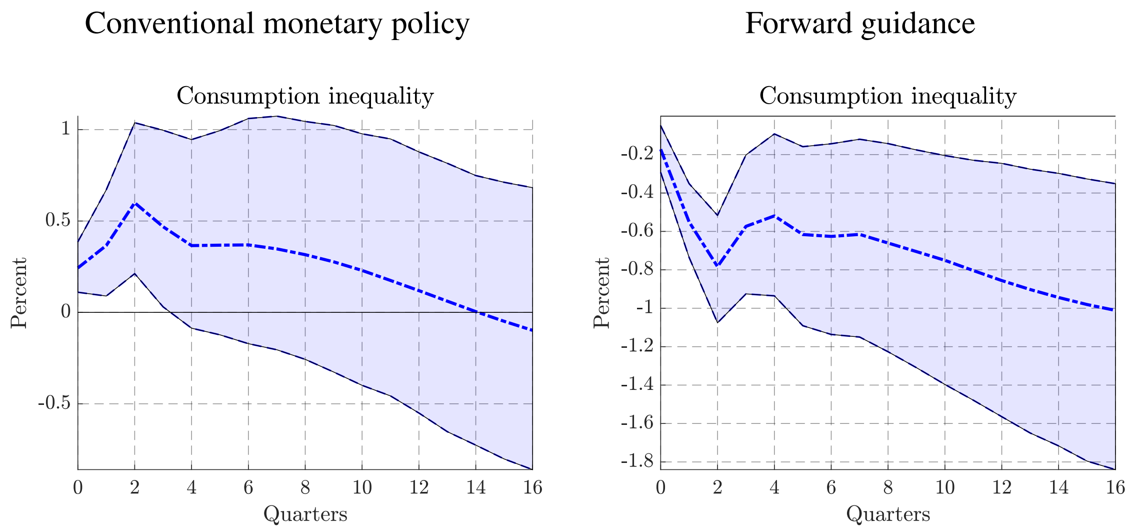
A positive FG shock raises the Treasury yield, but the Federal Funds rate does not respond significantly, as expected given the construction of the factors. The shock also leads to a substantial drop in GDP and an increase in the EBP a few quarters after the shock. The magnitude and persistence of these effects are again consistent with comparable studies. Notably, and in line with Barakchian and Crowe (2013) and Lakdawala (2019), prices initially rise for several quarters. However, as we illustrate in Appendix A.2, this price puzzle disappears after controlling for the central bank's private information, so that the response of inflation turns negative without affecting the sign of the consumption inequality response.[17]

[17] As discussed in Andrade and Ferroni (2021), the sign of the price response to a positive FG shock depends on how the shock is interpreted. If markets perceive the announcement as Delphic (signaling future macroeconomic conditions), prices will rise, whereas if markets view it as Odyssean (signaling the future stance of monetary policy), prices will fall. When shocks are cleaned from their Delphic component, we obtain the expected response with prices decreasing after a contractionary FG announcement.

2.3.2 Consumption inequality responses

We now turn to the response of our inequality measure, namely the log of the cross-sectional standard deviation of real consumption. The cumulated impulse responses to a CMP and a FG shock are presented in Figure 2.

Figure 2: Consumption inequality responses to monetary policy shocks



Notes: This figure depicts the cumulated impulse responses of consumption inequality to a one-standard-deviation increase in the target factor (left panel) and the path factor (right panel) of Swanson (2021). Consumption inequality is measured by the cross-sectional standard deviation of household-level real consumption. Impulse responses are from a VAR model using quarterly data for the period 1991Q3-2019Q2. Shaded areas represent 68% confidence intervals.

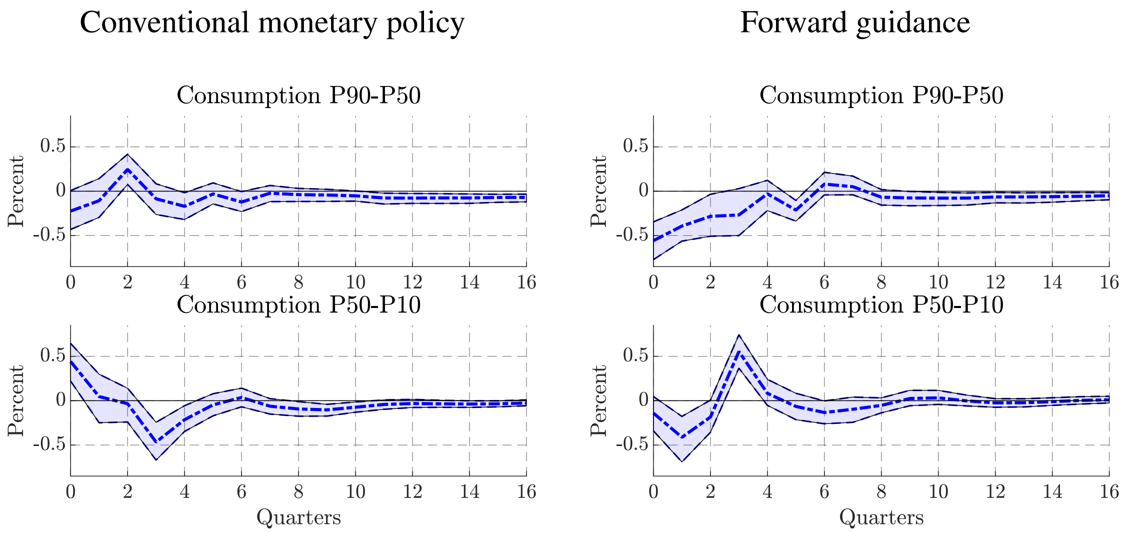
The two shocks have opposite effects on inequality. A policy rate hike today tends to increase the consumption dispersion across households, implying a countercyclical behavior relative to the output response. This result is consistent with Coibion et al. (2017) and Mumtaz and Theophilopoulou (2017). In contrast, when the central bank announces a future interest rate hike, there is an immediate, sharp decline in consumption inequality and hence a procyclical response. The cumulated response is thereby both stronger and much more persistent than that after a conventional shock. In relative terms, both impulse responses on impact are of comparable magnitude to the respective peak impact on output.

After a contractionary monetary shock of either type, total consumption in the economy declines, but not everyone at the individual household level reduces spending by the same amount.[18] To shed further light on which households drive this finding, we replace our inequality measure in the VAR model with two variables: the difference between log

[18] Our analysis focuses on total household consumption and does not distinguish between subcomponents such as durables, nondurables, or services. Recent evidence by Chang and Schorfheide (2024) indicates that these categories may respond differently to monetary policy shocks.

consumption at the 90th and 50th percentiles of the household consumption distribution (right tail minus median) and the difference between log consumption at the 50th and 10th percentile (median minus left tail). The impulse responses are shown in Figure 3.

Figure 3: Consumption responses to monetary policy shocks across percentiles



Notes: This figure depicts impulse responses to a one-standard-deviation increase in the target factor (left panel) and the path factor (right panel) of Swanson (2021). The variable of interest in the top row is the difference in log real consumption between the 90th and the 50th percentiles of the household consumption distribution. In the bottom row, it is the difference between the 50th and the 10th percentiles. Impulse responses are from a VAR model using quarterly data for the period 1991Q3-2019Q2. Shaded areas represent 68% confidence intervals.

In response to a contractionary CMP shock, households at the top 10% of the consumption distribution reduce their spending slightly more than those at the median, resulting in a negative but statistically insignificant difference (top left panel). As expected, households at the bottom 10% of the distribution experience a disproportionate decline in consumption on impact of the shock, further increasing the distance to the median household (bottom left panel). This pattern may be explained by the fact that a large share of these households are close to or even at their borrowing constraint, making their consumption very sensitive to changes in the current interest rate.[19] Overall, the sharp decrease in consumption at the left tail leads to a rise in inequality.

The right panels tell a different story. After a contractionary FG announcement, households at the bottom 10% of the distribution initially adjust their consumption similarly to the median household, at least in the first few periods after the shock (bottom right panel). However, spending at the right tail substantially decreases, reducing the difference to the 50th

[19]Households in the bottom 10% of the consumption distribution account for most of the observed change in consumption inequality following CMP shocks. Excluding them yields an insignificant response. In contrast, inequality dynamics under FG shocks remain largely unaffected by their presence.

percentile (top right panel). This dynamic implies that the cross-sectional standard deviation of real consumption declines significantly after a FG shock, as shown in Figure 2.

To sum up, the empirical analysis so far yields three main conclusions about the overall effects of CMP and FG. First, macroeconomic variables show similar and significant responses to both monetary policies. Second, consumption inequality is countercyclical under CMP, but procyclical and also more pronounced under FG. Third, these opposite inequality responses emerge from the differential sensitivity of households at the two tails of the consumption distribution to each shock.

2.3.3 Fiscal transfers as an explanatory factor

We now provide a potential rationale for the differing cyclicality of consumption inequality. The existing literature identifies multiple transmission channels through which monetary policy shocks can influence household consumption and inequality.[20] Some of these channels emphasize direct income effects, where monetary policy explicitly impacts the interest rates that households pay or earn. We provide a novel perspective by examining an underexamined factor of inequality, operating through an income composition channel that indirectly affects household income, namely fiscal policy.

Government bonds issued to finance public expenditures are one natural example of an asset that is directly impacted by interest rate movements, either through implied changes in the interest payments on public debt or through changes in the price of newly issued bonds. This affects the government's budget and, all else equal, its capacity to spend. It also calls for fiscal adjustments to rebalance the public budget, taking into account updates on the economic outlook.[21]

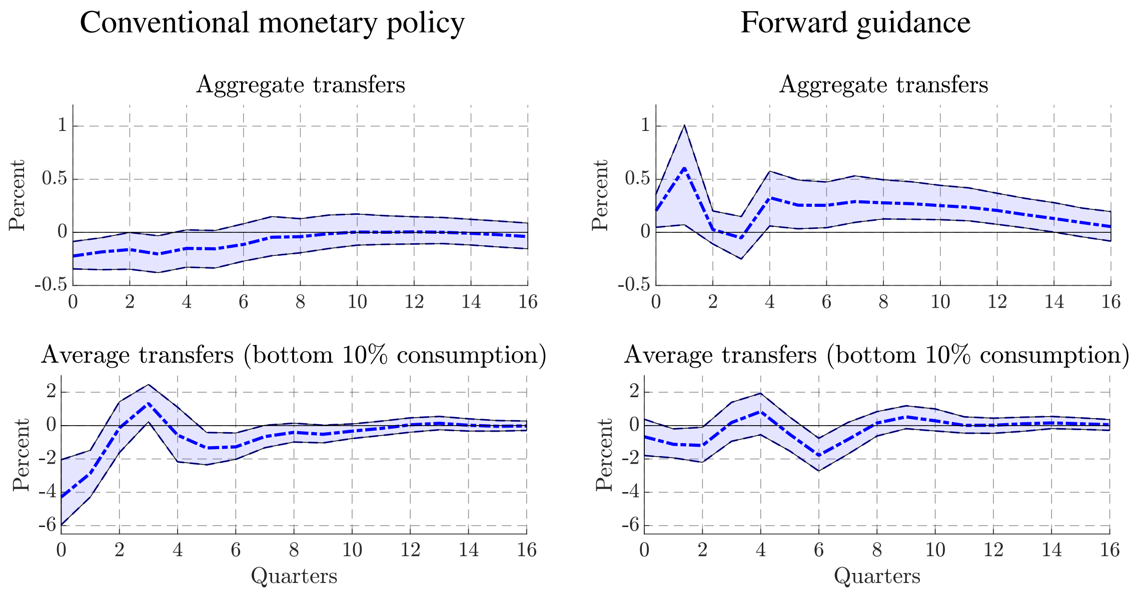
One way to rebalance the budget is by adjusting transfer payments to households. The amount of transfers distributed likely depends on the current and expected interest rate path, as recent evidence suggests. Breitenlechner et al. (2024) find significant adjustments in fiscal measures in response to a monetary policy shock, including social transfer payments. These adjustments are crucial in shaping how interest rate changes transmit to both nominal and real variables. Moreover, survey results from Dibiasi et al. (2024) indicate that when faced with unexpected increases in debt servicing costs, fiscal authorities are likely to rebalance the public budget not only by raising government debt but also by cutting transfers and spending.

[20] See Colciago et al. (2019) for an overview of distributional transmission channels.

[21] Appendix A.9 reinforces the idea that the government budget constraint is affected to varying degrees by the two monetary shocks, supporting the notion of a differential adjustment in fiscal instruments. We examine the responses of interest payments on government debt as an indicator of fiscal tightness following each shock. Debt servicing costs tend to rise significantly after a contractionary CMP shock but remain largely unresponsive to FG.

Furthermore, fiscal transfers play a substantial role in shaping household spending behavior, especially for low-income households, for whom transfer payments represent a significant share of income and thus crucially influence consumption decisions.[22] Empirical evidence supports this relationship, with Heathcote et al. (2010) underscoring the importance of public transfers in stabilizing income fluctuations and mitigating inequality for low-income households in the U.S. Similarly, McKay and Reis (2016) demonstrate the stabilization power of automatic transfer programs in sustaining aggregate consumption.

Figure 4: Household transfer income responses to monetary policy shocks



Notes: This figure depicts impulse responses to a one-standard-deviation increase in the target factor (left panel) and the path factor (right panel) of Swanson (2021). The variable of interest in the top row is the log of real total transfers. In the the bottom row, it is the log of real average transfer income for households in the bottom 10th percentile of the consumption distribution. Impulse responses are from a VAR model using quarterly data for the period 1991Q3-2012Q4. Shaded areas represent 68% confidence intervals.

To approximate the government's reaction to monetary shocks, we separately add fiscal transfer measures for both the aggregate and the household level to the vector of variables in the baseline VAR model (equation 2). The top row of Figure 4 shows the impulse responses of total transfer income, measured as total government social benefits paid to U.S. households. Aggregate transfers react procyclically to CMP, in line with the findings from Amberg et al. (2022), Coibion et al. (2017), or Evans (2022). However, FG induces the opposite effect, leading to an increase in transfer income. In relative terms, the response remains significantly above that of CMP over almost the entire horizon.

[22]According to data from the Bureau of Economic Analysis, the portion of U.S. government social benefits to households, relative to their disposable income, increased from 13.4% in 1980 to 19.1% in 2019.

A similar result emerges at the household level. The bottom row of Figure 4 displays the impulse responses of the average transfer income received by households belonging to the bottom 10% of the consumption distribution. Transfers to these agents decline significantly following a CMP shock. The drop is relatively large and around twice as much as the average response of, for example, the bottom 50% of the distribution. This suggests that the left tail is a major driver of total transfers. On the other hand, transfer income fluctuates around zero after a FG shock, particularly in the first few quarters after the shock, indicating a modest response of households with low consumption levels.

The results suggest that the fiscal response to CMP and FG plays a non-negligible role in the opposite cyclicality of consumption inequality.[23] There are clear differences between the impulse responses of aggregate transfers and the transfer income of low-consumption households. This supports the idea that monetary policy is transmitted through an income composition channel, where transfer income represents a varying proportion of total income across households and responds differently to policy rate changes. In the analytical model, we will incorporate this insight by introducing a more general representation of government transfers in lump-sum form, allowing us to replicate the empirical findings regarding the cyclical nature of inequality highlighted above.

The granularity of the BEA transfer data allows us to take a closer look at how different transfer components respond heterogeneously to the two shocks. Bouscasse and Hong (2023) already document varying sensitivities to monetary policy shocks across transfer components. Similarly, we decompose total transfers into a cyclical and a non-cyclical component. The cyclical component is expected to correlate closely with the business cycle. We follow McKay and Reis (2016) and include in this category unemployment and food stamp benefits as well as transfers from other safety net programs targeted at low-income or vulnerable households.[24] These public benefits provide crucial assistance in times of economic distress, making it therefore very likely that more individuals will apply or become eligible for them in recessions. As such, the cyclical component can be interpreted as capturing the automatic stabilizer part of the transfer system, which adjusts mechanically with changes in economic conditions. On the other hand, the non-cyclical component comprises all remaining total transfer categories.[25]

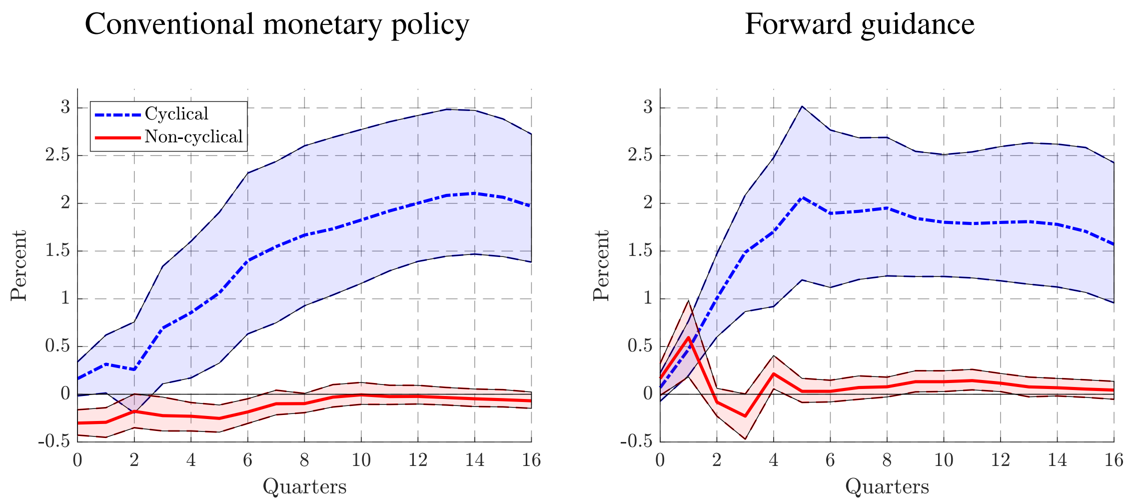
We present the impulse responses of the two transfer components in Figure 5. Following a contractionary shock of either type, the cyclical component increases significantly and

[23]In Appendix A.8, we compute counterfactual responses to the two monetary shocks by presupposing a zero response of total transfers. The absence of a fiscal reaction leads to a markedly weaker response of consumption inequality.

[24]The cyclical component includes government benefits from unemployment insurance, the Supplemental Nutrition Assistance Program (formerly known as Food Stamp Program), Supplemental Security Income, and family, general, and energy assistance programs.

[25]The non-cyclical component accounts for between 84% and 93% of total transfers over the sample period.

Figure 5: Transfer component responses to monetary policy shocks



Notes: This figure depicts the impulse responses of the cyclical and non-cyclical transfers components to a one-standard-deviation increase in the target factor (left panel) and the path factor (right panel) of Swanson (2021). The cyclical component includes unemployment and food stamp benefits as well as transfers from other safety net programs. The non-cyclical component includes the rest of total transfers. Impulse responses are from a VAR model using quarterly data for the period 1991Q3-2019Q2. Shaded areas represent 68% confidence intervals.

persistently, responding to the decline in real GDP. This pattern is consistent with the role of automatic stabilizers, which are designed to expand during downturns. Both the shape and the magnitude of the responses are similar, suggesting that the heterogeneous effects on consumption inequality are not due to this automatic component of total transfers. Instead, it is the non-cyclical component of transfers that drives the difference. It slightly decreases after a CMP shock but rises following a FG shock. This division of aggregate transfers into two components serves as the foundation for the proposed transfer rule in the theoretical model.

While fiscal policy is often seen as slow-moving, the immediate transfer responses shown in Figures 4 and 5 do not necessarily contradict this view. Some non-cyclical transfers are more responsive than the label suggests, operating under standing rules or flexible budgets that allow for rapid scaling or reallocation without new legislation. In response to macroeconomic shocks, such as an unexpected monetary tightening, governments can adjust eligibility criteria or shift discretionary spending within existing frameworks. Transfers often rise sharply during recessions, reflecting targeted responses driven by a few key episodes, which VAR identification strategies are well suited to capture.

Methodologically, the contemporaneous responses we estimate reflect fiscal adjustments correlated with monetary shocks within the same quarter, and not immediate day-to-day policy actions. Given the quarterly frequency of the data, these estimates average responses across programs with varying implementation speed and across different historical and institutional contexts. As a result, they can give the appearance of immediate fiscal action, even when some underlying components adjust more gradually.

2.3.4 Robustness of the empirical findings

In Appendix A, we conduct a series of robustness checks to strengthen the validity of our empirical findings. First, we use the Gini coefficient of real consumption as an alternative measure of consumption inequality. Second, we consider a number of alternative factors as measures of the structural monetary shocks: the FFR factor of Swanson (2021), cleaned from central bank private information following the approach of Miranda-Agrippino and Ricco (2021b), the cleaned path factor of Lakdawala (2019), and the factors computed by Gürkaynak et al. (2005). Third, we adopt two alternative empirical model specifications, namely the structural VAR model of Bundick and Smith (2020) to verify our dynamic responses to a FG shock, and Bayesian local projections as proposed by Ferreira, Miranda-Agrippino, and Ricco (2023). Fourth, we assess the sensitivity of our inequality and total transfer results under different parameter-variable combinations within the VAR model. Finally, we examine the historical robustness of our findings by comparing episodes of different FG types. Overall, the robustness checks broadly confirm our primary findings. In particular, they demonstrate that consumption inequality shows distinct cyclical patterns in response to CMP and FG shocks across a wide range of setups.

3 Analytical insights from a theoretical framework

In this section, we evaluate whether a simple heterogeneous-agent model can replicate the key findings from the empirical analysis, particularly the differential cyclical responses of consumption inequality to CMP and FG shocks. Our analytical framework combines a two-agent household structure, following Bilbiie (2008, 2020), with fiscal policy similar to that in Kaplan et al. (2018). The core of the model is a fiscal policy mix that includes both profit redistribution across households and a responsive lump-sum transfer scheme, which adjusts dynamically to changes in the government budget and cyclical fluctuations.

3.1 Simple two-agent economy

The model economy consists of four types of agents: households, firms, a government, and a monetary authority. Households are divided into constrained hand-to-mouth agents and unconstrained savers. Firms are modeled in a standard New Keynesian fashion, with nominal rigidities that imply sticky prices. The fiscal authority finances lump-sum transfers through short-term debt and conducts redistributive policies by taxing firm profits. Finally, the central bank controls the real interest rate and sets an exogenous time path for it. Appendix B provides further details on the model derivation and equilibrium conditions.

Households. The unit mass of households is divided into two types: a share λ are hand-to-mouth households (H), while the remaining $1-\lambda$ are savers (S). All households share the same period utility function over consumption C and labor L. For $j = \{H, S\}$,

$$U\left(C_t^j, L_t\right) = \frac{\left(C_t^j\right)^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} - \varphi^j \frac{L_t^{1+\nu}}{1+\nu} ,$$

with discount factor $\beta \in (0,1)$ and where σ is the elasticity of intertemporal substitution, $\frac{1}{\nu}$ denotes the Frisch elasticity of labor supply, and $\varphi^j > 0$ reflects the degree to which each agent values leisure relative to consumption. We assume that both household types supply the same amount of hours worked.[26]

Savers. Unconstrained households hold all assets in the economy. They can save in risk-free real bonds issued by the government and get uniform labor income, transfers, and dividends from profits made by the monopolistic firms they own. Each saver solves the following problem:

$$\max_{C_t^S, L_t, B_{t+1}^S} \mathbb{E}_t \sum_{t=0}^{\infty} \beta^t U\left(C_t^S, L_t\right) \quad \text{subject to}$$
$$C_t^S + B_{t+1}^S = (1+r_{t-1})B_t^S + W_t L_t + \Gamma_t^S + T_t^S ,$$

where B_{t+1}^S represents a saver's end-of-period-t holdings of liquid one-period government bonds issued in t, W_t is the real wage, Γ_t^S are dividends from monopolistic firms' profits net of taxes, T_t^S are real lump-sum government transfers, and r_t is the real interest rate on bonds, where $1 + r_t = \frac{1+i_t}{1+\pi_{t+1}}$ with net inflation rate $\pi_t = \frac{P_t}{P_{t-1}} - 1$.

The optimality conditions for this problem yield the following Euler equation for bonds and labor supply condition:

$$1 = \beta\, \mathbb{E}_t \left[\left(\frac{C_{t+1}^S}{C_t^S} \right)^{-\frac{1}{\sigma}} (1+r_t) \right] ,$$
$$W_t = \varphi^S \left(L_t\right)^{\nu} \left(C_t^S\right)^{\frac{1}{\sigma}} .$$

[26]One way to ensure equal labor supply across household types is to assume a centralized labor market. For example, Bilbiie et al. (2022) impose that a union consolidates labor inputs by households and sets the wage on their behalf.

Hand-to-mouth households. Constrained households have no access to asset markets and simply consume their labor income and transfers from the government. Their budget constraint reads

$$C_t^H = W_t L_t + \Gamma_t^H + T_t^H \ .$$

Redistributed dividend income Γ_t^H and lump-sum transfers T_t^H play a central role for the dynamic responses as outlined below. These factors substantially govern the direction of the inequality response to a CMP or FG shock.

The labor supply choice of hand-to-mouth agents is characterized by

$$W_t = \varphi^H \left(L_t\right)^{\nu} \left(C_t^H\right)^{\frac{1}{\sigma}} \ .$$

Firms. The supply side of the economy is standard and features monopolistically competitive producers providing intermediate goods to perfectly competitive final goods firms.

Final goods producers. A representative firm in the final goods sector aggregates differentiated intermediate inputs j into a final good according to the CES production function $Y_t = \left(\int_0^1 Y_t(j)^{\frac{\epsilon-1}{\epsilon}} di\right)^{\frac{\epsilon}{\epsilon-1}}$ with elasticity of substitution across goods ϵ. Profit maximization yields the demand for each input, $Y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\epsilon} Y_t$, where $P_t(j)$ is the price of intermediate good j, and the aggregate price index is given by $P_t^{1-\epsilon} = \int_0^1 P_t(j)^{1-\epsilon} dj$.

Intermediate goods producers. There is a continuum of monopolistically competitive firms, each producing a variety j of the intermediate good using labor N as input. Their production function reads $Y_t(j) = N_t(j)$ and cost minimization implies the real marginal cost $MC_t = W_t$. Each producer faces quadratic price adjustment costs as in Rotemberg (1982) given by $\Theta_t = \frac{\theta}{2}\left(\frac{P_t(j)}{P_{t-1}(j)} - 1\right)^2 Y_t$. Real profits of firm j are then given by

$$D_t(j) = \left(1+\tau^S\right) \frac{P_t(j)}{P_t} Y_t(j) - W_t N_t(j) - \Theta_t - T_t^F \ ,$$

where $P_t(j)$ is the price set by firm j and P_t denotes the aggregate price level. Following Bilbiie (2020), we assume that the government pays a subsidy on sales, financed by a lump-sum tax on firms, such that $T_t^F = \tau^S Y_t(j)$. With this, total profits across all firms are

$$D_t = \left(1 - MC_t - \frac{\theta}{2}\pi_t^2\right) Y_t \ .$$

An intermediate goods producer sets its price $P_t(j)$ to maximize the discounted stream of expected profits subject to the demand for its good. Appendix B.1 derives the solution to this pricing problem which leads to the following New Keynesian Phillips curve:

$$\pi_t(1+\pi_t) = \mathbb{E}_t\left[\frac{\Lambda_{t+k}}{\Lambda_t}\,\theta\pi_{t+1}(1+\pi_{t+1})\,\frac{Y_{t+1}}{Y_t}\right] + \frac{1}{\theta}\left[\epsilon MC_t - (1+\tau^S)(\epsilon-1)\right] \ .$$

Government. The fiscal authority issues one-period real bonds, only held by savers, to finance the repayment of existing debt and transfer payments to households. Its budget constraint is given by

$$B_{t+1} = (1+r_{t-1})B_t + T_t \ ,$$

where B_{t+1} represents newly issued bonds at time t, with $B>0$ denoting debt, r_t is the real interest rate, and T_t are total lump-sum transfers. We assume that bonds are in positive net supply in equilibrium.

The key instrument of fiscal policy is a tax and transfer system comprising two elements. First, the government levies taxes on the profits of monopolistic firms, which are owned by savers, and redistributes the revenues as a transfer to hand-to-mouth agents. This policy is balanced in every period, such that the following conditions hold:

$$\Gamma_t^H = \frac{\tau^D}{\lambda}D_t$$
$$\Gamma_t^S = \frac{1-\tau^D}{1-\lambda}D_t \ ,$$

where τ^D is the proportional tax on profits that determines the magnitude of the redistribution. When $\tau^D > \lambda$, hand-to-mouth agents receive a disproportionate share of profits, making them therefore more exposed to fluctuations in profit levels.

Second, there is a lump-sum transfer scheme in place, where total transfers are given by

$$T_t = \lambda T_t^H + (1-\lambda)T_t^S \ .$$

The exact functional form of individual transfers will be specified in Section 4. For now, they can be viewed as functions of key variables shaping the fiscal stance, such as interest rates, the level of debt, or the business cycle.

For this simple model, we assume that the government adjusts total lump-sum transfers to stabilize debt at a constant level over time, allowing for a clearer illustration of the fiscal adjustment mechanism. In other words, $B_t = B$ for all t, such that

$$-(r_{t-1}-r)B = \lambda\left(T_t^H - T^H\right) + (1-\lambda)\left(T_t^S - T^S\right) \ ,$$

where variables without time indices denote steady-state values. If the economy starts from a steady state, an expansionary monetary policy shock that lowers the real rate below its long-run value r will imply lower interest payments on government debt, allowing for higher transfer payments to households.

Monetary authority. Following McKay et al. (2016) and Kaplan et al. (2016), we assume that the central bank controls the real interest rate. It implements monetary policy by setting and committing to a path for the interest rate, $\{r_k\}_{k\geq 0}$, that is perfectly credible and foreseen by agents.

Once the central bank adjusts the real interest rate at some arbitrary point in time $\mathcal{T} > 0$, monetary policy will follow an exogenous rule thereafter. Prior to $\mathcal{T}$, the real rate remains fixed at its steady-state value r. Formally, for $\mathcal{T} \geq 0$:

$$r_t = \begin{cases} r, & t < \mathcal{T} \\ r + \rho^{t-\mathcal{T}}\varepsilon_{\mathcal{T}}, & t \geq \mathcal{T} \end{cases}$$

with policy shock $\varepsilon_{\mathcal{T}} = r_{\mathcal{T}} - r$ and persistence ρ.[27] As a result, we have $\mathcal{T} = 0$ for a CMP shock and $\mathcal{T} > 0$ for a FG shock. Moreover, the Fisher equation holds:

$$1 + r_t = \frac{1 + i_t}{1 + \pi_{t+1}} \, .$$

The theoretical modeling of the monetary shocks differs slightly from their empirical counterparts. This difference arises from the distinct purpose of each approach. Empirically, FG shocks are identified through high-frequency asset price movements around policy announcements, capturing how financial market participants revise their expectations about the future path of policy rates. These are perception-based shocks that are shaped by communication and interpretation. In contrast, theoretical models typically represent FG shocks as explicit commitments by the central bank to maintain or adjust interest rates in the future, which offers a stylized but tractable way to analyze expectation-driven transmission. This divergence does not imply a contradiction, but rather highlights the trade-off between realism in empirical analysis and clarity in theory, each capturing different but complementary dimensions of monetary policy.

Aggregation and market clearing. Aggregate consumption and labor market clearing are given by $C_t = \lambda C_t^H + (1-\lambda)C_t^S$ and $N_t = L_t$, respectively. Goods clearing requires $Y_t = C_t + \frac{\theta}{2}\pi_t^2\, Y_t$ and the bond market clears if $B_{t+1} = (1-\lambda)B_{t+1}^S$ holds.

[27] An alternative setup would be to assume that the nominal interest rate follows a standard Taylor rule. In that case, there exists a sequence of anticipated shocks to the policy rule that implies the same path for the real rate as the one set exogenously above. We verified that this yields identical results.

3.2 Cyclical inequality through redistribution between households

We now examine the key equilibrium conditions of our TANK model, building on parts of the previous work of Bilbiie, Monacelli, and Perotti (2024) and extending them for our analysis. The model is log-linearized around a non-stochastic steady state with no inequality ($C^H = C^S = C$), zero dividends ($\Gamma^S = \Gamma^H = 0$), and no transfers to hand-to-mouth agents ($T^H = 0$). In general, lowercase letters denote the log deviation of a variable from its steady state. Further details on the steady state and a summary of the log-linearized equilibrium conditions can be found in Appendices B.2 and B.3.

The individual consumption of households can be expressed as a function of aggregate income and transfers to constrained households:

$$c_t^H = \chi c_t + t_t^H \tag{3}$$

$$c_t^S = \frac{1-\lambda\chi}{1-\lambda} c_t - \frac{\lambda}{1-\lambda} t_t^H \ , \tag{4}$$

where

$$\chi \equiv 1 + (\sigma + \nu)\left(1 - \frac{\tau^D}{\lambda}\right) \ ,$$

which captures the elasticity of hand-to-mouth agents' income to total income. The parameter χ, discussed in detail by Bilbiie (2020), expresses the profit redistribution from savers to hand-to-mouth households. Empirical evidence from Auclert (2019) and Patterson (2023) supports a value of $\chi > 1$, indicating that the income of constrained households responds more than proportionally to changes in aggregate income.[28] All else equal, this holds if and only if $\tau^D < \lambda$, meaning that constrained agents receive a proportion of profits smaller than their population share.

The appearance of t_t^H in equations (3) and (4) implies that adjustments in transfers to households, driven by changes in the government's debt burden, directly influence individual spending levels. The spending of hand-to-mouth agents is particularly sensitive to changes in transfers, as these agents have a much higher marginal propensity to consume (MPC) out of current income compared to savers. Even more important, the equations indicate that transfers serve as an additional source of redistribution: when $t_t^H > 0$, it is actually the savers who pay for the increased income of financially constrained agents.

[28] Auclert (2019) shows that low-income households tend to have higher marginal propensities to consume (MPCs), while Patterson (2023) documents a positive relationship between workers' individual MPCs and the sensitivity of their income to output changes.

These insights are also reflected in the impact of transfers on total demand, which is characterized by the forwarded aggregate consumption Euler equation:

$$c_t = \frac{\lambda}{1-\lambda\chi}\, t_t^H - \sigma \frac{1-\lambda}{1-\lambda\chi} \sum_{k=0}^{\infty} \mathbb{E}_t r_{t+k} \,. \tag{5}$$

Combining the above elements, consumption inequality can be expressed as follows:

$$\Phi_t \equiv c_t^S - c_t^H = -\frac{1}{1-\lambda\chi}\, t_t^H - \sigma \frac{1-\chi}{1-\lambda\chi} \sum_{k=0}^{\infty} \mathbb{E}_t r_{t+k} \,. \tag{6}$$

The first term of the equation reflects how transfers to households and hence their consumption decision immediately respond to changes in the government's debt burden. The second term captures the channel of intertemporal substitution, brought about by the Euler equation of savers. Overall, adjustments in either the current or future real interest rates will have a direct effect on inequality dynamics.

Suppose now the monetary authority announces at time 0 that it will adjust the real interest rate either today or at some future point in time $\mathcal{T}$. The immediate impact of this policy on inequality, for $\mathcal{T} \geq 0$, is

$$\frac{\partial\, \Phi_0}{\partial\, r_{\mathcal{T}}} = -\frac{1}{1-\lambda\chi} \frac{\partial\, t_0^H}{\partial\, r_{\mathcal{T}}} + \sigma \frac{\chi - 1}{1-\lambda\chi} \frac{1}{1-\rho} \,. \tag{7}$$

As evident from this expression, the sign of the inequality response after a real interest rate change in any period depends considerably on the fiscal transfer system and redistribution. All else given, the transfer function t^H endogenously determines the inequality response, together with the profit redistribution represented by χ, which in turn governs inequality dynamics in the absence of such transfers.[29] By linking these two elements, we can derive a formal expression that characterizes the cyclical behavior of inequality.

Proposition 1 (Cyclicality of inequality for arbitrary transfer)**.** *In a standard TANK model with an arbitrary transfer t^H between the two household types, consumption inequality is countercyclical in response to a one-time change in the real interest rate at time $\mathcal{T} \geq 0$ if*

$$\frac{\partial\, t_0^H}{\partial\, r_{\mathcal{T}}} < \sigma(\chi - 1)\, \frac{1}{1-\rho} \,. \tag{8}$$

In contrast, consumption inequality is procyclical if the inequality sign is reversed.

Proof. Assuming that $\lambda\chi < 1$ holds, the proposition follows from (7). ■

[29]Throughout the paper, we assume $\lambda < 1/\chi$ as in Bilbiie (2020). If this condition does not hold, Bilbiie (2008) shows that the slope of the IS curve can reverse, causing expansionary monetary policy to reduce aggregate consumption through the intertemporal substitution channel.

Equation (8) illustrates the indirect influence of fiscal policy on inequality, depending on given values for the elasticity of intertemporal substitution σ and shock persistence ρ. Hand-to-mouth agents, lacking access to asset markets, experience a stronger consumption response to monetary policy shocks than savers, who can partially shield themselves from such shocks. However, the distribution of profits across households, captured by χ, narrows the gap in consumption responses between the two types. As a result, the extent of transfer payments to constrained agents, denoted by t^H, plays a decisive role in shaping the cyclicality of consumption inequality.

In this paper, the transfer mechanism referenced in the proposition, along with the associated income redistribution between households, is modeled through government-issued lump-sum transfers. However, this approach is only one among many potential redistribution schemes that could yield similar household-specific income effects and mirror the cyclical inequality patterns observed in the data. More generally, any redistribution mechanism in which the scope and timing of government intervention differ across distinct types of monetary policy shocks could produce comparable outcomes. Alternatively, non-fiscal channels may generate similar effects. For instance, households with diverse asset portfolios – such as stocks or real estate, whose values fluctuate depending on the type of monetary policy shock – may experience varying impacts on their portfolio values, which in turn lead to divergent consumption patterns across household types.

4 Dynamic effects of monetary shocks on inequality: A transfer function example

It is important to emphasize that the results presented thus far are general and do not rely on any specific transfer function. However, to compute the dynamic responses to shocks, it becomes necessary to select a specific functional form for total transfers. With this in mind, we now specify a transfer function that enables us to replicate and rationalize the empirical facts observed in the data.

In our baseline specification, we assume that the transfer function for hand-to-mouth agents consists of both a debt component and a cyclical component:

$$t_t^H = -\phi_1 r_t B_Y - \phi_2 y_t \ , \tag{9}$$

where $\phi_1 > 0$ and $\phi_2 > 0$ govern the response of transfer payments to constrained agents when the real interest rate or aggregate output deviates from its respective steady state value. The functional form is guided by the empirical division of total transfers into two components based on their cyclicality, as presented in Section 2.3.3. At the same time, although simplified, this transfer scheme parsimoniously captures the essence of estimated fiscal rules in other studies, where transfers are typically modeled as comprising separate cyclical, debt, and exogenous components (e.g., Leeper, Plante, & Traum, 2010; Leeper, Walker, & Yang, 2010; C. Reicher, 2014; C. P. Reicher, 2012).[30]

The intuition behind equation 9 is twofold. First, the transfer scheme is closely interlinked with fiscal debt. A look at the government's budget constraint unveils the channel: a rise in the real interest rate increases the public debt burden $r_t B_Y$ and triggers an instant fiscal adjustment in the form of fewer lump-sum transfers. Hence, $\phi_1 > 0$. If the rate change is announced to happen in the future instead, the fiscal authority does not immediately adjust transfers because the higher interest payments on government debt occur later. This mechanism mirrors the considerations in Kaplan et al. (2016), describing a direct channel through debt that tends to increase consumption inequality as the real interest rate rises.

Second, following a shock to the real interest rate, the government adjusts transfer payments to stabilize the income of hand-to-mouth agents over time. This helps to mitigate fluctuations in output y_t so that transfers act as an automatic stabilizer, implying $\phi_2 > 0$.[31] This setup is similar to the countercyclical transfer scheme proposed by Gerke et al. (2020) and establishes an indirect channel through which consumption inequality tends to decrease after a contractionary shock to the real interest rate.

Combined with the aggregate consumption Euler equation (5), the transfer rule (9) can be rewritten as

$$t_t^H = -\phi_1 \frac{1-\lambda\chi}{\Upsilon} r_t B_Y + \phi_2 \frac{\sigma(1-\lambda)}{\Upsilon} \sum_{k=0}^{\infty} \mathbb{E}_t r_{t+k} \;, \tag{10}$$

where

$$\Upsilon \equiv 1 - \lambda\chi + \phi_2 \lambda \;.$$

Substituting into equation (6), we obtain an expression for consumption inequality:

$$\Phi_t = \frac{\phi_1}{\Upsilon} r_t B_Y - \sigma \left[\frac{1-\chi}{1-\lambda\chi} + \phi_2 \frac{1-\lambda}{(1-\lambda\chi)\Upsilon} \right] \sum_{k=0}^{\infty} \mathbb{E}_t r_{t+k} \;. \tag{11}$$

In a next step, we are interested in magnitude of the change in inequality when the central bank announces a one-time change in the real interest rate that is going to occur either today at $\mathcal{T} = 0$ (CMP shock) or $\mathcal{T} > 0$ periods from now (FG shock). As outlined in the model description, the central bank implements this policy by setting a perfectly credible path for

[30] In the baseline specification, public debt remains constant for illustrative purposes, and the debt component only reflects the government's interest expenses. Appendix B.9 explores alternative transfer functions that relax the constant-debt assumption.

[31] See McKay and Reis (2016) for a theoretical analysis of the stabilization potential of automatic fiscal stabilizers in the business cycle.

the real interest rate. Specifically, it maintains the real rate at its steady-state value prior to $\mathcal{T}$ (i.e., $r_t = 0$ in log-linear terms) and follows an exogenously given rule with some persistence ρ after that (i.e., $r_t = \rho^{t-\mathcal{T}}\varepsilon_{\mathcal{T}}$).

Evaluating the previous equation at time 0, the response of inequality on impact of a CMP and a FG shock is given by

$$\frac{\partial\, \Phi_0}{\partial\, r_{\mathcal{T}}} = \begin{cases} \frac{\phi_1}{\Upsilon}\, B_Y + \sigma \left[\frac{\chi-1}{1-\lambda\chi} - \phi_2 \frac{1-\lambda}{(1-\lambda\chi)\Upsilon}\right] \frac{1}{1-\rho}, & \mathcal{T} = 0 \\ \sigma \left[\frac{\chi-1}{1-\lambda\chi} - \phi_2 \frac{1-\lambda}{(1-\lambda\chi)\Upsilon}\right] \frac{1}{1-\rho}, & \mathcal{T} > 0 \end{cases} \tag{12}$$

We can notice a few points. First, if bonds are in zero net supply ($B_Y = 0$) or transfers to financially constrained agents are not directly linked to debt ($\phi_1 = 0$), inequality will respond identically, regardless of when the policy shock occurs. This underscores the importance of the debt burden and fiscal adjustments in shaping households' income sensitivity and thus and their spending response. Second, given conventional values for σ, λ, and ρ, the sign and magnitude of the inequality response is shaped by the three parameters χ, ϕ_1, and ϕ_2. Drawing on Proposition 1, we can determine the condition under which the proposed transfer function (9) successfully replicates the cyclical pattern of inequality observed in the data. The following proposition summarizes the necessary condition.

Proposition 2 (Opposite cyclicality of inequality under a specific transfer scheme)**.** *Given a transfer function of the form $t_t^H = -\phi_1 r_t B_Y - \phi_2 y_t$, the impact response of consumption inequality is countercyclical for CMP shocks while being procyclical for FG shocks if the following condition holds:*

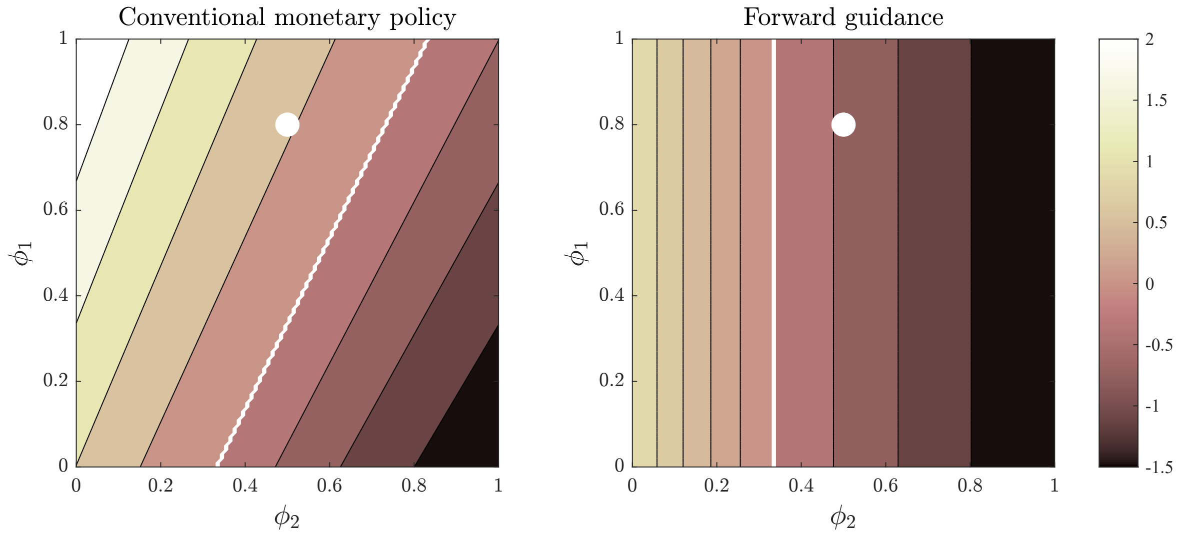
$$-\phi_1 \frac{(1-\rho)}{\sigma} B_Y + \phi_2 < \chi - 1 < \phi_2\ . \tag{13}$$

Proof. See Appendix B.5. ■

Building on this proposition, Figure 6 illustrates how the parameters related to fiscal policy influence the cyclicality of spending. It shows the contemporaneous responses of consumption inequality for different combinations of ϕ_1 and ϕ_2, using an otherwise standard calibration as outlined in Appendix B.6.[32] The white lines separate positive and negative inequality responses, while the white dots mark the baseline parameter values used for the subsequent computation of dynamic responses ($\phi_1 = 0.8$, $\phi_2 = 0.5$).

[32] Notably, the tax rate on profits τ^D is set to achieve $\chi = 1.33$, consistent with empirical estimates from Patterson (2023) and evidence from Auclert (2019). However, changes in τ^D affect inequality in the same direction as variations in ϕ_2, as shown in Appendix B.7 by the impact responses of inequality for different combinations of χ and ϕ_1.

Figure 6: Sensitivity of consumption inequality to transfer determinants



Notes: These heat maps show the response of inequality on impact of a CMP and a FG shock, respectively, for different combinations of the transfer rule coefficients on debt burden ϕ_1 and on output ϕ_2. The bar on the right labels the colors, where values above (below) zero refer to a positive (negative) inequality response. The white lines indicate the threshold with zero inequality response. The white dots mark the parameter values implied by the baseline calibration (see Table B.2).

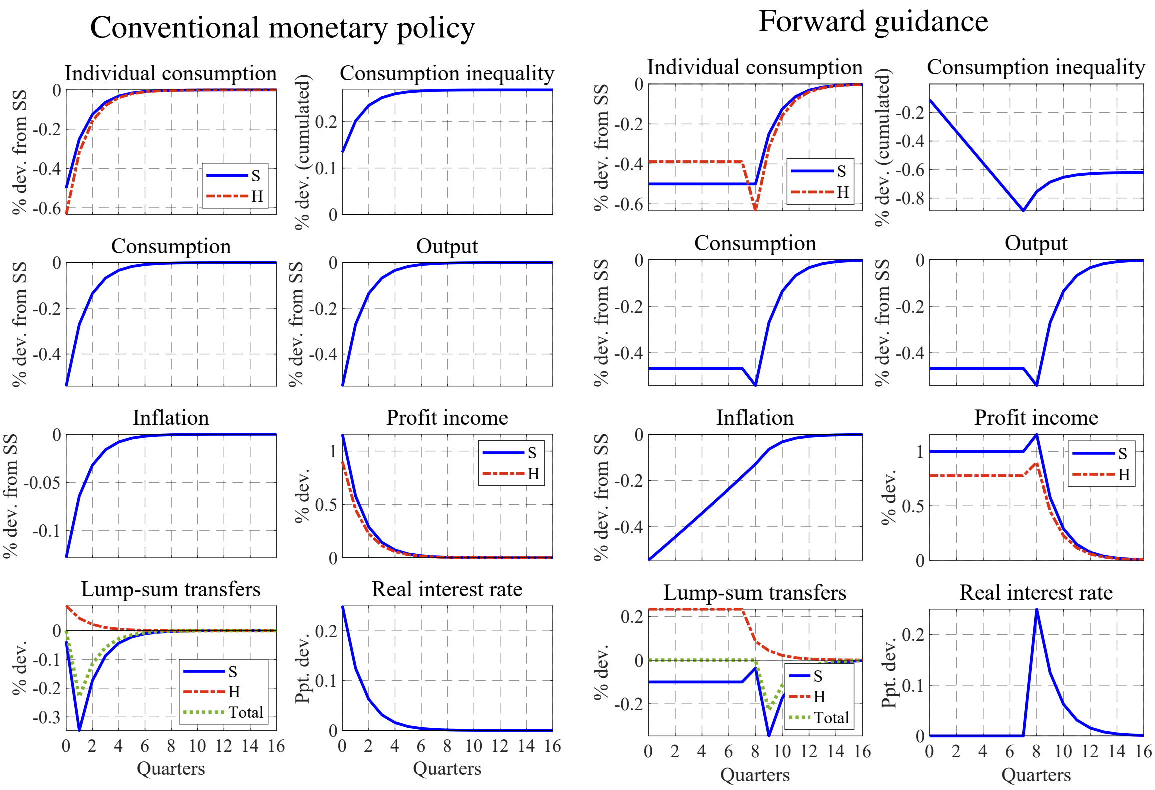
Higher values of ϕ_2 generally dampen consumption inequality after both contractionary shocks, as stronger automatic stabilization mitigates the adverse income effects for constrained agents. The role of ϕ_1 differs depending on the type of shock. Under CMP, a higher ϕ_1 amplifies the inequality response because transfers are linked to the size of the debt burden. In contrast, after a FG shock, ϕ_1 is irrelevant for the impact response as the interest rate hike occurs in the future, meaning debt servicing costs do not rise immediately.

The key insight from Figure 6 is that only a narrow range of parameter values allows our simple model to replicate the observed cyclical response of inequality. Due to the two opposing forces described, stabilization efforts for vulnerable households can be more effective when greater attention is paid to public debt costs when determining transfers. To align with the empirical evidence while avoiding an excessive burden on savers during recessions, the government must balance its redistribution objectives with the need for financing interest expenses in order to maintain a balanced budget.

4.1 Impulse response analysis

In the next step, we study the *dynamic* response of inequality after a one-time unexpected monetary shock with some exogenous persistence. Assume that the central bank either raises the real rate today by 25 basis points (i.e., $\varepsilon_0 = 0.0025$) or commits to an increase of the same size two years from now (i.e., $\varepsilon_8 = 0.0025$). Figure 7 presents the main impulse responses to these shocks under a mostly standard set of parameter values. More details on the calibration and additional impulse responses can be found in Appendices B.6 and B.7, respectively.

Figure 7: Impulse responses to monetary policy shocks: Analytical TANK model



Notes: This figure depicts selected impulse responses for the analytical TANK model to a 25-basis-point increase in the contemporaneous real interest rate (left panel) and in the real rate in eight quarters (right panel). Responses of profit income and transfers are in deviations from their steady-state levels, relative to steady-state output. Individual responses for savers (S) and hand-to-mouth agents (H) are shown in per-capita terms.

Both types of monetary policy result in a comparable decline in aggregate consumption and output on impact of each shock. In contrast, inflation falls more sharply after FG. This effect is driven by the permanently lower marginal costs in the periods up to the real rate adjustment, which affects price-setting behavior through the forward-looking nature of the Phillips curve.

Although hand-to-mouth agents are more sensitive to monetary policy shocks than savers, the redistribution of countercyclical profits reduces the gap in their individual consumption responses. On top of that, due to the automatic stabilizer component in the transfer rule (9), the government partially offsets the decrease in hand-to-mouth agents' consumption by increasing transfer payments to them while putting a higher cost on savers. However, only a hike in the current real interest rate immediately raises the debt burden. Under FG, the interest rate change occurs in the future and so does the adjustment in transfers tied to the debt burden component. As a result, what remains immediately effective is only the cyclical part of lump-sum transfers, which leads to a stronger response of the latter.[33]

The fiscal response to the two monetary shocks is crucial in shaping the cyclical behavior of consumption inequality. In line with the evidence in Section 2.3, both the aggregate and household-level responses of lump-sum transfers differ following a CMP and a FG shock. In the former case, the government immediately responds to the higher debt burden, resulting in minimal changes to transfers for constrained households. Their consumption declines relatively more than that of savers, causing inequality to increase. Conversely, when the real rate change occurs in the future, the debt component in the fiscal rule no longer plays a role, while the automatic stabilizer component becomes the main driver. In this case, financially constrained agents receive an income boost, which reduces consumption inequality.[34]

It is important to stress that the purpose of the transfer rule we consider is not to precisely match the sign of the empirical transfer responses, but rather to qualitatively capture their differential magnitudes in a tractable way. The empirical evidence serves only a partial proxy for the government's overall reaction we consider in the model. In addition, the values of ϕ_1 and ϕ_2 in the transfer function (9) may not remain constant over the business cycle and could vary with changes in the economic conditions. Under the baseline calibration, the cyclical component ensures that hand-to-mouth agents do not bear an excessive burden in the form of negative transfers during the recession that follows a contractionary shock. This reinforces the view of fiscal transfers being an effective tool for stabilizing fluctuations in the income of financially constrained agents (see, e.g., Heathcote et al., 2010; McKay & Reis, 2016; Oh & Reis, 2012).

In conclusion, the dynamic responses support the empirical evidence on the aggregate and distributional effects of CMP and FG. In particular, they demonstrate that the redistribution of profits and lump-sum transfers help to stabilize income fluctuations for financially constrained agents, thereby significantly shaping the sign of individual consumption responses. These elements allow the simple two-agent model to capture the cyclical nature of consumption inequality observed in the data. Notably, this replication is achieved without relying on complex modeling assumptions or sophisticated functional forms. More broadly, the findings

[33] The small response of transfers to constrained agents after CMP arises from the relatively higher weight on the debt burden in the transfer function ($\phi_1 = 0.8$) compared to the weight on output ($\phi_2 = 0.5$). This creates overall a downward pressure on these transfers. Moreover, in the data, transfers to low-consumption households decline after a CMP shock, which contrasts with the model, where transfers to hand-to-mouth agents do not fall and may even increase, depending on parameter choices. Negative responses in the model are possible without affecting our main results, provided that the response of transfers to savers is sufficiently strong. However, we view a positive response under contractionary conditions as more realistic, as it better captures the lump-sum components of fiscal policy. By comparison, the empirical transfer measure captures a broader set of social benefits and government support.

[34] Once the announced real rate change actually occurs, hand-to-mouth agents will reduce their consumption slightly more due to the suspended transfers from the government.

suggest that tractable models can serve as a valuable tool for analyzing the redistributive effects of monetary policy and gaining insights into the household dynamics that drive these outcomes.

4.2 Forward guidance and the maturity structure of debt

So far, we have assumed that government debt is entirely short-term, maturing every quarter, such that an announcement of a future policy rate change leaves current interest expenses unaffected. In reality, public debt is typically longer-term, and FG has an immediate effect on its market value and the government budget through the responsiveness of the yield curve. As a result, the economic impact of FG today depends heavily on the maturity structure of government debt.[35]

Appendix B.8 outlines an alternative framework with long-term debt, modeled as in Woodford (2001), with a price Q_t and coupon payments that decay geometrically at a rate $\kappa \in [0, 1]$. This parameter determines the maturity of debt, where $\kappa = 0$ corresponds to the case of short-term bonds used in the baseline model. The ex-post one-period real return on long-term bonds at time t is related to their price through the log-linear expression $r_t^L = \kappa\beta q_t - q_{t-1} - \pi_t$. In equilibrium, the bond price itself depends on the expected stream of future interest rates:

$$q_t = -\sum_{i=0}^{\infty} (\kappa\beta)^i \, \mathbb{E}_t \left(r_{t+i} + \pi_{t+1+i} \right) \ . \tag{14}$$

A key factor behind this equation is the no-arbitrage condition between short-term and long-term debt, which requires that the one-period real return on long-term assets is equal to the return on short-term assets, formally expressed as $\mathbb{E}_t r_{t+1}^L = r_t$ for $t \geq 0$.

There are two effects at play in equation (14), both of which influence the implications of FG for households and the government at time t: the revaluation of real debt and the Fisher channel (see, e.g., Auclert, 2019; Auclert, Rognlie, & Straub, 2024; Ferrante & Paustian, 2019). All else equal, an announcement by the central bank of a future increase in the real interest rate would cause an immediate drop in the bond price. However, while the real rate is higher for only one period in the future, inflation decreases right away. For a FG shock, the upward pressure on the bond price from lower inflation dominates the downward pressure from the higher real rate. The resulting higher bond price implies a realized real return on bonds at time t, r_t^L, that is higher than what agents had anticipated before the shock. Conversely, for a CMP shock, the increase in the real rate outweighs the effect of lower future

[35] Empirical evidence by Filardo and Hofmann (2014) shows that FG on policy rates has affected the expected path of future interest rates in different countries.

inflation, leading to a decline in the bond price. Figure B.3 illustrates these dynamics for different debt maturities.[36]

Despite the described impact effects of a monetary shock, the response of consumption inequality in the baseline model remains unchanged. After a FG shock, the higher bond price increases the market value of the government's outstanding debt and its refinancing costs, forcing the fiscal authority to cut lump-sum transfers to households more than in the baseline model in order to maintain a balanced budget. However, since debt is assumed to remain constant and the no-arbitrage condition holds, the interest expenses in each period are unchanged, meaning that transfers to hand-to-mouth agents are unaffected. On the other hand, savers bear the cost of the larger reduction in transfers. At the same time, they also benefit from an income gain because the real value of their bonds increases and they earn a higher return. In fact, due to the no-arbitrage condition, savers are indifferent between holding short-term, one-period bonds and long-term bonds today.

Overall, what concerns the household sector in our baseline model, changing the maturity of bonds does neither affect individual spending levels nor consumption inequality. It is worth noting that the responses of fiscal instruments and consumption are sensitive to the variable used to rebalance the public budget, the specification of individual transfer functions, and whether debt remains constant (see, e.g., Auclert et al., 2020).

4.3 Fully-fledged two-asset TANK model with investment

The baseline TANK model has shown that a combination of profit and lump-sum transfer redistribution can successfully replicate the cyclicality of consumption inequality observed in the data. To assess whether this finding remains to hold in a more complex setup, we implement our mechanism in a widely used framework from the heterogeneous-agent literature: the model by Kaplan et al. (2018). We focus on the two-agent version of their benchmark HANK model to make it more comparable to our simple analytical model. This framework includes the well-known channels of standard HANK models but remains tractable enough to examine the underlying transmission mechanisms. Appendix C contains a full description of the model, details on the calibration, and the impulse responses.

The two main elements added to the analytical TANK model are a multiple-asset structure and investment. Unconstrained households can save in two types of assets with different degrees of liquidity. There is a liquid asset with a low return, similar to the one-period

[36] Ferrante and Paustian (2019) argue that if bonds were real rather than nominal, the Fisher effect and thus the effects of inflation would be absent. After a FG shock, the long-term bond price would decrease, reducing the government's debt burden. Moreover, FG would become less effective as bond maturity increases.

government bond in the simple model, and a high-return illiquid asset.[37] Each saver can invest their illiquid savings either in capital or in equity shares. Capital is used by monopolistically competitive firms, together with the labor provided by individual households, to produce intermediate goods. Shares figure as a claim to a fraction of intermediate firms' profits. That part is reinvested into the illiquid account, while the remaining fraction of profits is paid lump-sum to the liquid account of savers.

Appendix C.3 illustrates that the outcomes of the fully-fledged TANK model are broadly consistent with those of the analytical TANK model, not only in terms of the sign and shape of the macroeconomic and consumption inequality responses, but largely also in terms of magnitudes. Given the calibration of the key model parameters, the additional model assumptions appear to have only a negligible influence in this respect.

5 Policy implications

In this section, we discuss several policy implications that can be derived from our empirical and theoretical findings. First, our analysis indicates that both conventional and unconventional monetary policies can generate adverse second-order effects, particularly regarding consumption inequality. At the same time, our results highlight the critical role of the fiscal-monetary policy mix in shaping these outcomes. Although central banks and governments operate independently, their actions are deeply intertwined, suggesting that some degree of coordination can help to mitigate the potential side effects of interest rate policy.

Second, our empirical evidence suggests that fiscal adjustments after monetary shocks may not always be fully optimal. For instance, cutting transfers in response to a contractionary policy rate change tends to increase consumption inequality, as this primarily harms vulnerable households. To better adapt to different monetary policy tools or regimes, fiscal authorities should keep transfer schemes flexible, putting more emphasis on current macroeconomic conditions rather than debt servicing costs. This flexibility is particularly beneficial during economic downturns, as targeted fiscal redistribution to households at the lower end of the consumption, income, or wealth distributions can help to maintain adequate expenditure levels. In our model's transfer rule, this corresponds to increasing the weight on the business cycle (ϕ_2) relative to the debt burden (ϕ_1) component. However, the success of these measures depends on the fiscal authority's understanding of the macroeconomic and distributional effects of various policy tools. This is a prerequisite for designing effective fiscal support through lump-sum transfers, unemployment benefits, or tax cuts.

[37] In addition to short-term government bonds, liquid assets are understood to include deposits in financial institutions and corporate bonds. The illiquid asset class captures assets such as housing, consumer durables, and equity.

Third, against this backdrop, clear and transparent communication by the central bank is crucial for improving the overall effectiveness of the fiscal-monetary policy mix. By providing forecasts and detailed reports on the expected aggregate effects of its policies, the central bank enables this information to be fully internalized in the government's decision-making process. Although price stability remains the primary objective, monetary authorities should also systematically report on how inequality influences policy efficiency and, conversely, how their actions affect the distribution of income and wealth. At the same time, since inequality plays a significant role in the transmission of monetary policy, it is essential that policymakers account for its distributional effects when designing the optimal policy mix. This integrated strategy not only strengthens policy coordination but also helps to ensure that the broader economic implications of monetary decisions are well understood and appropriately addressed.

These policy recommendations are particularly important in the context of the high-inflation, post-COVID-19 period. To contain rising prices, central banks have tightened monetary policy by raising their key interest rates, which according to our findings tends to increase consumption inequality. The subsequent evolution of income dispersion across households then largely depends on the government's fiscal response. As seen in practice, fiscal authorities can mitigate rising inequality by implementing sizable transfer programs that support financially constrained households rather than, for instance, adjusting tax rates regressively. Moreover, our results suggest that combining conventional interest rate policy with contractionary FG announcements such as a "higher-for-longer" policy can shape the expectations of economic agents and dampen the adverse distributional effects of rapid monetary policy normalization.

6 Conclusion

The relationship between monetary policy and inequality has received growing attention in the recent past. At the same time, central banks have increasingly relied on unconventional tools such as FG when nominal interest rates were constrained by the zero lower bound. However, there is still limited and often conflicting empirical evidence on the distributional effects of these policies.

This paper investigates the macroeconomic and distributional impact of FG as compared to CMP. Using U.S. household-level expenditure data, we construct a measure of consumption inequality and include it in a VAR model. Monetary policy shocks are identified through the latent factors extracted by Swanson (2021), based on high-frequency monetary policy surprises in asset prices. We find similar aggregate effects of both policies at the macroeconomic level, but a heterogeneous response of the consumption dispersion across households.

Specifically, consumption inequality is countercyclical following CMP but procyclical after FG.

We rationalize these empirical findings using a standard New Keynesian model with heterogeneous households and government redistribution. Drawing on empirical evidence, we highlight the government's fiscal response as a key determinant for the cyclicality of inequality. After specifying a lump-sum transfer scheme, we demonstrate that the timing of the policy rate change affects the interest payments on public debt, leading to fiscal adjustments that differ in timing and magnitude between CMP and FG. These differences give rise to opposing consumption inequality responses to the two monetary policy shocks.

From a policy perspective, our findings emphasize the potentially adverse second-order implications of central banks' interest rate policies. The way in which governments react to monetary policy decisions is key to counteract these effects, while distributional considerations may also be a crucial input in designing the optimal monetary policy mix itself.

Future work could explore potential asymmetries in the interaction between monetary and fiscal policy. The link between the two may be stronger when the fiscal budget is tight or during monetary tightening episodes, pointing to both state and sign dependence in the effects of monetary policy. It would also be useful to extend the analysis to large-scale asset purchases to provide a more comprehensive view of the distributional impact of unconventional policy tools.

References

Acharya, S., & Dogra, K. (2020). Understanding HANK: Insights from a PRANK. *Econometrica*, *88*(3), 1113–1158.

Altavilla, C., Brugnolini, L., Gürkaynak, R. S., Motto, R., & Ragusa, G. (2019). Measuring Euro Area Monetary Policy. *Journal of Monetary Economics*, *108*, 162–179.

Amberg, N., Jansson, T., Klein, M., & Picco, A. R. (2022). Five Facts about the Distributional Income Effects of Monetary Policy Shocks. *American Economic Review: Insights*, *4*(3), 289–304.

Andrade, P., & Ferroni, F. (2021). Delphic and Odyssean Monetary Policy Shocks: Evidence from the Euro Area. *Journal of Monetary Economics*, *117*, 816–832.

Attanasio, O. P., & Pistaferri, L. (2016). Consumption Inequality. *Journal of Economic Perspectives*, *30*(2), 3–28.

Auclert, A. (2019). Monetary Policy and the Redistribution Channel. *American Economic Review*, *109*(6), 2333–2367.

Auclert, A., Rognlie, M., & Straub, L. (2020, January). *Micro Jumps, Macro Humps: Monetary Policy and Business Cycles in an Estimated HANK Model* (NBER Working Paper No. 26647). National Bureau of Economic Research.

Auclert, A., Rognlie, M., & Straub, L. (2024, September). *Fiscal and Monetary Policy with Heterogeneous Agents* (NBER Working Paper No. 32991). National Bureau of Economic Research.

Barakchian, S. M., & Crowe, C. (2013). Monetary Policy Matters: Evidence from New Shocks Data. *Journal of Monetary Economics*, *60*, 950–966.

Bee, A., Meyer, B. D., & Sullivan, J. X. (2013). The Validity of Consumption Data: Are the Consumer Expenditure Interview and Diary Surveys Informative? In *Improving the Measurement of Consumer Expenditures* (pp. 204–240). National Bureau of Economic Research.

Bilbiie, F. O. (2008). Limited Asset Market Participation, Monetary Policy and (Inverted) Aggregate Demand Logic. *Journal of Economic Theory*, *140*(1), 162–196.

Bilbiie, F. O. (2020). The New Keynesian Cross. *Journal of Monetary Economics*, *114*, 90–108.

Bilbiie, F. O. (2024). Monetary Policy and Heterogeneity: An Analytical Framework. *Review of Economic Studies*, forthcoming.

Bilbiie, F. O., Känzig, D. R., & Surico, P. (2022). Capital and Income Inequality: an

Aggregate-Demand Complementarity. *Journal of Monetary Economics*, *126*, 154–169.

Bilbiie, F. O., Monacelli, T., & Perotti, R. (2024). Stabilization vs. Redistribution: The Optimal Monetary-Fiscal Mix. *Journal of Monetary Economics*, *147*, 103623.

Bouscasse, P., & Hong, S. (2023). *Monetary-Fiscal Interactions in the United States.* (Mimeo)

Breitenlechner, M., Geiger, M., & Klein, M. (2024, July). *The Fiscal Channel of Monetary Policy* (Working Paper in Economics and Statistics No. 2024-07). Universität Innsbruck.

Bundick, B., & Smith, A. L. (2020). The Dynamic Effects of Forward Guidance Shocks. *The Review of Economics and Statistics*, *102*(5), 946–965.

Chang, M., & Schorfheide, F. (2024, February). *On the Effects of Monetary Policy Shocks on Earnings and Consumption Heterogeneity* (NBER Working Paper No. 32166). National Bureau of Economic Research.

Cloyne, J., Ferreira, C., & Surico, P. (2020). Monetary Policy when Households have Debt: New Evidence on the Transmission Mechanism. *Review of Economic Studies*, *87*(1), 102–129.

Cloyne, J., & Hürtgen, P. (2016). The Macroeconomic Effects of Monetary Policy: A New Measure for the United Kingdom. *American Economic Journal: Macroeconomics*, *8*(4), 75–102.

Coibion, O. (2012). Are the Effects of Monetary Policy Shocks Big or Small? *American Economic Journal: Macroeconomics*, *4*(2), 1–32.

Coibion, O., Gorodnichenko, Y., Kueng, L., & Silvia, J. (2017). Innocent Bystanders? Monetary Policy and Inequality. *Journal of Monetary Economics*, *88*, 70–89.

Colciago, A., Samarina, A., & de Haan, J. (2019). Central Bank Policies And Income And Wealth Inequality: A Survey. *Journal of Economic Surveys*, *33*(4), 1199–1231.

Degasperi, R., & Ricco, G. (2021). *Information and Policy Shocks in Monetary Surprises.* (Mimeo)

Dibiasi, A., Mikosch, H., Sarferaz, S., & Steinbach, A. (2024, August). *Fiscal Responses to Monetary Policy: Insights From a Survey Among Government Officials* (KOF Working Paper No. 520). KOF Swiss Economic Institute, ETH Zurich.

Ehrmann, M., Gaballo, G., Hoffmann, P., & Strasser, G. (2019). Can More Public Information Raise Uncertainty? The International Evidence on Forward Guidance. *Journal of Monetary Economics*, *108*, 93–112.

Evans, C. (2022). *Household Heterogeneity and the Transmission of Monetary Policy.* (Mimeo)

Farhi, E., & Werning, I. (2019). Monetary Policy, Bounded Rationality, and Incomplete Markets. *American Economic Review*, *109*(11), 3887–3928.

Ferrante, F., & Paustian, M. (2019, November). *Household Debt and the Heterogeneous Effects of Forward Guidance* (International Finance Discussion Paper No. 1267). Board of Governors of the Federal Reserve System.

Ferreira, L. N. (2022). Forward Guidance Matters: Disentangling Monetary Policy Shocks. *Journal of Macroeconomics*, *73*, 103423.

Ferreira, L. N., Miranda-Agrippino, S., & Ricco, G. (2023). Bayesian Local Projections. *The Review of Economics and Statistics*, 1–45.

Filardo, A., & Hofmann, B. (2014, March). Forward Guidance at the Zero Lower Bound. *BIS Quarterly Review*.

Furceri, D., Loungani, P., & Zdzienicka, A. (2018). The Effects of Monetary Policy Shocks on Inequality. *Journal of International Money and Finance*, *85*(C), 168–186.

Gerke, R., Giesen, S., & Scheer, A. (2020). The Power of Forward Guidance in a Quantitative TANK Model. *Economics Letters*, *186*, 108828.

Gertler, M., & Karadi, P. (2015). Monetary Policy Surprises, Credit Costs, and Economic Activity. *American Economic Journal: Macroeconomics*, *7*(1), 44–76.

Gilchrist, S., & Zakrajsek, E. (2012). Credit Spreads and Business Cycle Fluctuations. *American Economic Review*, *102*(4), 1692–1720.

Guerello, C. (2018). Conventional and Unconventional Monetary Policy vs. Households Income Distribution: An Empirical Analysis for the Euro Area. *Journal of International Money and Finance*, *85*(C), 187–214.

Gürkaynak, R. S., Sack, B., & Swanson, E. (2005). Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements. *International Journal of Central Banking*, *1*(1).

Hagedorn, M., Luo, J., Manovskii, I., & Mitman, K. (2019). Forward Guidance. *Journal of Monetary Economics*, *102*, 1–23.

Heathcote, J., Perri, F., & Violante, G. L. (2010). Unequal We Stand: An Empirical Analysis of Economic Inequality in the United States: 1967-2006. *Review of Economic Dynamics*, *13*(1), 15–51.

Inui, M., Sudo, N., & Yamada, T. (2017, June). *The Effects of Monetary Policy Shocks on*

Inequality in Japan (BIS Working Paper No. 642). Bank for International Settlements.

Jarociński, M., & Karadi, P. (2020). Deconstructing Monetary Policy Surprises: The Role of Information Shocks. *American Economic Journal: Macroeconomics*, *12*(2), 1–43.

Jentsch, C., & Lunsford, K. G. (2019). The Dynamic Effects of Personal and Corporate Income Tax Changes in the United States: Comment. *American Economic Review*, *109*(7), 2655–2678.

Jordà, Ò. (2005). Estimation and Inference of Impulse Responses by Local Projections. *American Economic Review*, *95*(1), 161–182.

Kaplan, G., Moll, B., & Violante, G. (2016). *A Note on Unconventional Monetary Policy in HANK.* (Mimeo)

Kaplan, G., Moll, B., & Violante, G. (2018). Monetary Policy According to HANK. *American Economic Review*, *108*(3), 697–743.

Kuttner, K. N. (2001). Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Markets. *Journal of Monetary Economics*, *47*, 523–544.

Lakdawala, A. (2019). Decomposing the Effects of Monetary Policy Using an External Instruments SVAR. *Journal of Applied Econometrics*, *34*(6), 934–950.

Leeper, E. M., Plante, M., & Traum, N. (2010). Dynamics of Fiscal Financing in the United States. *Journal of Econometrics*, *156*(2), 304–321.

Leeper, E. M., Walker, T. B., & Yang, S.-C. S. (2010). Government Investment and Fiscal Stimulus. *Journal of Monetary Economics*, *57*(8), 1000–1012.

Lenza, M., & Slacalek, J. (2024). How Does Monetary Policy Affect Income and Wealth Inequality? Evidence from Quantitative Easing in the Euro Area. *Journal of Applied Econometrics*, *39*(5), 746–765.

Luetticke, R. (2021). Transmission of Monetary Policy with Heterogeneity in Household Portfolios. *American Economic Journal: Macroeconomics*, *13*(2), 1–25.

McKay, A., Nakamura, E., & Steinsson, J. (2016). The Power of Forward Guidance Revisited. *American Economic Review*, *106*(10), 3133–3158.

McKay, A., & Reis, R. (2016). The Role of Automatic Stabilizers in the U.S. Business Cycle. *Econometrica*, *84*, 141–194.

Miranda-Agrippino, S., & Ricco, G. (2021a, April). *Bayesian Local Projections* (Warwick Economics Research Paper No. 1348). University of Warwick.

Miranda-Agrippino, S., & Ricco, G. (2021b). The Transmission of Monetary Policy Shocks. *American Economic Journal: Macroeconomics*, *13*(3), 74–107.

Moessner, R., & Rungcharoenkitkul, P. (2019, March). The Zero Lower Bound, Forward Guidance and How Markets Respond to News. *BIS Quarterly Review*.

Montecino, J., & Epstein, G. (2015, October). *Did Quantitative Easing Increase Income Inequality?* (Working Paper No. 28). Institute for New Economic Thinking.

Mumtaz, H., & Theophilopoulou, A. (2017). The Impact of Monetary Policy on Inequality in the UK. An Empirical Analysis. *European Economic Review*, *98*, 410–423.

Oh, H., & Reis, R. (2012). Targeted Transfers and the Fiscal Response to the Great Recession. *Journal of Monetary Economics*, *59*, S50–S64.

Patterson, C. (2023). The Matching Multiplier and the Amplification of Recessions. *American Economic Review*, *113*(4), 982–1012.

Plagborg-Møller, M., & Wolf, C. K. (2021). Local Projections and VARs Estimate the Same Impulse Responses. *Econometrica*, *89*(2), 955–980.

Plagborg-Møller, M., & Wolf, C. K. (2022). Instrumental Variable Identification of Dynamic Variance Decompositions. *Journal of Political Economy*, *130*(8), 2164–2202.

Ramey, V. A. (2016). Macroeconomic Shocks and Their Propagation. In J. B. Taylor & H. Uhlig (Eds.), *Handbook of Macroeconomics* (Vol. 2, pp. 71–162). Elsevier.

Reicher, C. (2014). A Set of Estimated Fiscal Rules for a Cross Section of Countries: Stabilization and Consolidation through Which Instruments? *Journal of Macroeconomics*, *42*, 184–198.

Reicher, C. P. (2012). An Estimated Fiscal Taylor Rule for the Postwar United States. *Economics Letters*, *114*(3), 319–321.

Rotemberg, J. J. (1982). Monopolistic Price Adjustment and Aggregate Output. *The Review of Economic Studies*, *49*(4), 517–531.

Saiki, A., & Frost, J. (2014). Does Unconventional Monetary Policy Affect Inequality? Evidence from Japan. *Applied Economics*, *46*(36), 4445–4454.

Samarina, A., & Nguyen, A. D. M. (2024). Does Monetary Policy Affect Income Inequality in the Euro Area? *Journal of Money, Credit and Banking*, *56*(1), 35–80.

Shiu-Sheng, C. (2023). A Direct Approach To Kilian–Lewis Style Counterfactual Analysis In Vector Autoregression Models. *Journal of Applied Econometrics*, *38*(7), 1068–1076.

Swanson, E. T. (2021). Measuring the Effects of Federal Reserve Forward Guidance and Asset Purchases on Financial Markets. *Journal of Monetary Economics*, *118*, 32–53.

Sydney, L., Charles, S., & Martin, L. (2002). Monetary Policy Transmission Through the Consumption-Wealth Channel. *Economic Policy Review*, *8*(1), 117–133.

Werning, I. (2015, August). *Incomplete Markets and Aggregate Demand* (NBER Working Paper No. 21448). National Bureau of Economic Research.

Woodford, M. (2001). Fiscal Requirements for Price Stability. *Journal of Money, Credit and Banking*, *33*(3), 669–728.

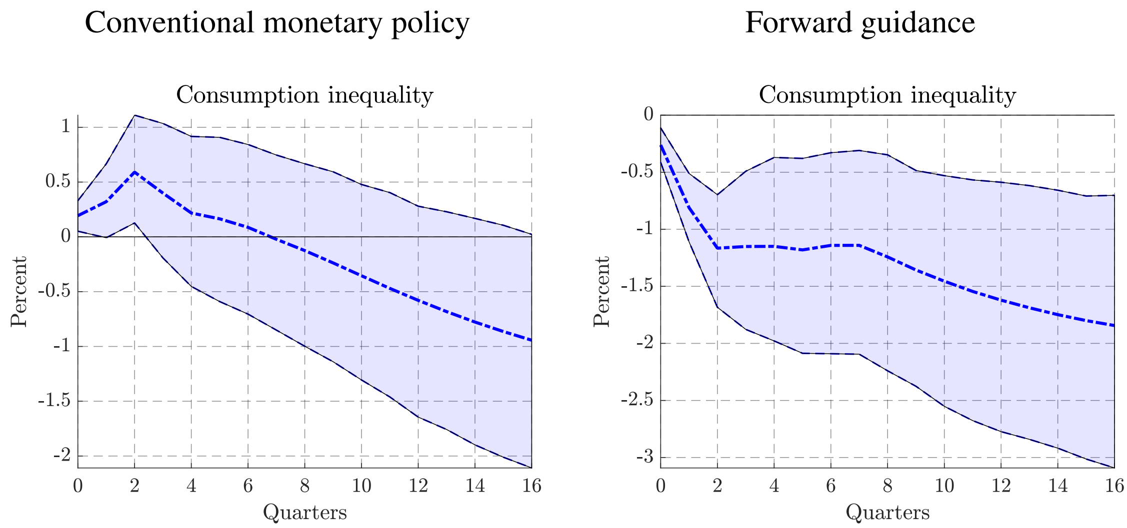
A Empirical analysis: Robustness and additional results

This appendix presents various sensitivity analyses and additional validation of the empirical results in Section 2.3. We use alternatives for the measure of consumption inequality (Section A.1), for the monetary policy factors extracted from high-frequency market data (Sections A.2 and A.3), and for the empirical model (Sections A.4 and A.5). In addition, we explore different parameter-variable combinations within our baseline empirical model (Section A.6), consider historical FG types (Section A.7), and analyze in more detail the fiscal mechanism through transfers (Sections A.8 and A.9).

A.1 Alternative inequality measure

In the main analysis, we measure inequality using the cross-sectional standard deviation of real consumption across households. Alternatively, we can compute the Gini coefficient of the cross-sectional distribution of household-level real consumption. Figure A.1 shows that the sign of both consumption inequality responses is unaffected initially. The response to a CMP shock turns negative after a few quarters, whereas after a FG shock, it is slightly larger in absolute terms compared to the baseline.[38]

Figure A.1: Consumption inequality responses to monetary policy shocks: Gini coefficient



Notes: This figure depicts the cumulated impulse responses of consumption inequality to a one-standard-deviation increase in the target factor (left panel) and the path factor (right panel) of Swanson (2021). Consumption inequality is measured by the Gini coefficient of the cross-sectional distribution of household-level real consumption. Impulse responses are from a VAR model using quarterly data for the period 1991Q3-2019Q2. Shaded areas represent 68% confidence intervals.

[38] The impulse responses of the macroeconomic variables are barely affected by the choice of the inequality measure and therefore not shown.

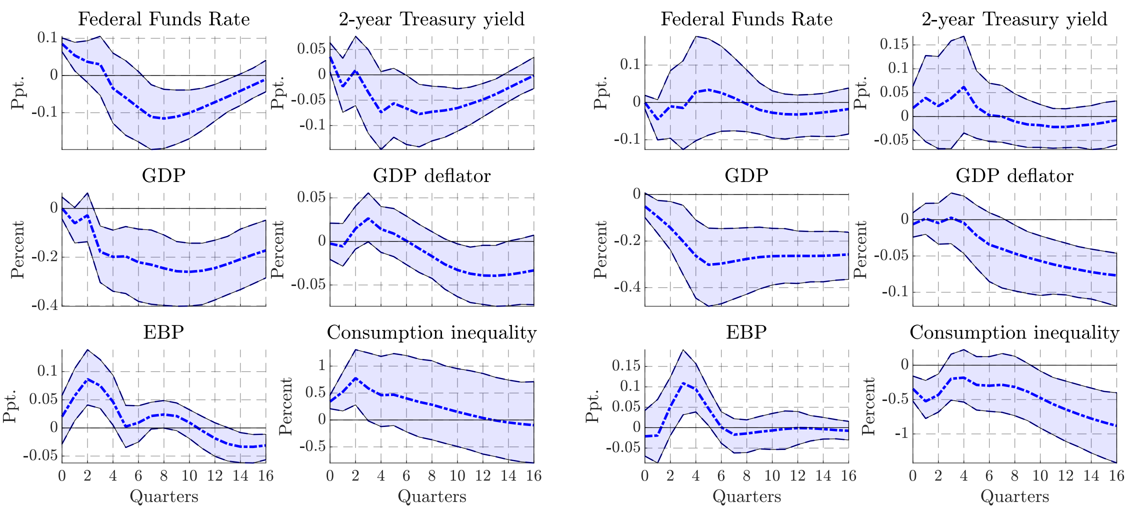
A.2 Controlling for the information set of the central bank

Central banks and market participants have different information about the state of the economy. Due to this asymmetry, market participants try to infer the potentially superior information that the policymakers might have through their policy actions (e.g., a change in the policy rate). Raw monetary policy surprises thus tend to include both the true policy shock as well as an information component about the fundamentals of the economy, which can give rise to empirical puzzles.

To correct for the presence of this information friction in our baseline target factor, we follow the approach proposed by Miranda-Agrippino and Ricco (2021b) and Degasperi and Ricco (2021). In particular, we isolate the pure monetary shocks that are orthogonal to both the central bank's economic projections and past market surprises by regressing the FFR factor of Swanson (2021) on the Greenbook forecasts and forecast revisions for real output growth, inflation (measured by the GDP deflator), and the unemployment rate. After controlling for this central bank private information and thus for the central bank information channel, the residuals of the regression are the exogenous and unpredictable component of the monetary surprises.

Figure A.2: Impulse responses to monetary policy shocks: Cleaned factors

Conventional monetary policy (Swanson, 2021) Forward guidance (Lakdawala, 2019)



Notes: This figure depicts the impulse responses to a one-standard-deviation increase in the cleaned target factor of Swanson (2021) (left panel) and the cleaned path factor of Lakdawala (2019) (right panel). Consumption inequality is measured by the cross-sectional standard deviation of household-level real consumption. Impulse responses are from a VAR model using quarterly data for the period 1992Q3-2016Q4 and 1991Q1-2011Q4, respectively. Shaded areas represent 68% confidence intervals.

The left panel of Figure A.2 presents the impulse responses to the cleaned FFR factor. The response of inequality is very similar to the baseline results. The remaining results are also much in line, except for the 2-year Treasury yield which turns negative almost immediately after the shock.

Lakdawala (2019) proposes a different approach to remove from the factors any component that is capturing the release of private information by the Federal Reserve. The main idea is that FG announcements are characterized by a Delphic and an Odyssean component. The former represents a signal from the Federal Reserve regarding its actions in the near future, whereas the latter is a signal related to the Federal Reserve's information concerning the future state of the economy. The economic response to these two components varies, with only an Odyssean FG shock typically yielding a decline in output and prices.

To clean the FG shock from the Delphic component, Lakdawala (2019) uses the residuals from a regression of the factors on controls for both the Federal Reserve and market information sets. In particular, on top of the Greenbook dataset used to capture the Federal Reserve's forecasts, the author includes consensus forecasts from the Blue Chip survey as an indicator of market expectations. The difference between the Greenbook and the Blue Chip forecasts can be considered as a measure of the Federal Reserve's private information. The cleaned measures are available from 1991Q1 to 2011Q4.

The responses from the VAR model with the cleaned path factor are displayed in the right panel of Figure A.2. After removing the information component, both GDP and inflation decrease following a positive FG shock. Consumption inequality shows a procyclical response, aligning with the baseline results.

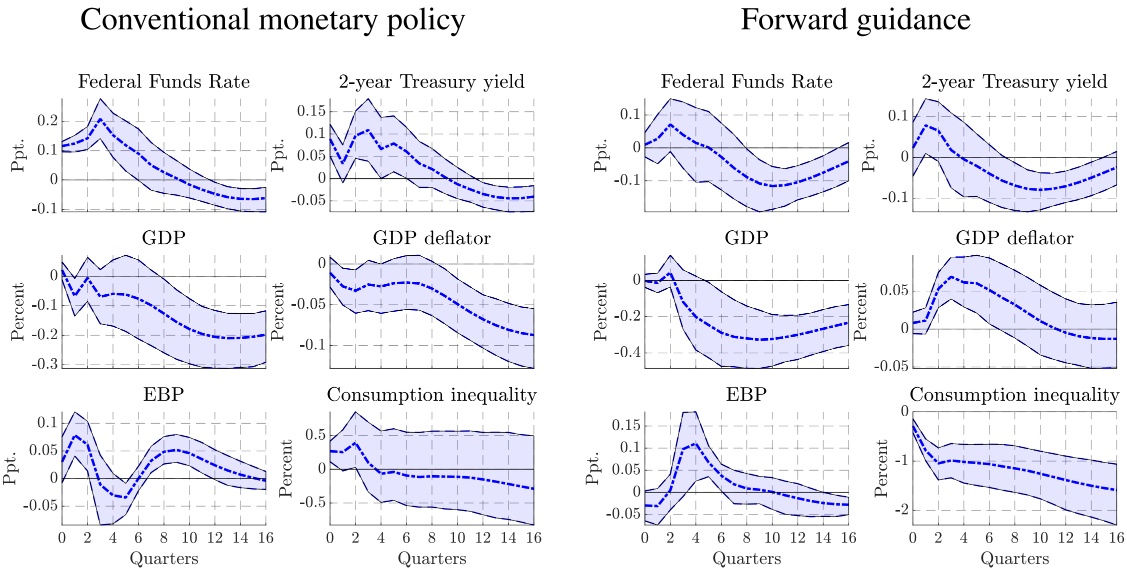
A.3 Factors of Gürkaynak et al. (2005)

Earlier, well-established measures of CMP and FG shocks are the target and path factors computed by Gürkaynak et al. (2005). Figure A.3 shows the impulse responses using these factors in our VAR model. Similar to the baseline specification, following a contractionary CMP shock, both GDP and inflation decrease, while the EBP increases, although the responses are less statistically significant. After a FG shock, GDP decreases while inflation shows a price puzzle that is similar to the baseline results. Moreover, the initial responses for consumption inequality are consistent with our main findings. After a few quarters, the response to a CMP shock turns negative, whereas it is larger in absolute terms after a FG shock.

A.4 Empirical model of Bundick and Smith (2020)

A comparable empirical specification to that employed in this study can be found in Bundick and Smith (2020). Their work evaluates the macroeconomic effects of FG shocks in a structural VAR model with a recursive identification scheme, focusing specifically on the

Figure A.3: Impulse responses to monetary policy shocks: Gürkaynak et al. (2005) factors



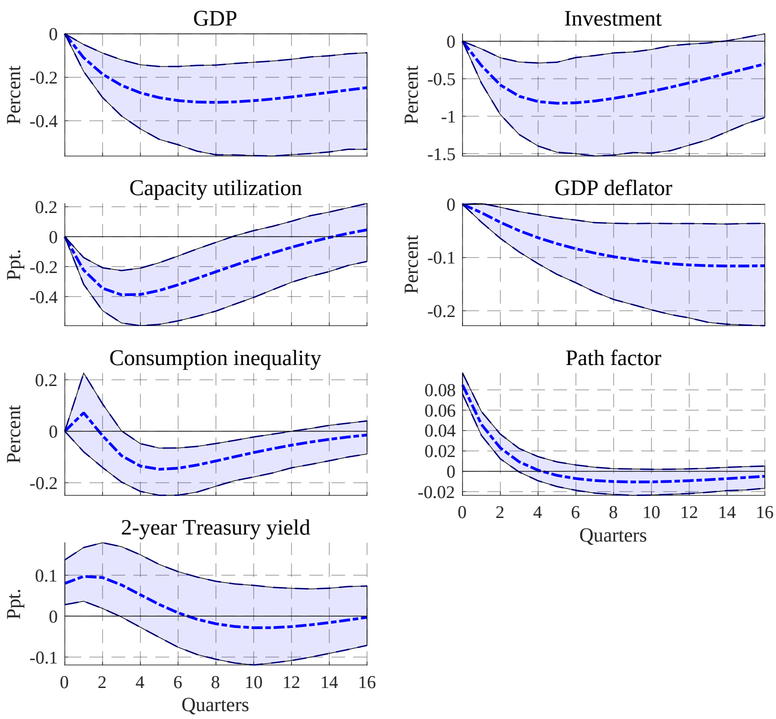
Notes: This figure depicts the impulse responses to a one-standard-deviation increase in the target factor (left panel) and the path factor (right panel) of Gürkaynak et al. (2005). Consumption inequality is measured by the cross-sectional standard deviation of household-level real consumption. Impulse responses are from a VAR model using quarterly data for the period 1991Q1-2016Q4. Shaded areas represent 68% confidence intervals.

zero lower bound period. The variables included in the VAR are the real GDP, a proxy for real equipment investment, capacity utilization, the GDP deflator, the cumulative sum of a path factor, and the 2-year Treasury yield. The construction of their path factor as a FG shock measure follows Gürkaynak et al. (2005), but with a slightly different sample and including longer-term market data. Bundick and Smith (2020) then assume that macroeconomic conditions adjust slowly to changes in expected policy rates, but financial markets may respond immediately. In their VAR model, they therefore order the path factor after real activity and the price level, but before the 2-year Treasury yield. Moreover, they use the pre-zero lower bound period to form the priors for the VAR parameters during the zero lower bound period, but uninformative priors lead to similar results.

We compute the impulse responses to a path factor shock using the same VAR specification, the same controls, and the same measure of FG. The only differences are that the VAR is computed at quarterly frequency and that we add our baseline measure of consumption inequality to the vector of variables.

The results are presented in Figure A.4. The responses of the macroeconomic variables are similar to those obtained by Bundick and Smith (2020). An increase in the path factor leads to a decrease in output, investment, capital utilization, and price level. Although the response of consumption inequality is initially weaker and statistically insignificant, it subsequently decreases, in line with the baseline findings.

Figure A.4: Impulse responses to a FG shock: Bundick and Smith (2020) model



Notes: This figure depicts the impulse responses to a one-standard-deviation increase in the path factor of Bundick and Smith (2020). Consumption inequality is measured by the cross-sectional standard deviation of household-level real consumption. Impulse responses are from the adapted VAR model of Bundick and Smith (2020) using quarterly data for the period 1994Q1-2015Q4. Shaded areas represent the 90% confidence interval.

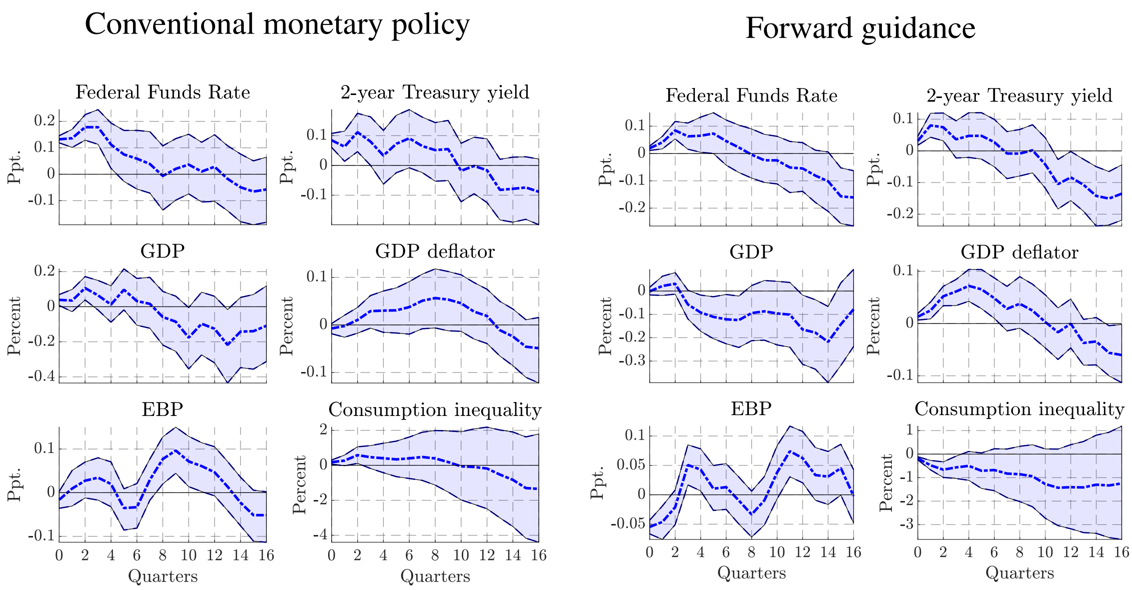
A.5 Bayesian local projections

The impulse response functions estimated by a VAR model can suffer from model misspecification, particularly when the sample size is small. This shortage can arise, for instance, if some important interactions are neglected, the number of lags is inappropriate, or non-linearities are ignored. As an additional robustness check, we draw on the local projection approach by Jordà (2005), which is considered more robust to misspecification and imposes fewer assumptions on the empirical model structure.

In our specific setup, standard local projections might provide imprecise estimates due to the small sample size. This potential problem can be overcome by using Bayesian local projections as proposed in Miranda-Agrippino and Ricco (2021a) and Ferreira et al. (2023). Their approach allows us to obtain more precise estimates by specifying a prior for the local projection coefficients at each horizon.

The results to contractionary CMP and FG shocks are depicted in Figure A.5. The responses of the macroeconomic and financial variables are qualitatively similar to those obtained with the baseline VAR model. What stands out are the less significant responses

Figure A.5: Impulse responses to monetary policy shocks: Bayesian local projections



Notes: This figure depicts the impulse responses to a one-standard-deviation increase in the target factor (left panel) and the path factor (right panel) of Swanson (2021). Consumption inequality is measured by the cross-sectional standard deviation of household-level real consumption. Impulse responses are from Bayesian local projections using quarterly data for the period 1991Q3-2019Q2. Shaded areas represent 68% confidence intervals.

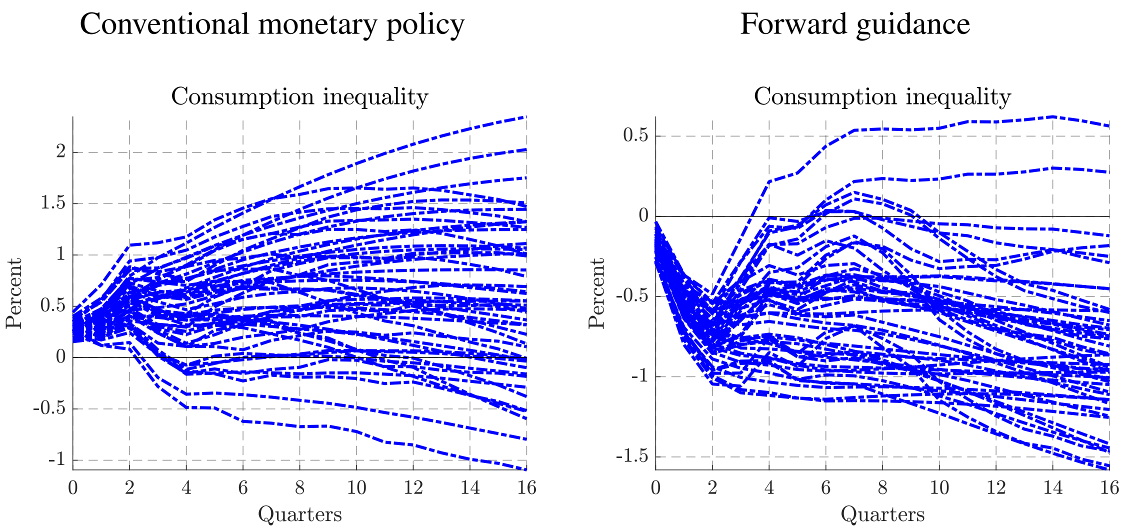
of GDP and the EBP as well as a persistent price puzzle after both shocks. Regarding consumption inequality, the alternative specification confirms the differing cyclicality of the responses under the two monetary shocks.

A.6 Alternative empirical specifications

As an additional sensitivity check, we assess whether alternative model specifications in terms of the variable choices in the VAR or the selected lag length significantly affect our main results. We compute the consumption inequality and transfer responses to CMP and FG shocks for all the possible combinations of the Swanson (2021) and the Gürkaynak et al. (2005) factors with either GDP or industrial production as a measure of real activity, with either GDP deflator or CPI as the price variable, with either the Federal Funds Rate or the 1-year Treasury yield as the short-term interest rate variable, either including the EBP in the VAR or not, and assuming lag lengths from 2 to 4. The nearly 100 impulse responses are presented in Figures A.6 and A.7.

Figure A.6 shows that the chosen combination of variables and lags indeed influence the shape and magnitude of the inequality responses to the two monetary policies. However, the vast majority of simulations point to countercyclical (procyclical) inequality after a CMP

Figure A.6: Consumption inequality responses for various parameter-variable combinations



Notes: This figure depicts the cumulated impulse responses of consumption inequality to a one-standard-deviation increase in the target factor (left panel) and the path factor (right panel) of Swanson (2021). Consumption inequality is measured by the cross-sectional standard deviation of household-level real consumption. The impulse responses arise from separate VAR models computed for different combinations of parameter and variable choices.

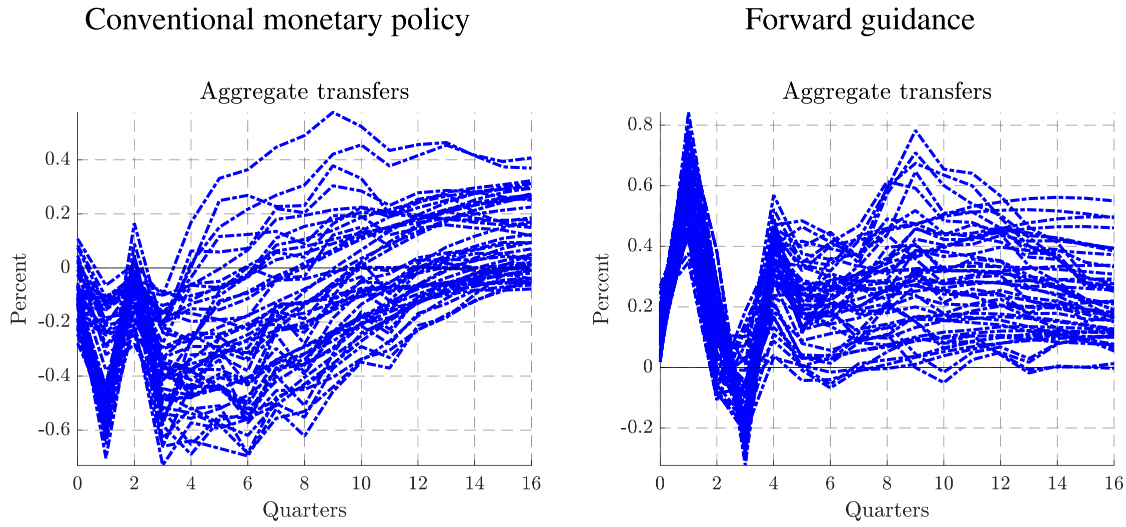
(FG) shock. Even more relevant appears that inequality consistently shows an immediate increase or decrease after the respective shock, regardless of the specification.. This suggests that the main finding regarding the cyclicality of inequality remains robust. A similar result emerges for the total government transfers to households. As depicted in Figure A.7, the two monetary shocks have apparent heterogeneous implications for the transfer response.

A.7 Type-dependency of forward guidance

The form of FG used by central banks has changed over time. It is therefore useful to evaluate whether the procyclical response of consumption inequality to FG announcements is contingent on the specific type of FG employed.

The main types identified in the literature are open-ended guidance, calendar-based guidance, and state-contingent guidance (see, e.g., Ehrmann, Gaballo, Hoffmann, & Strasser, 2019; Moessner & Rungcharoenkitkul, 2019). Open-ended FG is characterized by qualitative statements about the future policy path, time-dependent guidance entails more explicit statements with reference to calendar time, whereas the state-contingent type of FG links the policy path to economic developments or outcomes. This categorization is typically applied to the period since policy rates approached the effective lower bound for the first time.

Figure A.7: Total transfer responses for various parameter-variable combinations



Notes: This figure depicts the impulse responses of aggregate transfers to a one-standard-deviation increase in the target factor (left panel) and the path factor (right panel) of Swanson (2021). The impulse responses arise from separate VAR models computed for different combinations of parameter and variable choices.

The U.S. Federal Reserve has relied on all three types over different subperiods. According to Ehrmann et al. (2019), its FG policy can be roughly classified as open-ended from end-2008 to mid-2011, after that as time-dependent until end-2012, and then state-contingent until 2014. To compare these different FG periods, we compute the responses of consumption inequality to our baseline FG shock, ending the sample in 2008, 2012, and 2014, respectively.

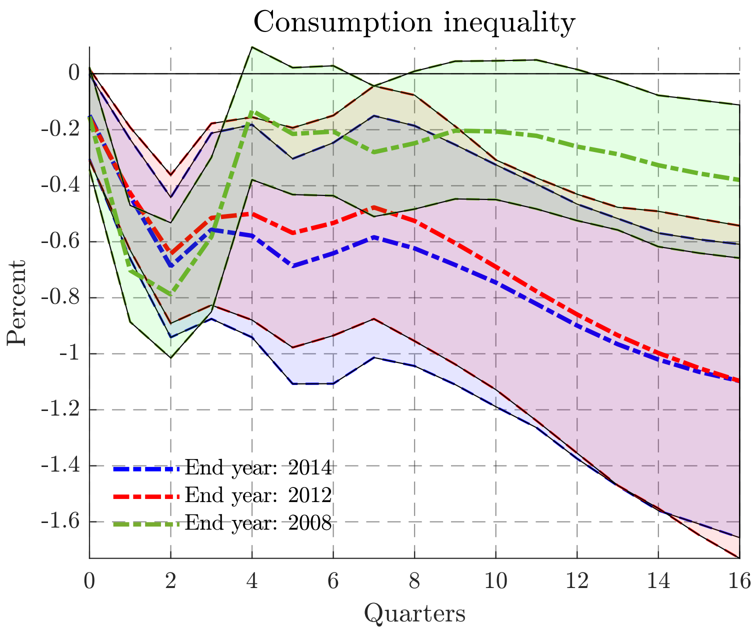
The results are shown in Figure A.8. The procyclical inequality response remains consistent across subperiods. However, when focusing on the sample up to 2008, the impact in the first few quarters after the shock appears slightly stronger before fading in the longer term. After 2008, there are no significant differences visible and the magnitudes are almost equivalent to the full-sample responses in Figure 2.

A.8 Counterfactual analysis

The importance of fiscal transfers for the inequality responses can be further supported by empirical counterfactuals. To simulate the effects of the shocks under a counterfactual regime, we follow the approach in Sydney, Charles, and Martin (2002) or Shiu-Sheng (2023) and set to zero the contemporaneous as well as lagged responses of the aggregate transfer variable in our baseline VAR model. This simple approach gives an idea of the contribution of transfers to the heterogeneous inequality response.

The impulse responses of the counterfactual analysis are displayed in Figure A.9. The blue lines are the baseline responses, while the red lines capture the counterfactual scenario

Figure A.8: Consumption inequality responses for different types of forward guidance



Notes: This figure depicts the cumulated impulse responses of consumption inequality to a one-standard-deviation increase in the path factor of Swanson (2021). It considers different time periods related to the type of forward guidance (see text). Consumption inequality is measured by the cross-sectional standard deviation of household-level real consumption. Impulse responses are from a VAR model using quarterly data starting in 1991Q3. Shaded areas represent 68% confidence intervals.

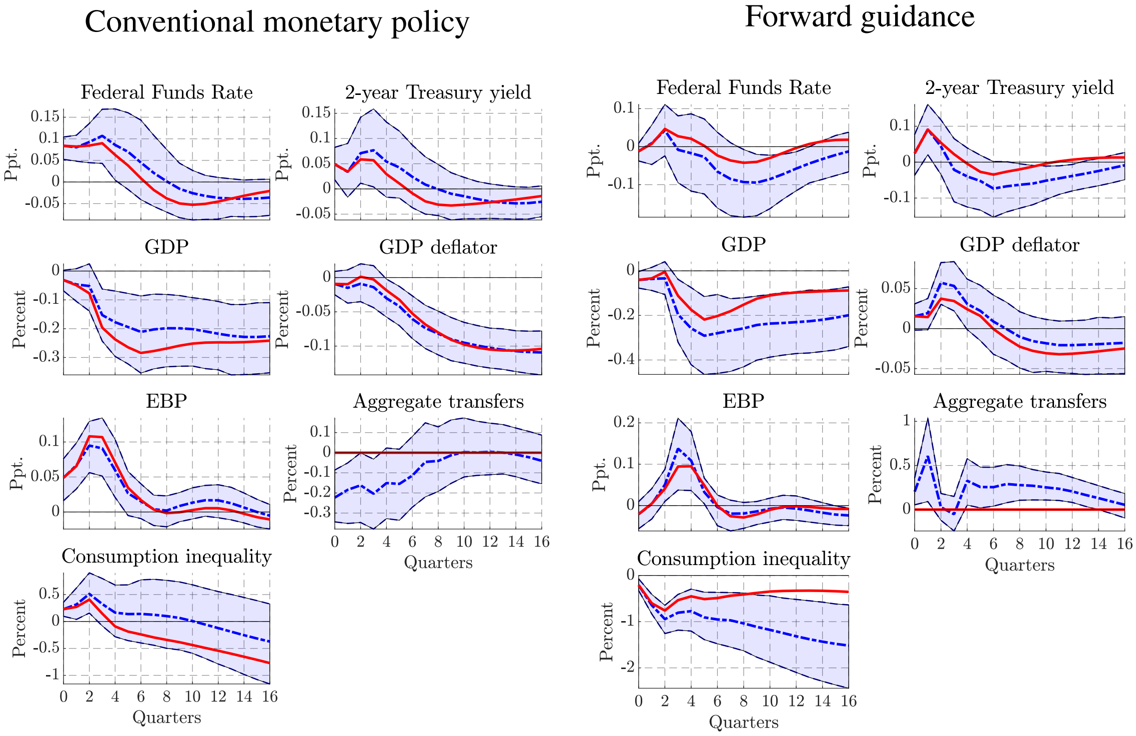
in which the response of transfers is switched off. The fall in real GDP after a CMP shock is larger in the counterfactual scenario, as it is not partially offset by a reduction in transfers. Interest rates therefore show a lower course, indicating a less restrictive monetary policy stance. The opposite is true after a FG shock. Focusing on consumption inequality, the responses to both shocks are markedly more muted once the contribution of transfers is excluded.

A.9 Government interest payments and fiscal tightening

Our empirical findings indicate that total transfers respond differently to CMP and FG shocks. One potential rationale is that these shocks have an asymmetric impact on the government budget constraint. Depending on whether the central bank increases the policy rate today or announces a future increase might alter the fiscal position differently, resulting in varying adjustments in fiscal policy instruments, including transfers to households.

To reinforce this hypothesis, we compute two interest payment variables as proxies to capture the degree of tightness in the fiscal position: an aggregate measure comprising the total interest payments on government debt and the same measure but net of interest receipts.

Figure A.9: Impulse responses to monetary policy shocks: Counterfactual analysis

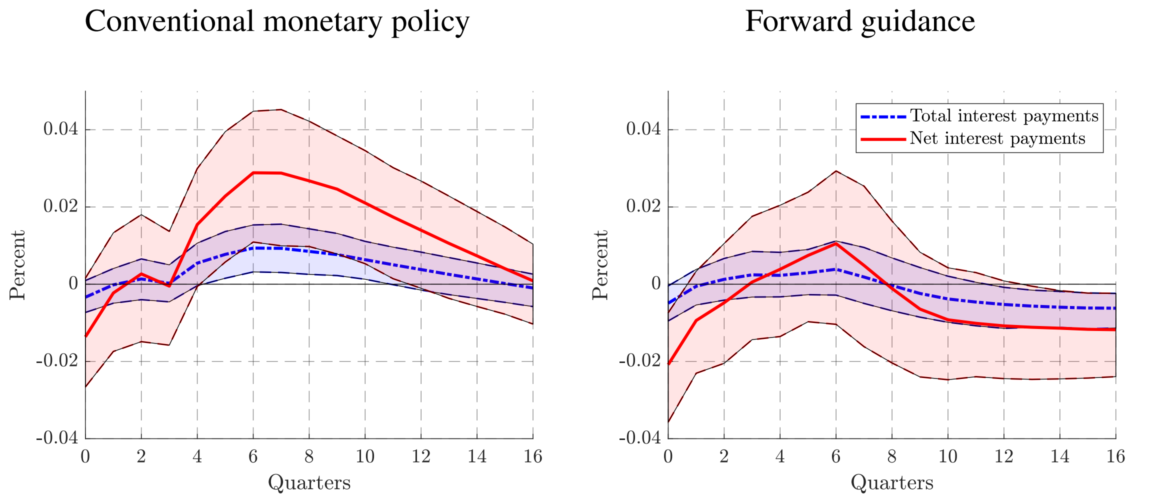


Notes: This figure depicts the impulse responses to a one-standard-deviation increase in the target factor (left panel) and the path factor (right panel) of Swanson (2021). Consumption inequality is measured by the cross-sectional standard deviation of household-level real consumption. Impulse responses are from a VAR model using quarterly data for the period 1991Q3-2019Q2. The blue lines are the baseline estimates whereas the red lines capture a counterfactual scenario assuming no response in fiscal transfers. Shaded areas represent 68% confidence intervals.

The two measures are presented at the level of both the total government (i.e., the sum of U.S. federal, state, and local governments) and the federal government. The data are from the NIPA tables 3.1 to 3.3. Each interest payment variable is divided by the respective level of government debt, which is calculated as the difference between total liabilities and total assets as reported in the U.S. Flow of Funds.

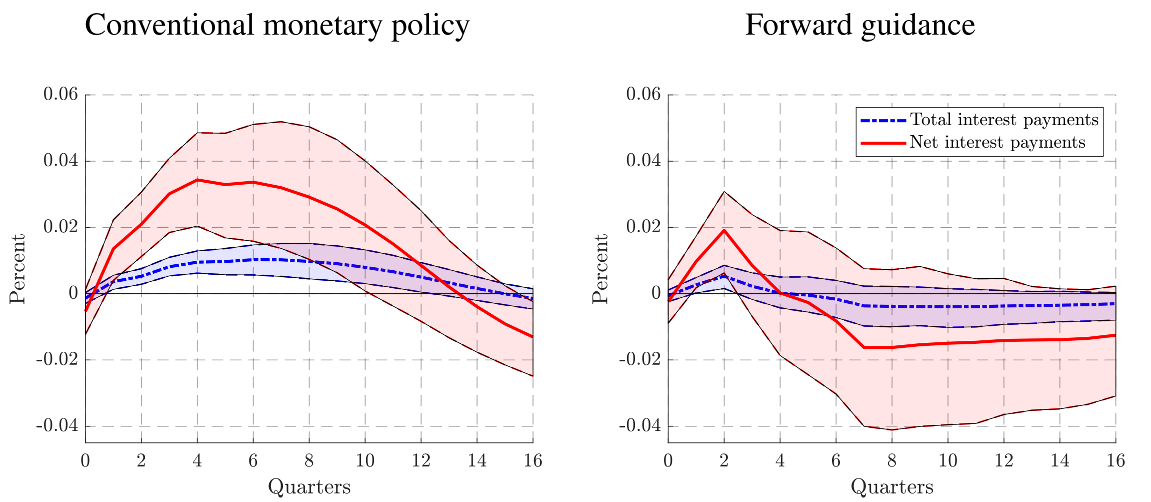
The impulse responses for the total and the federal government are shown in Figures A.10 and A.11, respectively. All measures of interest payments significantly increase after a CMP shock. Following a policy rate hike by the Federal Reserve, market interest rates tend to rise and, all else equal, the government's fiscal position with respect to its debt servicing costs becomes tighter. This is consistent with the evidence presented for aggregate transfers, which decrease in response to a conventional shock. In contrast, the responses of interest payments to a FG shock are highly insignificant.

Figure A.10: Responses of interest payments on public debt: Total government



Notes: This figure depicts the impulse responses of total government interest payments relative to general government debt to a one-standard-deviation increase in the target factor (left panel) and the path factor (right panel) of Swanson (2021). Impulse responses are from a VAR model using quarterly data for the period 1991Q3-2019Q2. Shaded areas represent 68% confidence intervals.

Figure A.11: Responses of interest payments on public debt: Federal government



Notes: This figure depicts the impulse responses of federal government interest payments relative to federal government debt to a one-standard-deviation increase in the target factor (left panel) and the path factor (right panel) of Swanson (2021). Impulse responses are from a VAR model using quarterly data for the period 1991Q3-2019Q2. Shaded areas represent 68% confidence intervals.

B Analytical TANK model: Derivations and figures

This appendix provides details on the derivations of the simple two-agent model presented in Section 3.1 and its key analytical expressions. Furthermore, it includes a summary of selected parameter values, additional impulse responses, and details on model extensions.

B.1 Problem of the intermediate goods producers

The price-setting problem of each intermediate goods producer takes the following form:

$$\max_{\{P_{t+k}(j)\}_{k=0}^{\infty}} \mathbb{E}_t \sum_{k=0}^{\infty} \Lambda_{t,t+k} \left\{ \left[(1+\tau^S) \frac{P_{t+k}(j)}{P_{t+k}} - MC_{t+k} \right] Y_{t+k}(j) - \Theta_{t+k}(j) - T^F_{t+k} \right\}$$

$$\text{subject to} \quad Y_{t+k}(j) = \left(\frac{P_{t+k}(j)}{P_{t+k}} \right)^{-\epsilon} Y_{t+k}$$

$$\Theta_{t+k}(j) = \frac{\theta}{2} \left(\frac{P_{t+k}(j)}{P_{t+k-1}(j)} - 1 \right)^2 Y_{t+k} \ ,$$

where $\Lambda_{t,t+k} = (\beta^S)^k \left(\frac{U^S_{c,t+k}}{U^S_{c,t}} \right)$ is the stochastic discount factor for payoffs in period $t+k$. The optimality condition of this problem is

$$\mathbb{E}_t \Bigg\{ \Lambda_{t,t} \Bigg[\left(1+\tau^S\right) (1-\epsilon)\, P_t(j)^{-\epsilon}\, P_t^{\epsilon-1}\, Y_t + MC_t\, \epsilon\, P_t(j)^{-\epsilon-1}\, P_t^{\epsilon}\, Y_t$$
$$- \theta \left(\frac{P_t(j)}{P_{t-1}(j)} - 1 \right) \frac{Y_t}{P_{t-1}(j)} \Bigg] + \Lambda_{t,t+1}\, \theta \left(\frac{P_{t+1}(j)}{P_t(j)} - 1 \right) \frac{P_{t+1}(j)}{P_t(j)^2}\, Y_{t+1} \Bigg\} = 0 \ .$$

In steady state, if adjustment costs are zero ($\theta = 0$), the last expression reduces to $MC = (1+\tau^S)\frac{\epsilon-1}{\epsilon}$, so that the optimal subsidy τ^S that induces marginal cost pricing in steady state ($MC = 1$) turns out to be $(\epsilon-1)^{-1}$.

Since all firms are identical and face the same demand, they make identical decisions and set the same price such that $P_t(j) = P_t$ and $Y_t(j) = Y_t = N_t$. Rearranging the last expression yields the Phillips curve:

$$(1+\tau^S)(1-\epsilon) + \epsilon MC_t - \theta(1+\pi_t)\pi_t + \mathbb{E}_t \left[\frac{\Lambda_{t+k}}{\Lambda_t}\, \theta(1+\pi_{t+1})\pi_{t+1} \frac{Y_{t+1}}{Y_t} \right] = 0 \ .$$

B.2 Steady state

We consider a steady state with net inflation rate $\pi = 0$, where output is normalized to one by setting $N = 1$ and thus $Y = C = 1$. The Euler equation yields the steady-state real interest rate $r = \beta^{-1} - 1$, which in turn equals the discount rate. We assume that the subsidy on firms' sales is set to its optimal value ($\tau^S = (\epsilon - 1)^{-1}$), which induces marginal cost pricing ($MC = W = 1$) and leads to zero profits ($D = 0$) and thus zero dividend income for households ($\Gamma^S = \Gamma^H = 0$) in steady state. For a given debt-to-GDP ratio $B_Y \equiv B/Y$, it follows that $B_Y^S = B_Y/(1-\lambda)$ and, using the government budget constraint, $T_Y \equiv T/Y = -rB_Y$. Furthermore, we assume that hand-to-mouth agents only consume their labor income in steady state, so that $T^H = 0$ and that steady-state consumption is the same across household types ($C^H = C^S = C$). This pins down transfers to savers by $T_Y^S = T_Y/(1-\lambda)$. Finally, the weights on hours worked in the utility function are given by $\varphi^j = W(L)^{-\nu}(C^j)^{-1}$ for $j = \{H, S\}$.

B.3 Log-linearized model

The simple TANK model is approximated around the previously described non-stochastic steady state. Table B.1 presents the log-linearized equilibrium conditions, where we have already imposed the assumption of constant debt. Lowercase letters denote the log deviation of a variable from its deterministic steady state, except for profits, transfers, and debt, which are considered relative to total income $\left(x_t^j = \frac{X_t^j - X^j}{Y} \text{ for } j = \{H, S\}\right)$. Interest and inflation rates are expressed in absolute deviations from steady state. Finally, we denote steady-state debt as a fraction of aggregate steady-state income by $B_Y \equiv B/Y$.

Table B.1: Model overview of the analytical TANK model

Euler equation, S	$c_t^S = \mathbb{E}_t c_{t+1}^S - \sigma r_t$
Budget constraint, S	$c_t^S = \frac{1}{1-\lambda} r_{t-1} B_Y + w_t + l_t + \frac{1-\tau^D}{1-\lambda} d_t + t_t^S$
Budget constraint, H	$c_t^H = w_t + l_t + \frac{\tau^D}{\lambda} d_t + t_t^H$
Labor supply	$\nu l_t = w_t - \sigma c_t$
Real marginal cost	$mc_t = w_t$
Phillips curve	$\pi_t = \beta \mathbb{E}_t \pi_{t+1} + \frac{\epsilon}{\theta} mc_t$
Production function	$y_t = n_t$
Real profits	$d_t = -mc_t$
Government constraint	$-r_{t-1} B_Y = \lambda t_t^H + (1-\lambda) t_t^S$
Aggregate consumption	$c_t = \lambda c_t^H + (1-\lambda) c_t^S$
Labor market clearing	$n_t = l_t$
Resource constraint	$y_t = c_t$
Fisher equation	$r_t = i_t - \mathbb{E}_t \pi_{t+1}$
Monetary policy	$r_t = \rho^{t-\mathcal{T}} \varepsilon_{\mathcal{T}}, \ \ t \geq \mathcal{T}$

Notes: This table summarizes the log-linearized equilibrium conditions for the simple analytical TANK model. The government's lump-sum transfers to individual households, t_t^h and t_t^S, are specified in the main text (see Section 4).

B.4 Reduced-form model equations for consumption and inequality

This section derives reduced-form expressions for the log-linearized analytical model, focusing on individual and aggregate consumption as well as inequality. The derivations here closely follow Bilbiie et al. (2024) but are further developed in the main part of the paper. We determine there the condition under which any arbitrary transfer function can replicate the cyclical behavior of inequality observed in the empirical analysis.

Drawing on Table B.1, the expression for labor supply can be rewritten as $w_t = (\sigma + \nu)c_t$. We can use this together with the profit condition in the budget constraint of hand-to-mouth agents to get

$$c_t^H = \chi c_t + t_t^H \ ,$$

where $\chi = 1 + (\sigma + \nu)\left(1 - \frac{\tau^D}{\lambda}\right)$. Replacing c_t^H in the equation for aggregate consumption by the last expression leads to

$$c_t^S = \frac{1 - \lambda\chi}{1 - \lambda} c_t - \frac{\lambda}{1 - \lambda} t_t^H \ .$$

Using the above equations, consumption inequality can be written as

$$\Phi_t \equiv c_t^S - c_t^H = \frac{1 - \chi}{1 - \lambda} c_t - \frac{1}{1 - \lambda} t_t^H \ .$$

If we iterate forward the Euler equation and assume $\lim_{i \to \infty} \mathbb{E}_t c_{t+i}^S = 0$, we get $c_t^S = -\sigma \sum_{k=0}^{\infty} \mathbb{E}_t r_{t+k}$. Replacing the saver's consumption with the previous expression and solving for aggregate consumption results in the aggregate Euler equation:

$$c_t = -\sigma \frac{1 - \lambda}{1 - \lambda\chi} \sum_{k=0}^{\infty} \mathbb{E}_t r_{t+k} + \frac{\lambda}{1 - \lambda\chi} t_t^H \ . \tag{B.1}$$

Finally, the stream of real interest rates can be rewritten as $\sum_{k=0}^{\infty} \mathbb{E}_t r_{t+k} = \sum_{k=0}^{\infty} \mathbb{E}_t \rho^{t+k-\mathcal{T}} \varepsilon_{\mathcal{T}} = 1/(1-\rho)\,\varepsilon_{\mathcal{T}}$, for $t \geq \mathcal{T}$. Combining the previous equations then leads to the expression for consumption inequality (6).

B.5 Proof of Proposition 2

Combining the proposed transfer function for constrained households, $t_t^H = -\phi_1 r_t B_Y - \phi_2 y_t$, with the aggregate Euler equation (B.1) yields

$$t_t^H = -\phi_1 \frac{1 - \lambda\chi}{1 - \lambda\chi + \phi_2\lambda} r_t B_Y + \phi_2 \frac{\sigma(1 - \lambda)}{1 - \lambda\chi + \phi_2\lambda} \sum_{k=0}^{\infty} \mathbb{E}_t r_{t+k} \ .$$

Let $\mathcal{T} \geq 0$ denote the period of the real interest rate change. According to Proposition 1, for consumption inequality to be countercyclical on impact of a CMP shock ($\mathcal{T} = 0$) while, at the same time, responding procyclically to a FG shock ($\mathcal{T} > 0$), the transfer function must simultaneously satisfy the following conditions:

$$\frac{\partial t_0^H}{\partial r_{\mathcal{T}}} \begin{cases} < \sigma(\chi - 1)\,\frac{1}{1-\rho}, & \text{if } \mathcal{T} = 0 \\ > \sigma(\chi - 1)\,\frac{1}{1-\rho}, & \text{if } \mathcal{T} > 0 \end{cases}$$

For the first condition to be satisfied, it has to hold that

$$-\phi_1 \frac{(1-\lambda\chi)}{1-\lambda\chi+\phi_2\lambda} B_Y + \phi_2 \frac{\sigma(1-\lambda)}{1-\lambda\chi+\phi_2\lambda} \frac{1}{1-\rho} < \sigma(\chi-1)\,\frac{1}{1-\rho}\ .$$

We assume that $\lambda < 1/\chi$ and further that $\phi_2 > 0$, as argued in Section 4, which together imply $1 - \lambda\chi + \phi_2\lambda > 0$. Simplifying the last equation then leads to

$$-\phi_1(1-\rho)B_Y + \phi_2\sigma < \sigma(\chi - 1)\ . \tag{B.2}$$

On the other hand, for the second condition to be satisfied, it has to hold that

$$\phi_2 \frac{\sigma(1-\lambda)}{1-\lambda\chi+\phi_2\lambda} \frac{1}{1-\rho} > \sigma(\chi-1)\,\frac{1}{1-\rho}\ ,$$

which simplifies to

$$\phi_2 > \chi - 1\ . \tag{B.3}$$

Combining (B.2) with (B.3) completes the proof.

B.6 Calibration of the analytical TANK model

Table B.2 summarizes the parameterization for the simple TANK model. Most parameter values are either based on convention or taken from Kaplan et al. (2018), except for the demand elasticity ϵ which is calibrated to match a price markup of 20%. The tax rate on profits is set such that $\chi = 1.33$. This choice matches the empirical estimates from Patterson (2023), who documents a positive relationship of 1.33 between workers' MPCs and their income elasticity with respect to changes in output. It also reflects the evidence from Auclert (2019) supporting $\chi > 1$ and is in line with the model-implied computations in Bilbiie (2020). The transfer rule coefficients ϕ_1 and ϕ_2 are jointly calibrated within the range of possible parameter values that satisfy Proposition 2, assuming that savers pay, through negative individual transfers, for the additional fiscal injection received by constrained households as a result of the contractionary monetary shock. The stronger sensitivity of transfers to the debt component compared to the output component in the short run aligns with findings from studies such as Leeper, Plante, and Traum (2010).

Table B.2: Parameter values for the simple TANK model

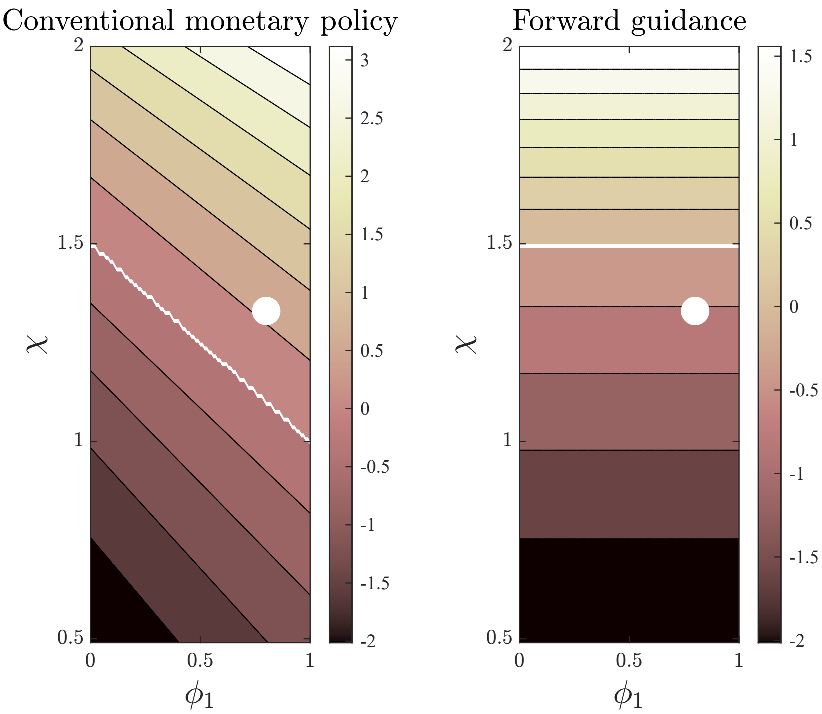
Parameter	Description	Value	Source / Target
λ	Share of hand-to-mouth	0.3	Kaplan et al. (2018)
β	Discount factor	1.0125^{-1}	Kaplan et al. (2018). Annual steady-state interest rate of 5%
σ	Intertemporal elasticity of substitution	1	Conventional
$1/\nu$	Frisch elasticity of labor supply	1	Conventional
ϵ	Elasticity of substitution between goods	6	Price markup of 20%
θ	Rotemberg price adjustment cost	100	Kaplan et al. (2018)
τ^D	Tax rate on profits	0.25	Empirical evidence in Patterson (2023)
ϕ_1	Transfer rule coefficient on debt	0.8	Based on Proposition 2 and Figure 6
ϕ_2	Transfer rule coefficient on output	0.5	Based on Proposition 2 and Figure 6
$\lvert B\rvert/(4Y)$	Steady-state debt to annualized GDP	0.23	Kaplan et al. (2018)
ρ	Persistence of policy shock	0.5	Kaplan et al. (2018)
$\varepsilon_{\mathcal{T}}$	Shock impact	0.0025	Annualized change of 1%

B.7 Additional figures for the analytical TANK model

Figure B.1 presents a graph similar to Figure 6 in Section 4, but with the weight on the cyclical component in the transfer function (ϕ_2) fixed at its baseline value, while the elasticity of the constrained household's income to aggregate income (χ) varies. The range of parameter values that replicate the cyclical response of inequality observed in the data remains narrow. Higher values of χ generally imply that consumption inequality reacts more positively after both contractionary CMP and FG shocks. When $\tau^D < \lambda$ and thus $\chi > 1$, constrained agents get a proportion of profits numerically smaller than their population share, but their income responds disproportionately to changes in aggregate income. Beyond a certain threshold, this ensures that consumption inequality responds countercyclically to a CMP shock. In contrast, when $\tau^D > \lambda$ and so $\chi < 1$, an otherwise standard calibration would require a relatively high ϕ_1. Constrained agents would receive a high share of profits relative to savers, requiring lower transfers through a larger sensitivity to debt servicing costs.

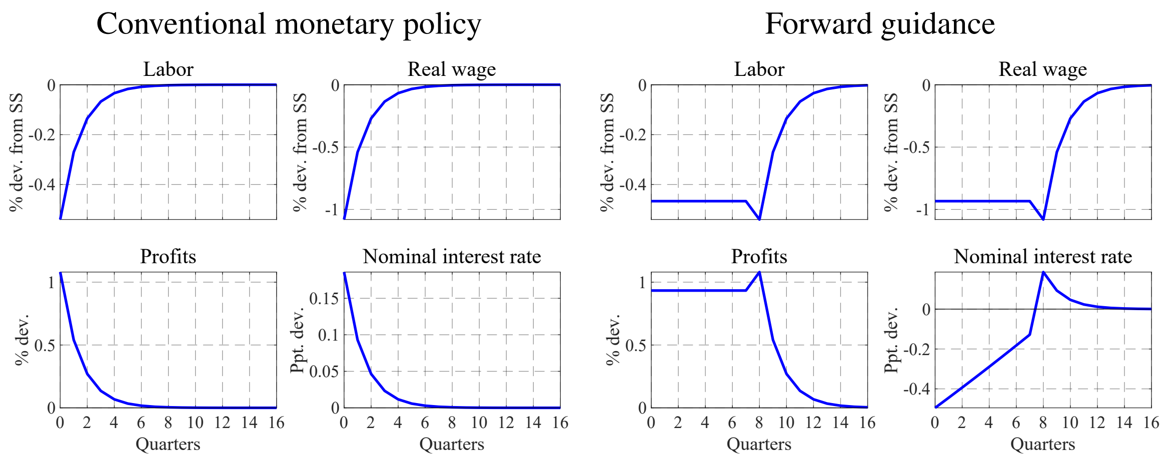
Figure B.2 complements the set of impulse responses for the simple TANK model, with the main graphs located in Figure 7.

Figure B.1: Sensitivity of consumption inequality: Alternative setup



Notes: These heat maps show the response of inequality on impact of a CMP and a FG shock, respectively, for different combinations of χ (elasticity of the constrained household's income to aggregate income) and ϕ_1 (coefficient on debt burden in the constrained agent's transfer function). The bars next to each plot label the colors, where values above (below) zero refer to a positive (negative) inequality response. The white lines indicate the threshold with zero inequality response. The white dots mark the parameter values implied by the baseline calibration (see Table B.2).

Figure B.2: Additional impulse responses: Analytical TANK model



Notes: This figure depicts supplementary impulse responses for the analytical TANK model to a 25-basis-point increase in the contemporaneous real interest rate (left panel) and in the real rate in eight quarters (right panel). It complements the results in Figure 7. The response of profits is in deviations from their steady-state level, relative to steady-state output.

B.8 Model with long-term bonds

The core structure and equations of this model align with the baseline framework presented in Section 3.1. The main modification is the replacement of short-term with long-term bonds.

We follow Woodford (2001) and model long-term bonds as perpetuities with coupon payments that decay geometrically at a rate $\kappa \in [0,1]$. A nominal bond $\widetilde{B}^L_{t+1}$ issued at date t pays a stream of coupons $1, \kappa, \kappa^2, \ldots$ in the following periods. Its price at time t is Q_t and its market value in real terms is defined as $B^L_{t+1} = Q_t \frac{\widetilde{B}^L_{t+1}}{P_t}$. This framework also nests short-term, one-period bonds as a special case when $\kappa = 0$.

The new setup modifies the budget constraint of savers, which now takes the following form:

$$P_t C^S_t + Q_t \widetilde{B}^{S,L}_{t+1} = (1+\kappa Q_t)\widetilde{B}^{S,L}_t + P_t W_t L_t + P_t \Gamma^S_t + P_t T^S_t \ ,$$

where $\widetilde{B}^{S,L}_{t+1}$ are the end-of-period-t holdings of nominal long-term bonds by saver S. The last equation can be rewritten in real terms:

$$C^S_t + B^{S,L}_{t+1} = \frac{1+\kappa Q_t}{Q_{t-1}} \frac{1}{1+\pi_t} B^{S,L}_t + W_t L_t + \Gamma^S_t + T^S_t \ ,$$

We can then define the gross ex-post one-period return on a long-term bond purchased at time $t-1$, expressed in real terms, as

$$R^L_t = \frac{1+\kappa Q_t}{Q_{t-1}} \frac{1}{1+\pi_t} \ .$$

The Euler equation for bonds therefore becomes

$$1 = \beta\, \mathbb{E}_t \left[\left(\frac{C^S_{t+1}}{C^S_t} \right)^{-\frac{1}{\sigma}} R^L_{t+1} \right] \ .$$

The setup above implies that the gross yield to maturity at time t on a long-term bond is given by

$$RL^n_t = \frac{1}{Q_t} + \kappa \ ,$$

so that the price of a long-term bond can be expressed by $Q_t = \frac{1}{RL^n_t - \kappa}$. Finally, in the absence of frictions and between two consecutive periods, there is a no-arbitrage condition between short-term, one-period debt and long-term debt, for $t \geq 0$:

$$\mathbb{E}_t R^L_{t+1} = R_t \ ,$$

where $R_t = 1 + r_t$ is the gross short-term real rate as used in the baseline model.

In log-linear terms, we have the following equations:

$$c_t^S = \mathbb{E}_t c_{t+1}^S - \sigma \mathbb{E}_t r_{t+1}^L \tag{B.4}$$

$$r_t^L = \kappa\beta q_t - q_{t-1} - \pi_t \tag{B.5}$$

$$rl_t^n = -(1-\kappa\beta) q_t \tag{B.6}$$

$$\mathbb{E}_t r_{t+1}^L = r_t \tag{B.7}$$

where interest rates are defined in log deviations from their non-stochastic steady state and where we used that $R^L = RL^n = \beta^{-1}$ holds in steady state. Due to the no-arbitrage condition (B.7), in equilibrium, the Euler equation (B.4) is equivalent to that from the baseline model (see Table B.1). All else equal, any changes in individual consumption levels will therefore originate from variations in government transfers.

Using the equations above, we can derive the price of the long-term bond as a function of expected real returns. From (B.5), the ex-post real return on bonds must satisfy $\mathbb{E}_t r_{t+1}^L = \kappa\beta\, \mathbb{E}_t q_{t+1} - q_t - \pi_t$. Solving for q_t and iterating forward yields

$$q_t = -\sum_{i=0}^{\infty} (\kappa\beta)^i\, \mathbb{E}_t \left(r_{t+1+i}^L + \pi_{t+1+i} \right) \ .$$

Equation (B.7) implies $\mathbb{E}_t r_{t+1+i}^L = \mathbb{E}_t r_{t+i}$, which highlights the immediate impact of FG on today's bond price. Figure B.3 shows the corresponding impulse responses. Although both CMP and FG become more effective with longer debt maturities, the bond price responses indicate only limited differences across maturities.

The other main model block that is affected by the replacement of short-term with long-term bonds is the budget constraint of the government, which is now given by

$$Q_t \widetilde{B}_{t+1}^L = (1+\kappa Q_t) \widetilde{B}_t^L + P_t T_t \ ,$$

or in real terms by

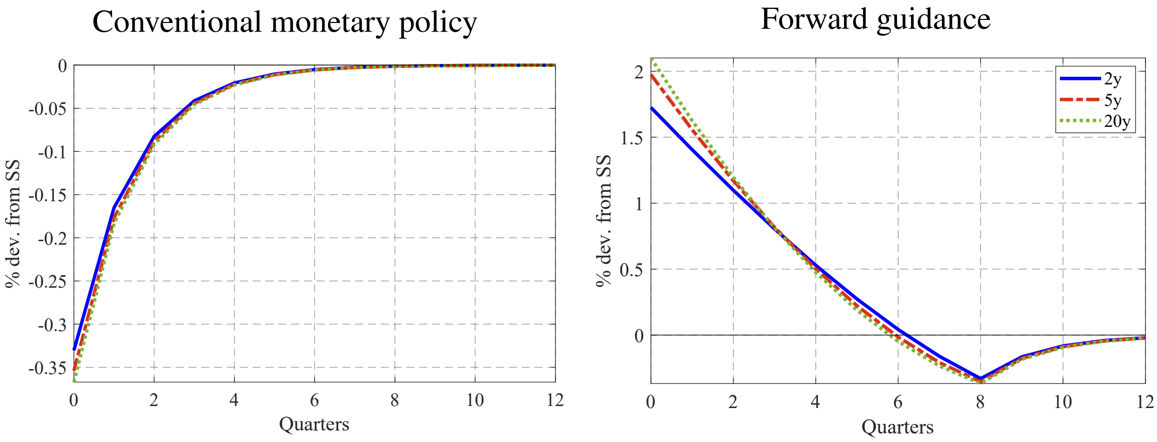
$$B_{t+1}^L = \frac{1+\kappa Q_t}{Q_{t-1}} \frac{1}{1+\pi_t} B_t^L + T_t \ .$$

Approximated around the non-stochastic steady state, we get

$$b_{t+1} = \beta^{-1} b_t + \beta^{-1} r_t^L B_Y^L + t_t \ ,$$

with debt-to-GDP ratio $B_Y^L \equiv B^L/Y$. For simplicity, we assume $B_Y^L = B_Y$ to make the analytical results more easily comparable to the baseline model.

Figure B.3: Long-term bond price responses to monetary policy shocks across different maturities



Notes: This figure depicts the impulse responses of the price of bonds for the analytical TANK model to a 25-basis-point increase in the contemporaneous real interest rate (left panel) and in the real rate in eight quarters (right panel). Different from the baseline model, debt and bonds are long-term. The impulse responses are calculated assuming long-term bond coupon decay rates of $\kappa = \{0.88594, 0.96187, 0.99984\}$, implying debt maturities of 2, 5, and 20 years, respectively.

B.9 Transfer functions with non-constant debt

For illustrative purposes, we have assumed in the baseline TANK model that the fiscal authority maintains a constant level of debt over time. Relaxing this assumption restores the simple government budget constraint $B_{t+1} = (1 + r_{t-1})B_t + T_t$, or in log-linear form $b_{t+1} = \beta^{-1}b_t + r_{t-1}B_Y + t_t$, where $\beta^{-1} = (1 + R)$, $t_t = \lambda t_t^H + (1 - \lambda)t_t^S$, and $B_Y \equiv B/Y$. Building on this, we assume that the government adjusts debt to balance its budget and define a rule that determines transfers to savers. Following the baseline model, we adopt transfer functions with a debt component and a cyclical component.

Non-constant debt servicing costs. Staying close to the baseline model, the first specification assumes the debt component now captures the government's interest expenses in their non-constant form:

$$t_t^H = -\phi_1 \left(Rb_{t+1} + r_t B_Y\right) - \phi_2 y_t \tag{B.8}$$

$$t_t^S = -\phi_1 \left(Rb_{t+1} + r_t B_Y\right) + \phi_2 y_t \; . \tag{B.9}$$

We assume the same functional form for both agents, with an opposite sign for ϕ_2 to reflect its role as an automatic stabilizer intended to smooth income fluctuations for constrained agents. Alternatively, setting $\phi_2 = 0$ for savers would yield comparable results.

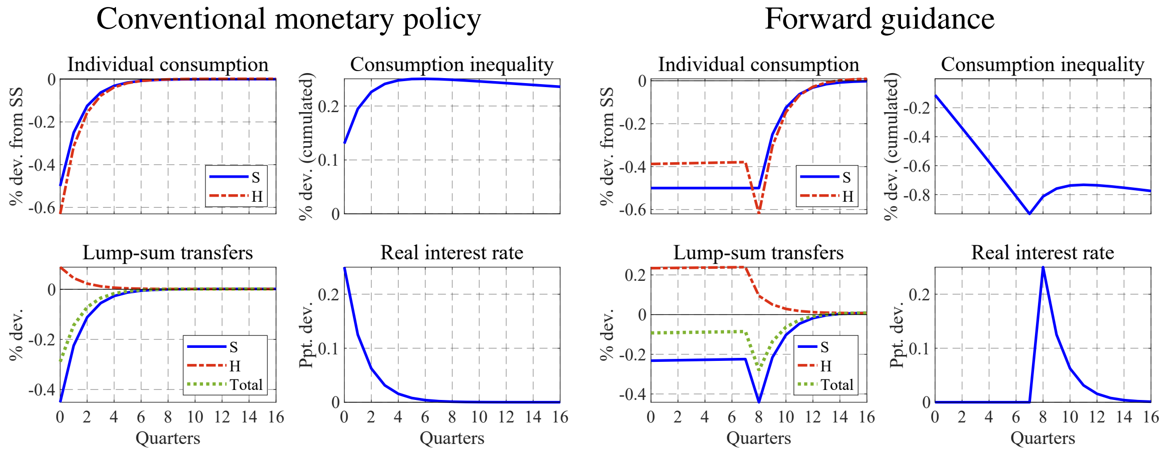
Non-constant debt. As a second specification, we consider a functional form where the first component is directly linked to the debt level rather than the interest payments on debt:

$$t_t^H = -\phi_1 b_{t+1} - \phi_2 y_t \tag{B.10}$$

$$t_t^S = -\phi_1 b_{t+1} + \phi_2 y_t \ . \tag{B.11}$$

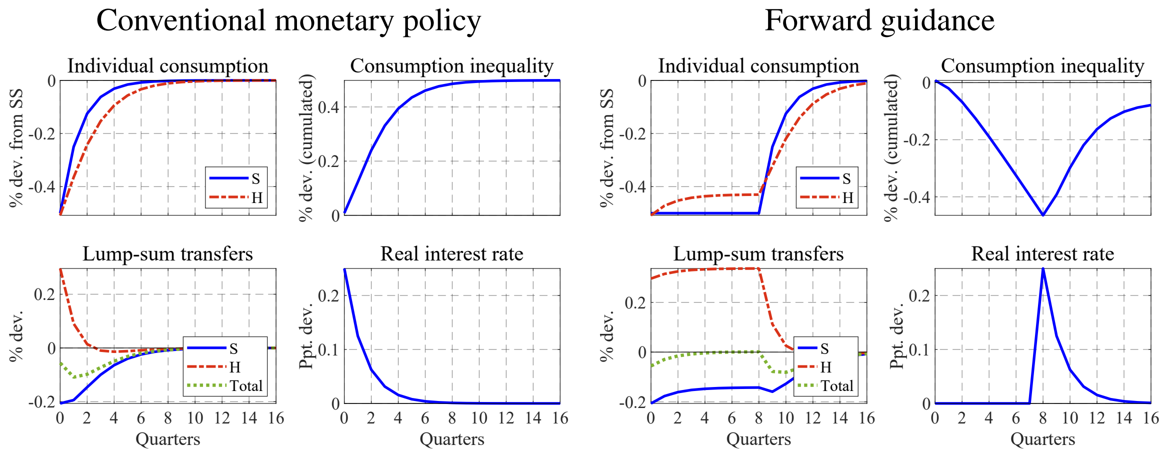
Figures B.4 and B.5 show the impulse responses from the two simulations using the baseline calibration in Table B.2, except that $\tau^D = 0.21$ in the second case. The results are qualitatively similar to those of the baseline model. One difference is that transfers to savers drop more sharply and immediately after a CMP shock. Moreover, in the second specification with non-constant debt, inequality responds more strongly to a CMP shock in the medium term but less to FG, driven by a slightly stronger yet less persistent transfer response for hand-to-mouth agents and the debt dynamics.

Figure B.4: Impulse responses to monetary policy shocks: Rule with non-constant debt servicing costs



Notes: This figure depicts alternative impulse responses for the analytical TANK model to a 25-basis-point increase in the contemporaneous real interest rate (left panel) and in the real rate in eight quarters (right panel). Different from the baseline model, debt is non-constant and individual transfers evolve according to equations (B.8) and (B.9). Responses of profit income and transfers are in deviations from their steady-state levels, relative to steady-state output. Individual responses for savers (S) and hand-to-mouth agents (H) are shown in per-capita terms.

Figure B.5: Impulse responses to monetary policy shocks: Rule with non-constant debt



Notes: This figure depicts alternative impulse responses for the analytical TANK model to a 25-basis-point increase in the contemporaneous real interest rate (left panel) and in the real rate in eight quarters (right panel). Different from the baseline model, debt is non-constant and individual transfers evolve according to equations (B.10) and (B.11). Responses of profit income and transfers are in deviations from their steady-state levels, relative to steady-state output. Individual responses for savers (S) and hand-to-mouth agents (H) are shown in per-capita terms.

C Fully-fledged TANK model: Derivations and figures

This appendix provides details on the derivations of the two-asset TANK model presented in Section 4.3 and explains key differences between our setup and the model of Kaplan et al. (2018). It also contains a summary of the parameterization and the impulse responses.

C.1 Model

The extended TANK model is largely based on the two-agent version of the heterogeneous-agent framework by Kaplan et al. (2018). The reader is referred to their Online Appendix for further details. The main differences with respect to their model are: i) a tax and transfer system implemented by the government that redistributes income between households, through either profit taxation or lump-sum transfers; and ii) a monetary policy setup where the central bank commits to a path for the real interest rate instead of setting the nominal rate according to a Taylor rule. These key distinctions are explained in detail throughout the model description.

Households. There is a continuum of households with an exogenous share $1 - \lambda$ of savers (S) who hold and price all assets in the economy. The remaining share λ of households has no access to financial markets and live hand-to-mouth (H) by consuming their total income in each period. This type of household is referred to as spenders by Kaplan et al. (2018).

Each household has preferences over utility from consumption C and disutility from supplying labor L:

$$U\left(C_t, L_t\right) = \frac{C_t^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} - \varphi \frac{L_t^{1+\nu}}{1+\nu} \ ,$$

where σ denotes the elasticity of intertemporal substitution, $\frac{1}{\nu}$ the Frisch elasticity of labor supply, and $\varphi > 0$ represents the relative weight of leisure in the utility function.

Savers. Unconstrained agents can save and borrow in a liquid real government bond B at the real interest rate r^B.[39] They can also hold illiquid assets A at a rate r^A, but need to pay a transaction cost χ for depositing into or withdrawing from that account.[40] The presence of this cost implies that, in equilibrium, the illiquid asset return will be higher than the liquid asset return. Besides this, savers consume, earn labor and dividend income, and pay taxes.

[39] To ensure comparability, the timing convention for the real rate on liquid assets is maintained in accordance with the simple TANK model.

[40] In the HANK model of Kaplan et al. (2018), the two assets are used by households to self-insure against idiosyncratic labor income risk. In this paper, we dispense with cyclical risk and precautionary savings.

Each of them solves the following problem:

$$\max_{C_t^S, L_t^S, D_t, B_{t+1}^S, A_{t+1}} \mathbb{E}_t \sum_{t=0}^{\infty} \beta^t U\left(C_t^S, L_t^S\right) \quad \text{subject to}$$

$$C_t^S + B_{t+1}^S + D_t + \chi_t = (1 + r_{t-1}^B) B_t^S + (1 - \tau) W_t L_t^S + \Gamma_t^S + T_t^S$$
$$A_{t+1} = (1 + r_t^A) A_t + D_t \ ,$$

where B_{t+1}^S and A_{t+1} denote end-of-period-t savings in liquid and illiquid assets, respectively. Moreover, D_t denotes deposits into ($D > 0$) or withdrawals from ($D < 0$) the illiquid account, W_t is the real wage, where labor income is taxed at proportional rate τ, Γ_t^S are dividends from monopolistic firms' profits net of taxes (specified below), and T_t^S are real lump-sum transfers from the government.[41] The functional form of the transaction cost depends on the deposit decision:

$$\chi_t = \chi_1 \left|D_t\right|^{\chi_2} \ ,$$

where $\chi_1 > 0$ and $\chi_2 > 1$ make sure that deposit rates are finite. The optimality conditions for this problem are:

$$\begin{aligned}
(C_t^S)^{-\frac{1}{\sigma}} &= \Lambda_t \\
\varphi (L_t^S)^{\nu} &= \Lambda_t (1 - \tau) W_t \\
\Psi_t &= 1 + \operatorname{sgn}(D_t) \left\{ \chi_1 \chi_2 \left|D_t\right|^{\chi_2 - 1} \right\} \\
\Lambda_t &= \mathbb{E}_t \left[\Lambda_{t+1} (1 + r_t^B) \right] \\
\Lambda_t \Psi_t &= \mathbb{E}_t \left[\Lambda_{t+1} \Psi_{t+1} (1 + r_{t+1}^A) \right] \ ,
\end{aligned}$$

where Λ_t and $\Lambda_t \Psi_t$ define the Lagrangian multipliers on the budget constraint and the illiquid asset accumulation equation, respectively, and $\operatorname{sgn}(.)$ is a function that extracts the sign of D_t. By combining the expressions above, we can derive the Euler equations for both liquid and illiquid assets as well as the standard intratemporal condition:

$$\begin{aligned}
1 &= \beta \mathbb{E}_t \left[\left(\frac{C_{t+1}^S}{C_t^S} \right)^{-\frac{1}{\sigma}} (1 + r_t^B) \right] \\
1 &= \beta \mathbb{E}_t \left[\left(\frac{C_{t+1}^S}{C_t^S} \right)^{-\frac{1}{\sigma}} \frac{1 + \operatorname{sgn}(D_{t+1}) \left\{ \chi_1 \chi_2 \left|D_{t+1}\right|^{\chi_2 - 1} \right\}}{1 + \operatorname{sgn}(D_t) \left\{ \chi_1 \chi_2 \left|D_t\right|^{\chi_2 - 1} \right\}} (1 + r_{t+1}^A) \right] \\
W_t &= \frac{\varphi}{1 - \tau} \left(L_t^S \right)^{\nu} \left(C_t^S \right)^{\frac{1}{\sigma}} \ .
\end{aligned}$$

[41] Different from the simple TANK model presented in Section 3.1, firm profits are denoted by Π_t, while D_t represents deposits.

Hand-to-mouth households. Constrained households own no assets and just consume in every period their total after-tax labor income $W_t L_t^H$ together with transfers from the government. The latter consists of two parts: a redistributed part arising from taxed profits Γ_t^H and a lump-sum transfer T_t^H. Each hand-to-mouth household thus solves the problem

$$\max_{C_t^H, L_t^H} U\left(C_t^H, L_t^H\right) \quad \text{subject to}$$
$$C_t^H = (1-\tau) W_t L_t^H + \Gamma_t^H + T_t^H \; .$$

The optimality condition is

$$W_t = \frac{\varphi}{1-\tau} \left(L_t^H\right)^{\nu} \left(C_t^H\right)^{\frac{1}{\sigma}} \; .$$

Firms. The supply side of the economy features monopolistically competitive producers that provide intermediate goods to perfectly competitive final goods firms.

Final goods producers. A representative firm in the final goods sector aggregates differentiated intermediate inputs j to a final good according to the CES production function $Y_t = \left(\int_0^1 Y_t(j)^{\frac{\epsilon-1}{\epsilon}} \, di\right)^{\frac{\epsilon}{\epsilon-1}}$ with elasticity of substitution across goods ϵ. Profit maximization yields the demand for each input, $Y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\epsilon} Y_t$, where $P_t(j)$ is the price of intermediate good j and $P_t^{1-\epsilon} = \int_0^1 P_t(j)^{1-\epsilon} \, dj$ the aggregate price index.

Intermediate goods producers. There is a continuum of monopolistically competitive firms, each of which produces a variety j of the intermediate good using capital K and labor N as inputs:

$$Y_t(j) = K_t(j)^{\alpha} N_t(j)^{1-\alpha} \; ,$$

where α is the capital share and $1-\alpha$ is the labor share. Each firm rents capital and hires labor in competitive factor markets at rate r_t^K and wage W_t, respectively. Cost minimization results in the following conditions for the optimal factor shares:

$$r_t^K = \alpha \frac{Y_t(j)}{K_t(j)} MC_t$$
$$W_t = (1-\alpha) \frac{Y_t(j)}{N_t(j)} MC_t \; ,$$

where the real marginal cost is given by

$$MC_t = \left(\frac{r_t^K}{\alpha}\right)^{\alpha} \left(\frac{W_t}{1-\alpha}\right)^{1-\alpha} \; .$$

An intermediate goods producer sets its price $P_t(j)$ to maximize profits subject to consumers' demand and a quadratic price adjustment cost as in Rotemberg (1982):

$$\Theta_t = \frac{\theta}{2}\left(\frac{P_t(j)}{P_{t-1}(j)} - 1\right)^2 Y_t \, .$$

Considering the above, the price-setting problem takes the following form:

$$\max_{\{P_{t+k}(j)\}_{k=0}^{\infty}} \mathbb{E}_t \sum_{k=0}^{\infty} \Lambda_{t,t+k}\Psi_{t,t+k} \left\{ \left[\frac{P_{t+k}(j)}{P_{t+k}} - MC_{t+k}\right] Y_{t+k}(j) - \Theta_{t+k} \right\} \qquad \text{subject to}$$

$$Y_{t+k}(j) = \left(\frac{P_{t+k}(j)}{P_{t+k}}\right)^{-\epsilon} Y_{t+k} \, ,$$

where P_t denotes the aggregate price level and $\Lambda_{t,t+k}\Psi_{t,t+k} = \frac{\Lambda_{t+k}\Psi_{t+k}}{\Lambda_t\Psi_t}$ is the stochastic discount factor for payoffs in period $t+k$. Since dividends will be classified as illiquid asset streams below, the flow of future profits is discounted using the respective interest rate r^a, captured by the Lagrangian multipliers from the saver's optimization problem.

Since all firms are identical and face the same demand, they will all set the same price P_t and we can drop the j subscripts. It also implies that we can write the aggregate production function as $Y_t = K_t^{\alpha} N_t^{1-\alpha}$. This leads eventually to the following Phillips curve, with inflation defined by $\pi_t = \frac{P_t}{P_{t-1}} - 1$:

$$\pi_t(1+\pi_t) = \mathbb{E}_t \left[\frac{\Lambda_{t+k}\Psi_{t+k}}{\Lambda_t\Psi_t} \, \pi_{t+1}(1+\pi_{t+1}) \, \frac{Y_{t+1}}{Y_t}\right] + \frac{1}{\theta}\left[\epsilon MC_t - (\epsilon - 1)\right] \, .$$

Finally, aggregating over firms yields total profits:

$$\Pi_t = \left(1 - MC_t - \frac{\theta}{2}\pi_t^2\right) Y_t \, .$$

Profit distribution and illiquid assets. The portfolio of illiquid assets available to savers is composed of capital K_t^S and equity shares S_t^S. The latter figures as a claim to a fraction ω of intermediate firms' profits that are reinvested directly into the illiquid account. A saver's end-of-period-t stock of illiquid assets can therefore be written as

$$A_{t+1} = K_{t+1}^S + q_t S_{t+1}^S \, ,$$

where end-of-period-t shares S_{t+1}^S are priced by q_t in period t. To remain the focus on the illiquid account as a whole, it is assumed that savers can allocate between the two illiquid asset types for free. Therefore, the return on equity must be equal to the return on capital (no-arbitrage condition):

$$\frac{\omega\Pi_t + (q_t - q_{t-1})}{q_{t-1}} = r_t^K - \delta \equiv r_t^A \ ,$$

where δ is the depreciation rate of capital. The share price evolves according to

$$q_t = \frac{1}{1 + r_{t+1}^A} \left(\omega\Pi_{t+1} + q_{t+1}\right) \ ,$$

which justifies the choice of the interest rate r^a for the discounting of future profits of intermediate firms.

Drawing on the above, the law of motion for illiquid assets, $A_{t+1} = (1 + r_t^A)A_t + D_t$, can be rewritten as

$$A_{t+1} = (1 + r_t^K - \delta)K_t^S + (\omega\Pi_t + q_t)S_t^S + D_t \ .$$

Aggregated over all savers and imposing market clearing for capital and shares (see below), the last expression becomes

$$(1 - \lambda)A_{t+1} = (1 + r_t^K - \delta)K_t + (\omega\Pi_t + q_t) + (1 - \lambda)D_t \ .$$

The remaining proportion of profits $1 - \omega$ not reinvested in the illiquid account is distributed to savers as a lump-sum transfer in liquid form. However, the government taxes the shareholders on the total amount of profits at a rate τ^D. Hence, each saver receives an after-tax dividend income of

$$\Gamma_t^S = \frac{(1 - \omega) - \tau^D}{1 - \lambda}\Pi_t \ .$$

In the two-agent model version of Kaplan et al. (2018), even though only savers have an illiquid account, the fraction $(1 - \omega)\Pi_t$ is assumed to be equally distributed lump-sum to both household types and then to be taxed at the same rate as labor income (τ). Based on the simple TANK model presented in Section 3.1, we assume instead that savers initially receive all the profits net of the portion that is reinvested into the illiquid account. At the same time, however, they are taxed on total profits whenever $\tau^D > 0$ and hand-to-mouth agents receive these revenues from the government.

Government. The fiscal authority issues liquid real bonds B and collects taxes on households' labor income to finance public expenditures G_t, lump-sum transfers T_t, and interest payments on pre-existing debt. Its budget constraint is given by

$$B_{t+1} = (1 + r_{t-1}^B)B_t - \tau W_t N_t + T_t + G_t \ ,$$

where B_{t+1} represents end-of-period-t outstanding debt. We assume that the government adjusts transfers to balance its budget, while debt and expenditures remain fixed at their steady-state levels.

Besides labor income and equivalent to the analytical TANK model in Section 3.1, the government levies taxes on the profits of monopolistic firms, paid by savers who own those firms, and redistributes the revenues to financially constrained households. This policy is balanced in every period such that

$$\Gamma_t^H = \frac{\tau^D}{\lambda}\Pi_t \ .$$

Furthermore, the government runs a lump-sum scheme with total transfers given by

$$T_t = \lambda T_t^H + (1 - \lambda)T_t^S \ .$$

Unlike Kaplan et al. (2018), who model individual transfers as a fixed share of total transfers, we adopt the alternative specification from the analytical part, assuming that transfers to constrained agents vary with debt servicing costs and the business cycle:

$$T_t^H = -\phi_1 r_t^B B - \phi_2 Y_t \ .$$

Monetary authority. Following McKay et al. (2016) and Kaplan et al. (2016), we assume that the central bank controls the real interest rate. More precisely, it implements monetary policy by setting and committing to a path for the interest rate, $\{r_k^B\}_{k\geq 0}$, that is perfectly credible and foreseen by agents. Prior to $\mathcal{T}$, the real rate remains fixed at its steady-state level, whereas monetary policy will be given by an exogenous rule afterwards. Formally, for $\mathcal{T} \geq 0$:

$$r_t^B = \begin{cases} r^B, & t < \mathcal{T} \\ r^B + \rho^{t-\mathcal{T}}\varepsilon_{\mathcal{T}}, & t \geq \mathcal{T} \end{cases}$$

where $\varepsilon_{\mathcal{T}} = r_{\mathcal{T}}^B - r^B$ denotes the policy shock and ρ its persistence. Moreover, the Fisher equation holds:

$$1 + r_t^B = \frac{1 + i_t}{1 + \pi_{t+1}} \ .$$

Aggregation and market clearing. Aggregate consumption and labor are given by

$$C_t = \lambda C_t^H + (1-\lambda) C_t^S$$
$$N_t = \lambda L_t^H + (1-\lambda) L_t^S \ .$$

Liquid asset market clearing requires

$$B_{t+1} = (1-\lambda) B_{t+1}^S \ .$$

Aggregating capital and equity shares yields

$$K_{t+1} = (1-\lambda) K_{t+1}^S$$
$$1 = (1-\lambda) S_{t+1}^S \ ,$$

where we normalized the total number of shares to one. The illiquid asset market then clears when

$$(1-\lambda) A_{t+1} = K_{t+1} + q_t \ .$$

Finally, the goods market clearing condition reads

$$Y_t = C_t + I_t + G_t + (1-\lambda)\chi_t + \Theta_t \ ,$$

where investment evolves according to $I_t = K_{t+1} - (1-\delta)K_t$. By combining the law of motion and market clearing for illiquid assets, this can be rewritten as

$$I_t = r_t^K K_t + \omega \Pi_t + (1-\lambda) D_t \ .$$

C.2 Calibration of the extended TANK model

Table C.1 summarizes the parameterization for the two-asset TANK model with investment. Apart from the paper-specific parameters, all values are taken from Kaplan et al. (2018), except for the demand elasticity ϵ, which is chosen to match a price markup of 20% as in the baseline model, and the tax rate on profits, which is set slightly higher to make the setup more comparable to the baseline model without labor taxes.

C.3 Impulse responses for the extended TANK model

Figure C.1 shows the main impulse responses to a 25-basis-point increase in the real interest rate, either today or eight quarters from now. Both shocks lead to a decrease in consumption,

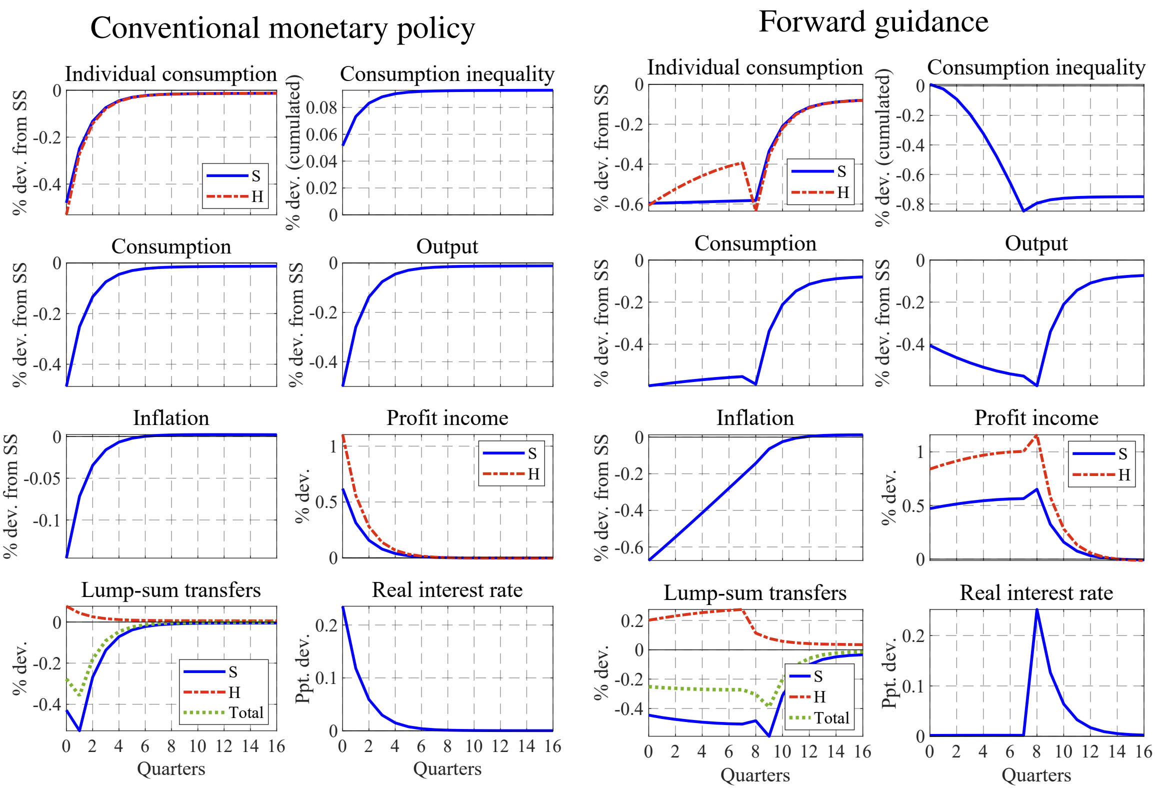
Table C.1: Parameter values for the fully-fledged TANK model

Parameter	Description	Value
λ	Share of hand-to-mouth	0.3
β	Discount factor	1.0125^{-1}
σ	Intertemporal elasticity of substitution	1
$1/\nu$	Frisch elasticity of labor supply	1
$\chi_1 \mid \chi_2$	Deposit cost parameters	$0.956 \mid 1.402$
ϵ	Elasticity of substitution between goods	6
α	Capital share	0.33
δ	Depreciation rate	0.017
θ	Rotemberg price adjustment cost	100
ω	Share of profits reinvested into illiquid account	0.33
τ	Labor tax rate	0.25
τ^D	Tax rate on profits	0.29
ϕ_1	Transfer rule coefficient on debt	0.8
ϕ_2	Transfer rule coefficient on output	0.5
T	Steady-state lump-sum transfer (% of GDP)	0.06
$\lvert B^G \rvert/(4Y)$	Steady-state debt to annualized GDP	0.23
r^b	Steady-state real liquid return (p.a.)	0.05
ρ	Persistence of policy shock	0.5
$\varepsilon_{\mathcal{T}}$	Shock impact	0.0025

output, and inflation on impact, where the latter sees again a stronger drop after FG due to persistently lower marginal costs. The drop in consumption for the hand-to-mouth agents is partially offset by profit redistribution and the fiscal adjustment through transfers.

As in the simple model, the government's response varies between the two policy tools. Following a contemporaneous change in the real rate, both components of the transfer function – that is, the parts related to the debt burden and the automatic stabilizer – react to the shock. However, only the second component is affected by the positive FG shock, resulting in countercyclical lump-sum transfers that are higher for hand-to-mouth agents. The difference in the timing and magnitude of the fiscal response gives rise to the heterogeneous responses of consumption inequality after the two monetary shocks, in line with the empirical evidence.

Figure C.1: Impulse responses to monetary shocks: Fully-fledged TANK model



Notes: This figure depicts selected impulse responses for the extended TANK model to a 25-basis-point increase in the contemporaneous real interest rate (left panel) and in the real rate in eight quarters (right panel). Responses of profit income and transfers are in deviations from their steady-state levels, relative to steady-state output. Individual responses for savers (S) and hand-to-mouth agents (H) are shown in per-capita terms.